

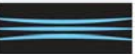
# Grid Upgrade Plan 2008 Instalment 1

## Part V: Wilton 110 kV Interconnection Investment Proposal

*Keeping the energy flowing*



TRANSPOWER



## Document Revision Control

Document Number/Version	Description	Date
001/Rev A	Wellington 110 kV Interconnection Investment Proposal	19-12-2008

## Executive Summary

### Transpower's Wellington 110 kV Interconnection Investment Proposal

The purpose of this Wellington 110 kV Interconnection Investment Proposal (the **Proposal**) is to obtain Electricity Commission (the **Commission**) approval to recover the costs (up to \$9.57 million) associated with installing a 220/110 kV interconnecting transformer at Wilton by 2011.

#### Proposal at a Glance

What:	Installation of a 250 MVA 220/110 kV interconnecting transformer at Wilton
When:	Commissioning in 2011 or before
How much:	Transpower is seeking approval to recover up to \$9.57 million

### Background on the Proposal

At present, the Wellington region 110 kV transmission network relies on four interconnecting transformers connecting to the 220 kV transmission network. Three of these interconnecting transformers are located at Haywards with the fourth at Wilton. Currently, interconnecting transformer capacity is insufficient to meet peak load on the Wellington 110 kV network under n-1 conditions, which means that the Wellington 110 kV network does not currently meet the Grid Reliability Standards (GRS). It is only through operational measures that peak load can be met and this Proposal proposes an option to restore the Wellington 110 kV network to a state where the GRS are met.

### Process to date

Transpower has been considering the Wellington 110 kV interconnection issue for some time and the project is listed in the Annual Planning Reports for 2006 to 2008. In October 2008, Transpower consulted with interested parties on the various assumptions, methodologies and long list of options for restoring the Wellington 110 kV network to a state which meets the GRS.

From that consultation, which also acted as a Request for Information (RFI) with respect to information on potential non-transmission alternatives, a long list of options was developed.

The long list of options was reduced to a short list and analysed using the GIT.

Following that process, Transpower has determined that it is appropriate to submit an investment proposal to the Electricity Commission for approval to recover the costs of installing a new 250 MVA 220/110 kV interconnecting transformer at Wilton.

### Options considered

The Wellington 110 kV network comprises feeders from the Bunnythorpe 220 kV and 110 kV network and offtakes at several substations south of Bunnythorpe. The long list of options for the project was refined to the following short list:

1. New transformer at Wilton substation.
2. New transformer at Haywards substation.
3. New transformer at Takapu Road substation.
4. New transformer at Paraparaumu substation.
5. Automatic switching at Paraparaumu substation.
6. Splitting Paraparaumu load at Paraparaumu substation.

For the GIT evaluation, Option 1, a new 250 MVA 220/110 kV interconnecting transformer at Wilton, was chosen as a reference case against which the other short list options were compared, rather than comparing each option to a base case. This is consistent with the previous approach adopted by Transpower and the Commission in circumstances where a reliability investment is required in order to meet the GRS.

Some of the short-list options by themselves do not ensure the GRS can be met for the full 20 year analysis period required to complete the GIT analysis. Therefore, additional staged upgrades over the longer term were included as modelled projects for each short list option. Transpower seeks Commission approval for a stage 1 upgrade only, with any necessary stage 2 or subsequent upgrade to be included in a future grid upgrade plan.

The development plan for each short listed option (including staged modelled projects) is set out in Table 0-1 below.

**Table 0-1: Final option short list**

Option	Stage 1 Upgrade (implemented by 2011)	Stage 2 Upgrade (modelled)	Stage 3 Upgrade (modelled)
Reference Case	WIL 250 MVA	HAY 200 MVA	
2	HAY 200 MVA	WIL 250 MVA	
3	TKR 250 MVA	WIL 250 MVA	
4	PRM 250 MVA	WIL 250 MVA	
5	Automatic switching at PRM	WIL 250 MVA	
6	Split load at PRM	WIL 250 MVA	HAY 200 MVA

### Option costs

The costs have been estimated at a level of accuracy commensurate with the estimated capital expenditure for the various investment options.

### Application of the GIT

The short-list includes a number of alternatives, but Transpower considers that there are no material benefit differences between the short-listed options, with the exception of avoided unserved energy and terminal values<sup>1</sup>.

By treating these latter differences as costs, the GIT application condenses to become a cost comparison (on a Present Value basis), with the lowest overall cost alternative passing the GIT. The GIT results are shown in Table 0-2:

<sup>1</sup> Because the development plans differ in the number of years of load growth they cover, some alternatives do have a terminal value at the end of the 20 year analysis period, and this value is included in the analysis.

**Table 0-2: Grid Investment Test Results**

Present Value \$NZ million	Unserviced Energy (A)	Transmission costs (B)	Terminal benefit (C)	Expected Net Market Cost (A+B-C)
Reference Case - WIL/ HAY	0	9.19	1.48	7.72
Option 2 - HAY/ WIL	0	14.62	0.83	13.79
Option 3- TKR/ WIL	0	11.77	1.16	10.61
Option 4- PRM/ WIL	0	19.02	0.99	18.03
Option 5 -PRM switching/ WIL	18.47	8.58	0.65	26.40
Option 6 -PRM Split/ WIL/HAY	0	11.86	1.92	9.93

The reference case, which is installing a new 250 MVA 220/110 kV interconnecting transformer at Wilton, has the least Expected Net Market Cost and therefore becomes the Proposal.

### Accuracy of GIT

Transpower recognises there is inherent uncertainty in the several of the input assumptions used in the GIT analysis, namely the demand forecasts and cost assumptions.

However, Transpower considers the rigour and comprehensiveness of the analysis undertaken is commensurate with the estimated capital expenditure required for the proposed investment.

### Timing

As the configuration of the Wellington 110 kV network does not currently meet the GRS, the timing for the Proposal reflects installing a new 250 MVA 220/110 kV interconnecting transformer at Wilton as soon as possible.

Lead times between ordering new transformers and delivery are currently approximately two years, due to extraordinarily high world demand. Therefore, it is assumed the Proposal could be installed and commissioned in late 2011 and this is the date reflected in the economic analysis.

### Relationship to Woodville–Mangamaire–Masterton reconductoring

The technical studies undertaken for this investment proposal assume the existing conductor and rating for the Woodville–Mangamaire–Masterton 110 kV line. It is split at Mangamaire to minimise the impact of the constrained Woodville–Mangamaire–Masterton 110 kV line on Wellington 110 kV load.

Part VI of the 2008 GUP, submitted along with this Part V, seeks approval however, to reductor the Woodville–Mangamaire–Masterton 110 kV line with a larger conductor.

This reductoring would remove the existing circuit constraint and increase 110 kV transfer capacity into Wellington, which could potentially defer the need for investment at Wilton.

However, technical studies have shown that increased capacity on the Woodville–Mangamaire–Masterton 110 kV line only allows more Wellington 110 kV load to be met for a limited range of HVDC north transfers. For HVDC north transfers outside this range, the existing Wilton interconnecting transformer still constrains.

Deferring investment at Wilton to take advantage of the increased capacity on the Woodville–Mangamaire–Masterton 110 kV line would require HVDC transfers to be constrained. The savings from deferring investment at Wilton would be far outweighed by

the costs in constraining HVDC transfers hence, even if Part VI of the 2008 GUP is approved it does not affect the economic case for investment at Wilton.

The main impact on the Proposal of reconductoring the Woodville–Mangamaire–Masterton 110 kV line with a larger conductor is to defer the need for the Stage 2 modelled projects in this analysis. Although this has not been reflected in the analysis, it would not affect the ranking of the options and the reference case would still pass the GIT.

### Maximum Approval Cost

For GIT purposes, the costs used are an Expected Cost, being the Estimated Cost plus a scope allowance, in current year dollars - \$2008 in this case.

For approval purposes, a Maximum Approval Cost (MAC) is calculated, being a reasonable maximum expected cost for the project, in commissioning year dollars. The MAC is similar, but not the same, as previous proposals which included the use of a P90 figure (being the figure for which there is a 90% probability of the actual costs falling within the figures quoted).

The MAC, being the amount for which approval is sought from the Commission, is shown below in comparison to the Expected Cost and an Expected End Cost, which is the cost Transpower expects the Proposal to cost in commissioning year dollars. The Expected End Cost is similar to the old P50 figure.

**Table 0-3: Approval Cost**

\$NZ million	Estimated Cost	Expected Cost	Price contingency	Exchange rate variability	Exchange rate hedge	Inflation	IDC	TOTAL
Expected Cost	5.70	6.27						6.27
Expected End Cost	5.70	6.27	0.79	0.40	0.25	0.63	0.15	8.50
Maximum Approved Cost	5.70	6.27	1.36	0.69	0.30	0.76	0.18	9.57

It is worth noting that the price contingency allowance on the transformer capital cost is higher than would normally be used, to reflect the high volatility currently being observed in transformer purchasing costs.

### Transpower Board Approval

Transpower considers it important that the Wellington 110 kV network be reinforced to meet the GRS as soon as possible. To that end, the Transpower Board has approved expenditure to purchase a 250 MVA 220/110 kV interconnecting transformer and the purchasing process is underway, prior to Commission approval. The design stage is underway, but a tender has not yet been let. Transpower considers this is a prudent and responsible step to take as the Wellington 110 kV network does not currently meet the GRS and there are currently extraordinarily long lead-times for purchasing transformers.

### This Document

The remainder of this document is Transpower's formal submission to the Commission for approval of the costs of the Proposal. It is split into two parts:

- Part A sets out the actual proposal for which approval of cost recovery up to \$9.57 million is sought; and
- Part B, together with the attachments, sets out the technical and economic analysis of the proposal, and justifies the Proposal against the requirements of the Rules.



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A	Needs Report
B	Options Report inc long list to short list
C	Wilton 250 MVA 220/110 kV Solution Study Report
D	Costing Report

## Part A - Proposal

This part describes Transpower's Wilton interconnecting transformer Proposal (the **Proposal**).

### Components of the Proposal

Procuring, installing and commissioning a new 250 MVA 220/110 kV interconnecting transformer at Wilton.

Obtaining designations, easements, resource consents and property purchases for these works.

Any additional minor works and activities required to facilitate the above.

### Timing

Transpower will work towards commissioning of the Proposal as soon as practicable, with an expected commissioning date of 2011.

### Costs

On commissioning of the Proposal, Transpower seeks approval to recover the full costs associated with implementing the Proposal up to a total amount of \$9.57 million. This amount is the estimated Maximum Approval Cost (MAC) to implement the Proposal, based on the timing above, expressed in New Zealand dollars exclusive of GST.

Appendix B describes how the MAC has been derived.

## Part B – Justification

### 2 Introduction

*This section outlines the purpose and structure of Part B*

#### 2.1 Purpose

This document is Transpower’s request for Commission approval to recover the costs of the Proposal.

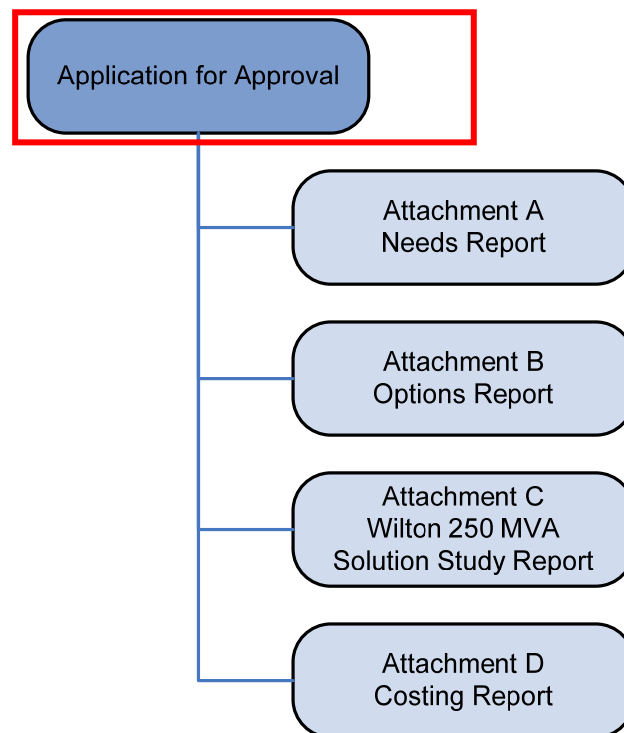
The purpose of Part B of this document is to provide information for the Commission to assess compliance of this Proposal with the Rules.

In the course of assessing the options presented in this document, Transpower has sought feedback from interested parties so as to be able to incorporate their views into the decision-making.

#### 2.2 Document structure

The document is structured to lead readers through the process Transpower has followed in applying the GIT and to present the conclusions of the GIT analysis.

The document consists of this paper and several attachments as follows:



The attachments provide the detail of the analysis presented in this document.



## 2.3 The Proposal as part of the 2008 Grid Upgrade Plan

This document forms Part V of the 2008 Grid Upgrade Plan.

Transpower has already submitted the following parts of the 2008 GUP to the Commission:

- Part I: Comprehensive Plan for Asset Management and Operation of the Grid; (17 December 2008)
- Part II: Investment Contracts (17 December 2008); and
- Part III: Wairakei Ring Investment Proposal (17 December 2008).

This Part V is being submitted along with:

- Part IV: Maungatapere Bus Security Investment Proposal; and
- Part VI: Woodville–Mangamaire–Masterton Transmission Investment Proposal.

## 2.4 Compliance with the GUIRP

Transpower notes that the development of the investment proposal and alternative options, and the analysis of those options, does not follow in a number of respects the processes and policies set out in the Grid Upgrade and Investment and Review Policy (GUIRP).

However, for smaller projects, Transpower has abbreviated the process consistent with the principles that the analysis undertaken in applying the Grid Investment Test (GIT) is commensurate with the estimated capital expenditure required for the proposed investment.<sup>2</sup> This approach reflects one of the key principles of the GUIRP.<sup>3</sup>

## 2.5 Glossary/terminology

A glossary of terms and acronyms used in the Consultation Paper is included in Appendix A.

All references to Rules in this document refer to those in section III of Part F of the Electricity Governance Rules 2003 unless otherwise specified.

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<sup>2</sup> Clause 12, Schedule F4 of the Rules.

<sup>3</sup> Grid Upgrade Investment and Review Policy, June 2008, para 2.1.1(h).

### 3 Transmission Need and Type of Investment

*This section provides background on the Wellington 110 kV Interconnection Proposal*

#### 3.1 Background to the Proposal

At present the Wellington 110 kV region is supplied via four interconnecting transformers (three at Haywards and one at Wilton) and a single 110 kV circuit from Bunnythorpe via the Wairarapa. Several of the 110 kV transmission links in the Wellington region, as well as the 220/110 kV interconnections at Wilton and Haywards, are defined as a part of the core grid under Schedule F3A.

**Figure 3-1: Wellington regional transmission circuits**

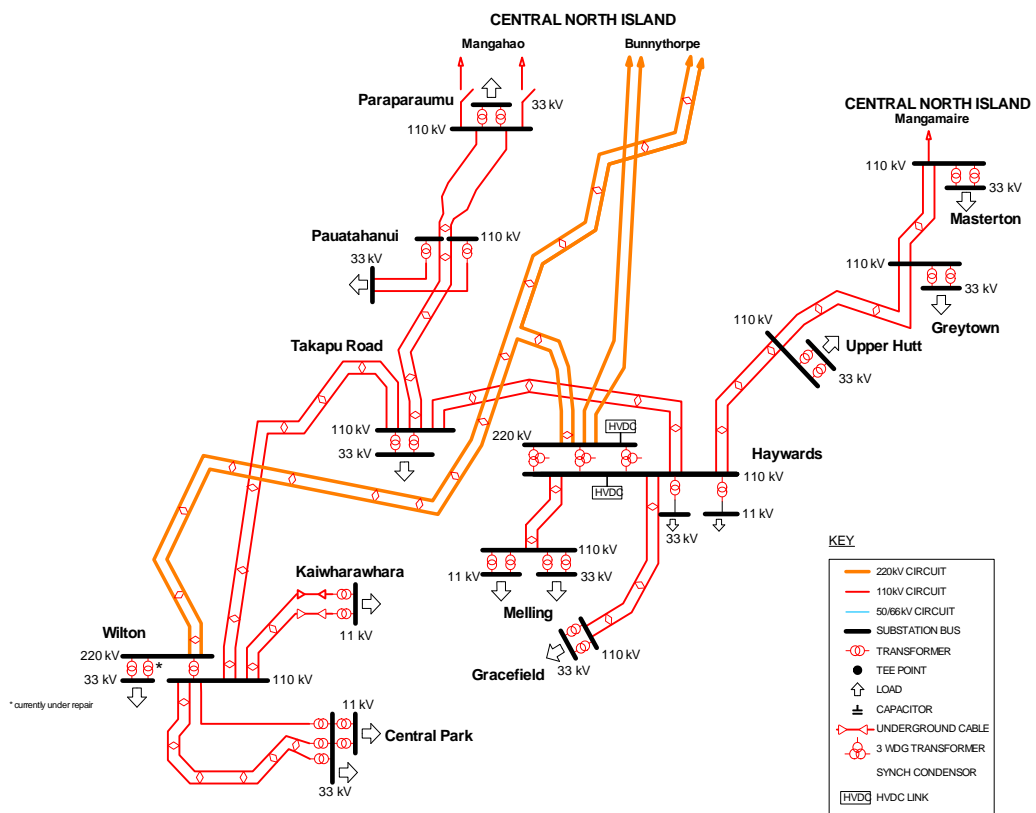


Figure 3-2 shows the five transfer paths to the Wellington 110 kV region, with their ratings in Table 3-1.



Figure 3-2: Graphical representation of the Wellington 110 kV regional network

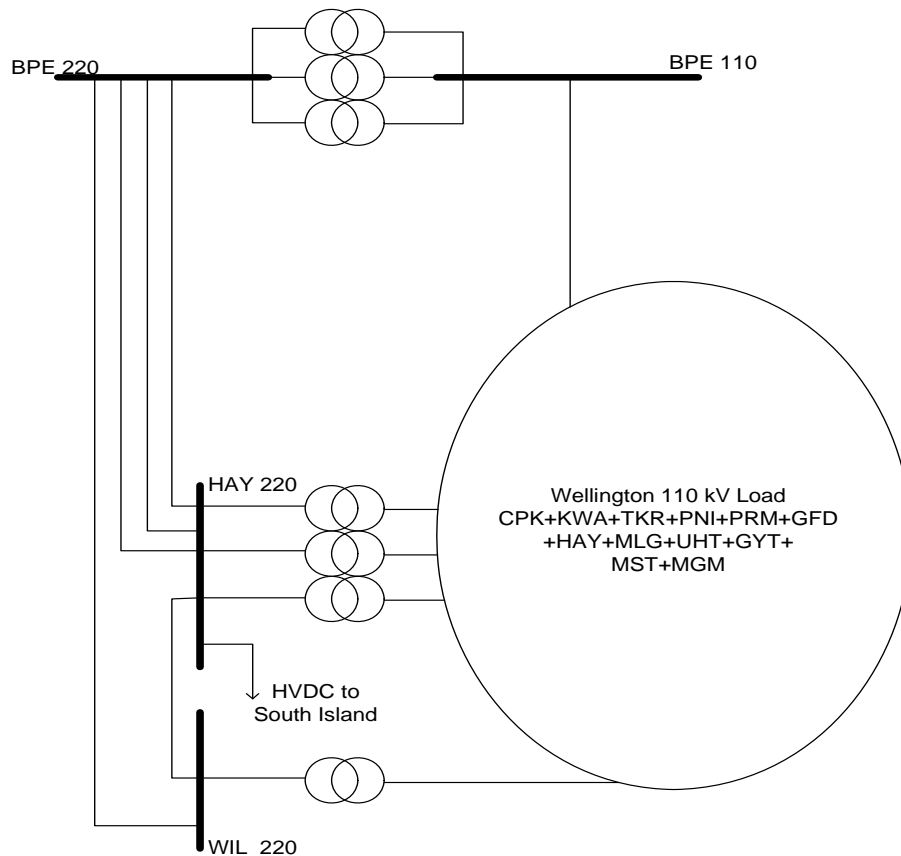


Table 3-1: Thermal ratings of transfer paths into Wellington 110 kV network

Component	Continuous Rating (MVA)	Short term rating Summer (MVA)	Short term rating Winter (MVA)
HAY T1	200	233	243
HAY T2	200	233	243
HAY T5	200	233	243
WIL T8	110	139	147
MGM-WDV	51	42	51

The maximum pre-contingency capacity of the 110 kV network is 761 MVA if the sharing between the five paths is equal. Being part of the core grid, the transmission system is designed and operated so that load can be supplied with a circuit or transformer out of service (operation on an n-1 level of security). In the case of the Wellington region, the highest capacity transformers are located at Haywards. In the event of such an outage the n-1 capacity of the network is reduced to 647 MVA in summer and 684 MVA in winter.

The maximum load that can be supplied into the Wellington 110 kV network is set by the first of the three in-feeding lines (through Haywards, Wilton and Mangamaire) which reaches its maximum capacity. The maximum in-feed also varies with the level of power being transferred along the HVDC link, as this changes the sharing of the load between the three in-feeding transmission lines. The HVDC transfer limit using only the existing Pole 2 is 700 MW north and 626 MW south.



Table 3-2 shows the Wellington 110 kV load limits with all circuits and transformers in service for different levels of power transferred on the HVDC link between the North and South Islands (at the n level of security). It also shows the n-1 level of security load limits when one of the various transformers is out of service:

**Table 3-2: Existing Constraints for Wellington 110 kV Load with All Circuits and Transformers in Service**

HVDC Transfer	Haywards ICT limit		Wilton T8 limit		MGM-WDV limit	
	n	n-1	n	n-1	n	n-1
700 MW North	845	739	517	552	856	778
0 MW	912	810	442	498	548	502
626 MW South	792	725	350	420	242	225

These results show that the Wilton T8 interconnecting transformer imposes a maximum limit for the 110 kV network of between 350 MW and 517 MW, depending on the size of the load being transferred by the HVDC link. As the peak load on the Wellington 110 kV network in 2008 is forecast to be about 612 MW, the table indicates that load cannot be supplied with all circuits and transformers in service. If the Wilton T8 interconnecting transformer is out of service the load limits rise slightly as the load can be shared more evenly across the remaining interconnecting transformers in the region. However, even with the Wilton T8 interconnecting transformer out of service, the n-1 limit of the 110 kV network is forecast to be breached by winter 2009. Hence, the relatively low capacity Wilton T8 is a constraint on the Wellington 110 kV network capacity and/or constraints on the amount of power that can be transferred via the HVDC link.

In summary, the current 110 kV Wellington grid does not meet the requirements of the GRS. At present, it is only the use of operational measures, including removal of the Wilton T8 interconnecting transformer from service that allows the Wellington 110 kV load to be met at peak times.

A full description of the needs identification process used to produce the long list of options is provided in Attachment A – Needs document.

### 3.2 Type of investment

The primary aim of further investment is to avoid unserved energy.

Transpower considers that the Proposal is a “reliability investment” under the Rules as:

- the Proposal is an investment by Transpower in the grid;
- the primary effect of the Proposal is to reduce expected unserved energy on the grid; and
- the expected unserved energy will result from likely planned or unplanned outages of primary transmission equipment.

## 4 Process to date

Transpower has been considering the Wellington 110 kV interconnection issue for some time and the project is listed in the Annual Planning Reports for 2006 to 2008. In October 2008, Transpower consulted with, and sought feedback from, interested parties on the main assumptions and a long list of options, to be considered in the Wellington 110 kV Interconnection project.



The consultation document asked for feedback on:

- The demand assumptions to be used
- The generation assumptions to be used
- The long list of options
- The criteria to be used for reducing the long list of options to a short list of options

The consultation document also served as a RFI (Request for Information) with respect to non-transmission alternatives and sought sufficient information to be provided with any submission to enable their inclusion on the long list of options.

The consultation documentation including submissions received can be found on the Grid New Zealand website at:

<http://www.gridnewzealand.co.nz/wellington-transformer-publications>

Submissions were received from four parties, two of which explicitly supported the need for upgrading Wellington 110 kV interconnection capacity. One submission suggested some long list options and discussion on these is included in Attachment B – Options report.

Following the receipt of feedback from interested parties, Transpower:

- considered the feedback received;
- further developed the options (as presented in this paper);
- developed the economic approach; and
- analysed the results.

The process carried out is in accordance with the timetable for consultation and approval as agreed between Transpower and the Commission.<sup>4</sup>

## 5 Identification and consideration of options

***This section outlines how Transpower has identified alternative projects to be considered in applying the Grid Investment Test***

### 5.1 Requirements under the Rules

The application of the GIT requires an analysis and comparison of the market benefits and costs of a proposed investment and those of a number of alternative projects. Therefore Transpower must first identify those options that fall within the definition of “alternative projects” under the Rules.

### 5.2 Option identification

#### 5.2.1 Long list of options

The long list aims to canvas a broad range of viable investment options, while balancing the desirability of a broad range of options with the resources and time invested in the options that are likely to be progressed to the short list.

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<sup>4</sup> The Commission must consult with Transpower in relation to a process for consultation with persons that the Commission thinks are representative of the interests of persons likely to be substantially affected by reliability investments and content of grid upgrade plans. Rule 13.2.3 of Section III, Part F.

In compiling the long list of options, Transpower considered the technical feasibility of each option and information received in response to Transpower's consultation on a draft long list and request for information (RFI) in relation to non-transmission alternatives published in October 2008.<sup>5</sup>

Transpower identified five categories of investment options for inclusion in the long list:

- non-transmission alternatives to reduce load on the Wellington 110 kV network;
- reconfiguring existing assets to reduce load on the Wellington 110 kV network
- increasing transfer capacity of the 110 kV lines into Wellington;
- transferring 110 kV load to the 220 kV network; and
- increasing 220 kV/110 kV interconnecting transformer capacity in the Wellington region.

A full description of the long list of options is provided in Attachment B – Options document.

### 5.2.2 Short-listing approach

The purpose of the short-listing analysis was to reduce the long list of options to a short list, for further development and analysis to select a preferred option. The short-listed options that are not selected as the preferred option comprise the alternative projects against which the preferred option is compared under the GIT.

In summary, Transpower's short-listing approach was to screen its long list to formulate a short list, based on the following criteria:

- fitness for purpose;
- technical feasibility;
- practicality of implementation;
- Good Electricity Industry Practice (GEIP);
- system security; and
- whether an option will clearly be more expensive than another option with similar or greater benefits.

In addition, the Rules require that the alternative projects used in applying the GIT must be limited to those appropriate in number and technology given the cost magnitude of the proposed investment, the complexity of the modelling and the urgency of the proposed investment.<sup>6</sup>

The short-listing approach and application is also fully described in Attachment B – Options document.

### 5.2.3 Further staged investments for Short list options

Some of the options do not ensure the GRS can be met for the next 20 years. In order to complete the GIT analysis, longer term development plans, which include additional staged upgrades as modelled projects, were developed as necessary for each short list option.

Transpower's approach is to seek Commission approval for only a stage 1 upgrade, with any necessary stage 2 or subsequent upgrades to be included in a future grid upgrade plan.

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<sup>5</sup> <http://www.gridnewzealand.co.nz/wellington-transformer-publications>

<sup>6</sup> Schedule F4 clause 11.



### 5.2.4 Final short list

The final short list, including the development plan for each short listed option is set out in Table 5-1 below. Note that for each option, different technical options, including transformer sizes were considered by Transpower. More details are included in Attachment B – Options Report.

Table 5-1: Final short list

Option	Stage 1 Upgrade (all implemented by 2011)	Stage 2 Upgrade (modelled project)	Stage 3 Upgrade (modelled project)
1	WIL 250 MVA	HAY 200 MVA	
2	HAY 200 MVA	WIL 250 MVA	
3	TKR 250 MVA	WIL 250 MVA	
4	PRM 250 MVA	WIL 250 MVA	
5	Automatic switching at PRM	WIL 250 MVA	
6	Split load at PRM	WIL 250 MVA	HAY 200 MVA

### 5.3 Reflecting Good Electricity Industry Practice in meeting the GRS

Rule 13.4.1.1 permits the Commission to approve a reliability investment where the proposed investment reflects GEIP in meeting the GRS.

#### 5.3.1 The short list options reflect GEIP

The Rules define GEIP in relation to transmission as:

*"The exercise of that degree of skill, diligence, prudence, foresight and economic management, as determined by reference to good international practice, which would reasonably be expected from a skilled and experienced **asset** owner engaged in the management of a transmission network under conditions comparable to those applicable to the **grid** consistent with applicable law, safety and environmental protection. The determination is to take into account factors such as the relative size, duty, age and technological status of the relevant transmission network and the applicable law."*

Accordingly, comparable international practice should be considered in assessing what is GEIP in terms of grid investment planning. Transpower, as a prudent planner, owner and operator of a transmission network, can reasonably be expected to adopt solutions consistent with good international practice.

Transpower considers that all the short-list options reflect GEIP as required by rule 13.4.1.1. Specifically, the approach taken for the Proposal is consistent with international practice as being a prudent investment given the size, nature and importance of the Wellington 110 kV network load.

#### 5.3.2 The short list options meet the Grid Reliability Standards

The GRS are contained in Schedule F3 of the Rules. These provide that the grid satisfies the grid reliability standards if:

*"4.1 the power system is reasonably expected to achieve a level of reliability at or above the level that would be achieved if all **economic reliability investments** were to be implemented; and*



- 4.2 *with all **assets** that are reasonably expected to be in service, the power system would remain in a **satisfactory state** during and following any **single credible contingency event** occurring on the **core grid**.”*

As the Proposal is a reliability investment on the core grid, the Proposal must meet both clauses 4.1 and 4.2 of the GRS. Accordingly, Transpower undertook a power system analysis to ensure that the short-listed options would provide the level of security required by the n-1 safety net criterion under clause 4.2 from the commissioning date, and will reduce expected unserved energy.

Transpower considers that all short list options (including the Proposal) meet the GRS as required by rule 13.4.1.1

## 5.4 Base case

For the purposes of the GIT, the Rules require that the Proposal and the alternative projects be assessed against a base case, which is defined as the market development scenarios developed for the reasonable future state of the electricity industry without the proposed investment or any alternative project<sup>7</sup>.

As noted by both the Commission and Transpower in analysis of the North Island Grid Upgrade Proposal, it is difficult to identify a suitable base case for the analysis when an investment proposal is required to meet the GRS, because the base case must meet the GRS but not be an alternative project.

The Commission has previously resolved this issue by using one of the “alternative projects” as a reference case. Transpower has adopted this approach.

Transpower considers that a reasonable base case for this investigation would be to replace the existing Wilton T8 interconnecting transformer with a transformer of a greater capacity (and which results in the transmission network comprising the Wellington 110 kV meeting the GRS). This base case reflects Option 1 of the short list, and therefore Transpower has chosen Option 1 as a reference case against which the other short list options are compared.

## 6 Methodology and assumptions

***This section sets out Transpower’s approach to applying the Grid Investment Test***

### 6.1 Approach to the GIT analysis in the context of the Wellington 110 kV interconnection

The GIT requires Transpower to determine the market benefits and costs of each of the short-list options for each of a number of market development scenarios for the future.<sup>8</sup>

The GIT analysis requires certain input assumptions and parameters to be determined and applied and then results tested against various sensitivities.

<sup>7</sup> Clause 20 of Part F Section III Schedule F4

<sup>8</sup> Clause 5 of Schedule F4.

Under the Rules, the rigour and comprehensiveness of the GIT analysis should be commensurate with the estimated capital expenditure of a proposed investment.<sup>9</sup>

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

- project costs
- reliability differences (under limited circumstances)

Transpower considers that there are no material benefit differences between the short-listed options, with the exception of avoided unserved energy and terminal benefits. The development plans include different timings for modelled projects and some of those modelled projects have un-utilised capacity at the end of the analysis period. The cost of un-utilised capacity has been credited back as a terminal benefit.

By treating these differences (avoided unserved energy and terminal benefits as costs), the GIT application condenses to become a cost comparison, with the lowest overall cost alternative passing the GIT.

The consultation document asked interested parties whether they agreed with this assessment and those that responded directly to the question agreed.

## 6.2 Approach to market development scenarios

Reflecting the approach outlined above, there is no new generation in any of the market development scenarios detailed in the Electricity Commission's 2008 SoO, or in any other reasonable future state of the electricity industry, that would materially impact on the GIT analysis. In this case, Transpower considers that an analysis of the net market benefits of the short-list options under multiple market development scenarios would yield the same results for each scenario. Therefore, Transpower has assessed the net market benefits of the short-list options on the basis of one generation scenario, in which there is no new generation built in the region. This scenario is assigned a 100% probability. In effect, the future market development scenarios have a neutral effect on the analysis of the comparative net market costs of the short list options.

Transpower notes that this approach is broadly similar to the approach adopted by the Commission in the Reasons to Approve the North Island Grid Upgrade Proposal.<sup>10</sup>

## 6.3 Market costs

Assessment of the costs of each short-list option requires identification and quantification of the following categories of costs over the analysis period:

- transmission costs for each transmission option;
- statutory compliance costs;
- inflation costs;
- interest during construction; and
- exchange rates.

For the purposes of applying the GIT, Transpower has costed the short-list options to a level of accuracy which:

- confirms the scope of the technical work required; and

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<sup>9</sup> Clause 12 of Schedule F4.

<sup>10</sup> See Reasons for Decision set out in Notice of Intention to Approve Transpower's North Island Grid Upgrade Proposal, para 6.3.22.



- a budget to an accuracy of +/-30%, subject to exchange rate variations<sup>11</sup>.

Operating and maintenance costs have not been explicitly included in the GIT analysis, on the basis that they would not be expected to differ significantly (nor disproportionately) between the options, all of which are new-build options by Transpower. Similarly, interest during construction (IDC) costs have also not been explicitly included in the GIT analysis as they are not material to differentiating between the costs of the short-list options, as all short-list options are new-build options by Transpower and IDC will not vary disproportionately between options.

### 6.3.1 Value of unserved energy

Where reliability differences are relevant to a consideration of a short list option, Transpower has applied the Rule requirement and valued unserved energy differences at \$20,000 per MWh.<sup>12</sup> The \$20,000 per MWh was determined in December 2004 and Transpower has inflated it accordingly to a June 2008 value of \$22,145 per MWh.

Transpower sought feedback on whether this value was appropriate for the purposes of this project and those respondents that replied directly to this question agreed that it was.

### 6.3.2 Summary of market costs

The following is a summary of the approach to estimating costs.

**Table 6-1 Summary of market costs**

Market Cost	Approach	
Transmission costs	Line and substation capital costs	Included
	Property and easement costs	Included
	Project management	Included
	Consenting costs	Included
	Operating and maintenance costs	Not explicitly included
	Decommissioning costs	Included
Statutory compliance costs	Included	
Inflation costs	Included as appropriate, 3%, or 3.2% for MAC	
Interest during construction	Not explicitly included in GIT, but used to determine approval cost, 7.3%, 7.5% for MAC.	
Exchange rates	USD reflected at a rate of 0.6614, varied for calculating \$2011	
Value of unserved energy	\$20,000 per MWh, inflated	

## 6.4 GIT Sensitivities

***This section sets out sensitivities used by Transpower in applying the Grid Investment Test***

<sup>11</sup> The actual accuracy level of the costs differs by component. For detailed breakdown refer to Attachment D, the cost report.

<sup>12</sup> Clause 8.3.4, Schedule F4 of the Rules.

The sensitivities analysed or considered in applying the GIT to the short list of options is described in the table below:

**Table 6-2 Summary of Sensitivities**

Sensitivity	Value
Forecast demand	Included – Medium and low demand as per 2008 SoO
Variations in the size, timing, location, and operating and maintenance costs	Not included as a sensitivity
Capital cost	Not included as a sensitivity
Timing of decommissioned assets	Not significant therefore not included
Value of expected unserved energy	\$10,000 and \$30,000 per MWh
Discount rate	4% and 10%

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

Transpower considers this level of sensitivity analysis is sufficient to ensure the rigour and comprehensiveness of the analysis is commensurate with the estimated capital expenditure required for the Proposal, and therefore further sensitivity analysis is not reasonably necessary.<sup>13</sup>

## 7 Application of the Grid Investment Test

*This section sets out Transpower's application of the Grid Investment Test*

### 7.1 Compliance with the Grid Investment Test

As the Proposal concerns the core grid and must therefore meet the grid reliability standard set out in clause 4.2 of Schedule F3, the Proposal will satisfy the GIT under clause 4.1 of Schedule F4 if:

- the **proposed investment** maximises the **expected net market benefit** or minimises the **expected net market cost** compared with a number of **alternative projects**; and
- if sensitivity analysis is conducted, the conclusion (on net market benefits or net market costs) that a **proposed investment** satisfies clause 4.1.1 is sufficiently robust having regard to the results of that sensitivity analysis.

As identified below, Transpower considers that Option 1 (which is also the reference case), installing a new 250 MVA 220/110 kV interconnecting transformer at Wilton, complies with the GIT.

### 7.2 GIT results

The GIT results are presented as a comparison of the expected net market cost for the short-list options under a prudent demand growth forecast.

<sup>13</sup> Clause 17, Schedule F4.

The following table summarises the results of the GIT analysis:

**Table 7-1: Grid Investment Test Results**

Present Value \$NZ million	Unserviced Energy (A)	Transmission costs (B)	Terminal benefit (C)	Expected Net Market Cost (A+B-C)
Reference Case – Option 1 WIL/ HAY	0	9.19	1.48	7.72
Option 2 - HAY/ WIL	0	14.62	0.83	13.79
Option 3- TKR/ WIL	0	11.77	1.16	10.61
Option 4- PRM/ WIL	0	19.02	0.99	18.03
Option 5 -PRM switching/ WIL	18.47	8.58	0.65	26.40
Option 6 -PRM Split/ WIL/HAY	0	11.86	1.92	9.93

The reference case (being Option 1), which is installing a new 250 MVA 220/110 kV interconnecting transformer at Wilton, is the least cost option and therefore becomes the Proposal.

### 7.3 Sensitivity analysis

The sensitivity analysis is presented as a comparison of the expected net market cost for the short-list options when various parameters are varied.

The following table summarises the results of the sensitivity analysis:

**Table 7-2: Grid Investment Test sensitivity analysis**

Expected Net Market Cost \$NZ million	Reference Case Option 1 WIL/ HAY	Option 2 HAY/ WIL	Option 3 TKR/ WIL	Option 4 PRM/ WIL	Option 5 PRM switching/ WIL	Option 6 PRM Split/ WIL/HAY
Base results	<b>7.72</b>	13.79	10.61	18.03	26.40	9.93
Sensitivities						
Medium demand	<b>7.49</b>	13.18	10.43	17.53	37.87	9.46
Low demand	<b>5.97</b>	12.16	9.12	16.44	32.58	7.45
Discount rate 4%	<b>8.07</b>	14.00	11.07	18.55	29.80	10.59
Discount rate 10%	<b>7.24</b>	13.36	10.08	17.33	23.43	9.23
VoLL at \$10,000	<b>7.72</b>	13.79	10.61	18.03	16.27	9.93
VoLL at \$30,000	<b>7.72</b>	13.79	10.61	18.03	32.95	9.93

The results of the sensitivity analysis indicate that Option 1 minimises the expected net market costs under each of the variations of the variables considered as part of the sensitivity analysis. Transpower therefore considers the sensitivity analysis shows that the conclusion that Option 1 minimises the expected net market costs compared with the other short list options is robust.

### 7.3.1 Accuracy of GIT

Transpower recognises there is inherent uncertainty in several of the input assumptions used in the GIT analysis, namely the demand forecasts and cost assumptions.

However, Transpower considers the rigour and comprehensiveness of the analysis undertaken is commensurate with the estimated capital expenditure required for the proposed investment.

### 7.3.2 GIT analysis conclusion

Transpower considers that the Base Case satisfies the GIT because:

- it minimises the expected net market cost when compared with the alternative projects; and
- it is robust having regard to the results of sensitivity analysis.

## 7.4 Timing of the Proposal

The Proposal is a reliability investment and is required in order to meet the n-1 reliability criteria on the Wellington 110 kV network. The GRS are currently not being met, hence this Proposal is justified as soon as possible.

Transpower intends to progress the project as early as possible. However, transformer lead-times are approximately two years at present so the Proposal is not expected to be commissioned until 2011. It should be noted that the Transpower Board has approved expenditure to purchase a 250 MVA 220/110 kV interconnecting transformer for installation at Wilton and the purchasing process is underway, prior to Commission approval. The design stage is underway, but a tender has not yet been let. This step has been taken because the Wellington 110 kV network does not currently meet the GRS and because of the extraordinarily long lead times for purchasing transformers.

## 7.5 Relationship to Woodville–Mangamaire–Masterton reconductoring

The technical studies undertaken for the Proposal assume the existing conductor and rating for the Woodville–Mangamaire–Masterton 110 kV line. It is split at Mangamaire to minimise the impact of the constrained Woodville–Mangamaire–Masterton 110 kV line on Wellington 110 kV load.

Part VI of the 2008 GUP, submitted along with this Part V, seeks approval however, to reconductor the Woodville–Mangamaire–Masterton 110 kV line with a larger conductor.

This reconductoring would remove the existing circuit constraint and increase 110 kV transfer capacity into Wellington, which could potentially defer the need for investment at Wilton.

However, technical studies have shown that increased capacity on the Woodville–Mangamaire–Masterton 110 kV line only allows more Wellington 110 kV load to be met for a limited range of HVDC north transfers. For HVDC north transfers outside this range, the existing Wilton interconnecting transformer still constrains.

Deferring investment at Wilton to take advantage of the increased capacity on the Woodville–Mangamaire–Masterton 110 kV line would require HVDC transfers to be constrained. The savings from deferring investment at Wilton would be far outweighed by the costs in constraining HVDC transfers. Hence, even if Part VI of the 2008 GUP is approved it does not affect the economic case for investment at Wilton.



The main impact on the Proposal of reconductoring the Woodville–Mangamaire–Masterton 110 kV line with a larger conductor is to defer the need for the Stage 2 modelled projects in this analysis. Although this has not been reflected in the analysis, it would not affect the ranking of the options and the reference case would still pass the GIT.

## 8 Compliance with the processes set out in the Rules

The Commission may approve a proposed reliability investment where the proposed investment complies with the processes set out in the Rules. Transpower notes that the Commission interprets this rule as requiring that Transpower has complied with the processes required by the Rules in relation to the proposed investment under consideration.

The processes in the Rules require Transpower to:

- submit a grid upgrade plan in accordance with Rule 12.2;
- comply with any requests from the Commission prescribed in writing to provide information it considers is reasonably required to enable it and interested persons to evaluate the proposed investment – Rule 12.3.4;
- comply with the timetable for consultation and approval of reliability investments proposed in Transpower's grid upgrade plan, agreed between Transpower and the Commission, or as stipulated by the Electricity Commission, in accordance with Rule 13.2; and
- respond to any requests for further investigation or further information in accordance with Rule 13.3.3.

The processes under the Rules that Transpower follows in respect of potential investments are project specific and accordingly do not assist in differentiating between the short-list options.

### 8.1 Submission of a Grid Upgrade Plan

Rule 12.2.1 provides that either:

- Transpower must submit a grid upgrade plan to the Commission within 3 months of receiving a written request from the Commission, or such other date as the Commission agrees; or
- Transpower may submit a grid upgrade plan for the Commission's consideration at any other time.

Transpower has not received a written request for submission of a grid upgrade plan (GUP). Transpower is submitting this document, as part of its 2008 GUP to the Commission.

### 8.2 Provision of information

Rule 12.3.4 requires a grid upgrade plan to, amongst other things, include:

*"such other content as prescribed in writing by the **Board**, to ensure that **grid upgrade plans** includes such information that the **Board** considers is reasonably required to enable the **Board** and interested parties to evaluate **proposed transmission investments**, such as indicative pricing impacts of **investment proposals**."*

The Commission has not requested any information under Rule 12.3.4. No further requests for information under Rule 12.3.4 or otherwise were made.



Accordingly, Transpower has complied with the requirements of Rule 12.3.4.

### 8.3 Compliance with the timetable and process

Rule 13.2.1 requires the Commission and Transpower to agree a timetable for consultation and approval of reliability investments. In the absence of agreement, the Commission may stipulate such a timetable.

Additionally, the Commission must consult with Transpower on the process for consultation and persons who the Commission will consult with.

Transpower and the Commission have agreed on a timetable for consultation and approval of the Proposal, including persons who the Commission will consult with.

Transpower considers that, to date, it has complied with the timetable and process agreed with the Commission.

### 8.4 Requests for further investigation and further information

Under rule 13.3.3, the Board may:

- direct Transpower to undertake further investigations into its proposed reliability investment;
- ask questions of Transpower or require further information or consultation on part or all of Transpower's Proposal;
- ask Transpower to evaluate alternative reliability investments; and
- where Transpower possesses relevant expertise, ask Transpower to evaluate transmission alternatives.

The Commission has not requested any information under rule 13.3.3. Transpower will endeavour to continue to comply with any reasonable requests the Commission may have in accordance with the above requirements.

## 9 The Proposal meets the Rule requirements

***This section sets out Transpower's conclusion that the Proposal meets the tests for approval under the Rules***

As the Proposal is a "reliability investment", the Commission can approve the Proposal under rule 13.4.1, if the Proposal:

- reflects good electricity industry practice (GEIP) in meeting the Grid Reliability Standards (GRS);
- complies with the processes set out in the Rules; and
- meets the requirements of the GIT.

Transpower considers the Commission may approve the Proposal on the grounds that it satisfies the criteria under rule 13.4.1.

## 10 Approval amount for the Proposal

### 10.1 Approval amount sought

This application seeks Commission approval to recover the lesser of actual costs or the estimated Maximum Approved Cost (MAC) of the Proposal. The Expected Cost of the Proposal, as used in the GIT, is estimated to be \$6.27 million and the MAC of the Proposal is estimated to be \$9.57 million.

### 10.2 Approval amount methodology

Previously, Transpower has used what is known as a P90 methodology to calculate the approval amount. For this Proposal, Transpower has used a simplified methodology to determine a formulaic Maximum Approval Cost (MAC). This allows for variations in such items as financing costs, exchange rates and commodity prices, costs typically beyond the control of Transpower. Transpower considers the use of a MAC aids transparency and makes tracking of project costs against the approved amount much simpler.

It is worth noting that the cost of foreign exchange hedging is included in the Maximum Approved Cost.

The amount for which approval is sought from the Commission is shown below, in comparison to the Expected Cost, as used in the GIT analysis, and the Expected End Cost, which is the cost Transpower expects the Proposal to cost. The Expected End Cost is similar to the old P50 figure.

**Table 10-1: Expected Cost and Maximum Approved Cost Comparison**

\$NZ million	Estimated Cost	Expected Cost	Price contingency	Exchange rate variability	Exchange rate hedge	Inflation	IDC	TOTAL
Expected Cost	5.70	6.27						6.27
Expected End Cost	5.70	6.27	0.79	0.40	0.25	0.63	0.15	8.50
Maximum Approved Cost	5.70	6.27	1.36	0.69	0.30	0.76	0.18	9.57

Appendix B describes how the MAC has been derived.

It should also be noted that the price contingency for the capital cost of the transformer itself, is higher than the price contingency for other elements of this proposal. Whereas a price contingency of -10% to +20%, has been used for most components in this analysis, for the capital cost of the transformer, a price contingency of -10% to +50% has been used. This reflects the high volatility observed in transformer purchasing costs currently. The MAC costs are based on a cost estimate derived in August 2008, but actual tender prices being received for very similar transformers in December 2008 are approximately 50% higher.

For comparison, Transpower has calculated a P90 figure for the Proposal, using the same approach as use for past GUPs. The MAC and P90 are shown in Table 10-2 below:

**Table 10-2: Maximum Approval and P90 Costs, \$ million**

MAC	P90
9.57	9.22



## Appendix A Glossary

Term	Description
<b>Alternative Project</b>	Projects that are reasonable to consider as alternatives to the proposed investment in applying the Grid Investment Test, in accordance with rule 19, Schedule F4, Part F Section III, Electricity Governance Rules.
<b>APR</b>	<b>Annual Planning Report</b>
<b>Expected costs</b>	Expected costs represent the estimated cost plus a contingency for scope accuracy. Scope accuracy allows for unexpected variations in the design scope and a standard allowance, based on experience, for items not considered in the design. Expected costs are in current dollars and do not allow for cost uncertainty related to price variations, inflation, or financing costs.
<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>GEIP</b>	<b>Good Electricity Industry Practice.</b>
<b>GEM</b>	<b>Generation Expansion Model</b> , a model for generation expansion modelling developed by the Electricity Commission.
<b>GIT</b>	<b>Grid Investment Test.</b> A cost-benefit analysis for both reliability and economic investments. The specific rules defining the Grid Investment Test, as developed according to the process in rule 6 of section III, are set out in Schedule F4 of section III of Part F.
<b>GPS</b>	<b>Government Policy Statement on Electricity Governance.</b>
<b>GUP</b>	<b>Grid Upgrade Plan.</b> A plan for grid expansions, replacements and upgrades, developed in accordance with rule 12 of section III of part F, Electricity Governance Rules.
<b>HVAC</b>	<b>High Voltage Alternating Current</b>

**HVDC** High Voltage Direct Current

**MAC** Maximum Approval Cost

**modelled projects** Transmission augmentation projects and non-transmission projects, other than the proposed investment and alternative projects, which are likely to occur in a market scenario, are reasonably expected to occur in that market development scenario within the time horizon for assessment of the market benefits and costs of the proposed investment and alternative projects, and the likelihood, nature and timing of which will be affected by whether the proposed investment or any alternative project proceeds.

**Monte Carlo** Monte Carlo simulation is a method for iteratively evaluating a deterministic model using sets of numbers randomly generated within certain ranges as inputs. It creates a distribution of possible outcomes on which descriptive statistics can then be run.

**P90 cost** Estimated 90<sup>th</sup> percentile of project costs.

**Rules** The Electricity Governance Rules 2003. In the context of this document, it generally refers to Part F Transport, Section III Grid Upgrade and Investments.

**Transpower** Transpower New Zealand Limited, owner and operator of New Zealand's high-voltage electricity network (the National Grid).

## Appendix B Maximum Approved cost methodology

This application seeks Commission approval to recover the lesser of actual costs or the estimated Maximum Approved Cost (MAC) of the Proposal.

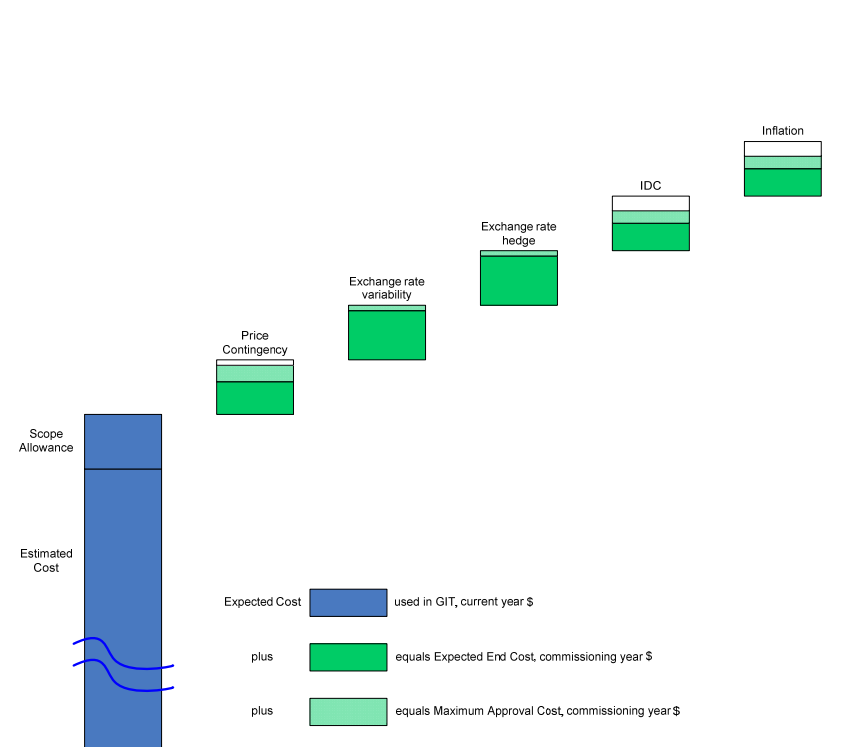
The Expected Cost of the Proposal, as used in the GIT, is estimated to be \$6.27 million and the MAC of the Proposal is estimated to be \$9.57 million. This section sets out how Transpower has estimated the MAC and describes the difference between the Expected Cost and the MAC.

In previous investment proposals submitted to the Commission, Transpower has sought approval to recover up to a P90 cost. It is expected there is only a 10% probability that the P90 figure would be exceeded once the Proposal was commissioned. The P90 figure was derived from a probabilistic analysis of the expected cost of the Proposal using a Monte Carlo approach.

However, experience has shown that the development of a P90 figure lacks transparency and in particular it is difficult to relate the P90 back to actual, trackable, project specific costs. Transpower has applied a different method for the Wellington 110 kV Interconnection Investment Proposal and has determined a MAC. The methodology for determining a MAC is described below.

For comparison, Transpower has also calculated and reported a P90 figure, in order to assist the Commission understand how the new approach for calculating a maximum approval amount relates to the previous approach.

The relationship between the Expected Cost used in the GIT and the MAC is represented in Appendix Figure 1.



Appendix Figure 1: – Relationship between Expected Cost and MAC<sup>14</sup>

<sup>14</sup> Exchange rate variations are based on historical volatility and estimated on a 90<sup>th</sup> percentile likely over the period between the Reference Date (used for calculating costs used in the GIT) and when tenders might be accepted.



The approval amount is higher than the Expected Cost used in the GIT because:

- The Expected Cost comprises an estimated cost plus an allowance for scope variations. It does not include an allowance for all uncertainties present in a construction project of the type proposed.
- The Expected Cost is in current (today's) dollars, whereas the approval amount is an estimate of the end cost of the project in future (commissioning year) dollars.
- The approval amount is required to cover the full cost of the project including financing costs, price variations on materials, exchange rate variations and foreign exchange hedging, etc.

Importantly at the approval stage the actual costs are known at a high level only as such things as transformer suppliers are yet to be determined and there is also a reasonable time gap between approvals and when the majority of actual costs are incurred.

Appendix Figure 1 shows that the Expected Cost used in the GIT is the Estimated Cost plus Scope Allowance only, in current year dollars.

The Maximum Approved Cost is higher than the Expected Cost because it includes an allowance for price contingencies and all other variables. Estimates are used to produce an overall MAC similar in magnitude to the previously calculated P90.

#### Method of calculating Maximum Approval Cost

The following inputs and variables are considered in deriving the Expect Cost and MAC:

- **Estimated Cost.** The Estimated Cost is the estimated cost of designing, procuring, constructing and commissioning the components which make up the Proposal. These costs can include decommissioning costs and the costs of obtaining designations, easements, resource consents and property purchases for these works if applicable. The Estimated Cost does not include contingencies. The Estimated Cost is in current dollars, as calculated on the Reference Date.
- **Reference Date.** Transpower prepared estimated capital costs as at 20 May 2008. A reference date is used to ensure consistency between the estimated capital costs of components within each option considered in the GIT and between options. For calculating costs at commissioning time, Transpower has assumed a commissioning date of 31 December 2011. These commissioning dates are assumed to be the dates at which accumulated costs for the project would be included in Transpower's regulated asset base and from which costs would start to be recovered through the Transmission Pricing Methodology –
- **Scope allowance.** Transpower also estimates a scope allowance, which is added to the Estimated Cost, to cover two distinct categories of costs: (a) costs for works which are planned, but which have not been included in the estimated capital costs except through this general allowance, and (b) costs for works not anticipated at the time costs were estimated. The Estimated Cost plus Scope Allowance equals the **Expected Cost** of the project or various components of it and this is the cost used in GIT analyses. The Scope Allowance is treated as a fixed percentage of Estimated Costs which are added to the Estimated Cost.
- **Price Contingency.** As regulatory approval occurs prior to the issuing of tenders, there is uncertainty over the price of equipment to be installed. In particular, this includes the risks that:
  - market pressures may affect the cost of capital items, e.g. if worldwide demand for transformers is high at the time Transpower seeks tenders, the prices offered may reflect a tighter supply situation and therefore be higher than at other times; and



- commodity price movements. Tender prices for some capital items include escalators linked to market price variations in significant elements of that item eg metals such as steel and copper. As with exchange rate variations, Transpower would not, typically, consider hedging anticipated commitments until a contract is awarded/signed. This is because of the somewhat speculative nature of entering commodity futures contracts in advance of commitment and the costs involved, which may or may not be required, depending upon the terms of the eventual contract. Hence, Transpower is exposed to commodity price movements up until contracts are signed and so an estimate is made of the potential cost variation this might cause.

Price movements could be downward as well as upward and for this reason the price contingency is estimated as the minimum and maximum variations expected. A price contingency of -10% to +20%, would be typical and has been used for most components in this analysis. The exception is the capital cost of the transformer itself, for which a price contingency of -10% to +50% has been used. This reflects the high volatility observed in transformer purchasing costs currently. The MAC costs are based on a cost estimate derived in August 2008, but actual tender prices being received for very similar transformers in December 2008 are approximately 50% higher.

For the purposes of calculating the Expected End Cost, the 50<sup>th</sup> percentile of this range is taken ie 5% for the example above.

For the purposes of calculating the MAC, the 70<sup>th</sup> percentile of this range is taken ie 11% for the example above.

- **Exchange rate variations.** Transpower's current practice is to enter foreign exchange contracts to hedge foreign exchange movements, once contractual commitments are made. This provides NZ dollar cost certainty from the point that tenders are awarded/contracts signed.

Transpower does not, typically, hedge anticipated commitments. This is because of the somewhat speculative nature of entering foreign exchange contracts in advance of commitment and the added costs of having to pay option premiums for hedging a range of possible currencies and execution dates, most of which would not be exercised. Hence the requirement to estimate the effect on costs of exchange rates moving in the interim period before signing contracts.

The Estimated Costs were based on average exchange rates around the Reference Date. For the purposes of calculating the MAC, the Proposal cost reflected a USD exchange rate of 0.6614.

The exchange rate variations are based on historical volatility and are estimated on either a 50<sup>th</sup> or 90<sup>th</sup> percentile likely over the period between the Reference Date and when tenders might be accepted. The methodology used to calculate the 50<sup>th</sup> and 90<sup>th</sup> percentile volatility variations is as developed by Bancorp and as used for the HVDC Proposal.

- **Exchange rate hedge.** As mentioned above, Transpower's current practice is to enter foreign exchange contracts to hedge foreign exchange movements, once contractual commitments are made. The cost of foreign exchange hedging has been estimated and included in the cost of the Proposal.

The hedging cost included has been estimated using current forward exchange rate premiums, for the expected period between committing to contracts which include foreign exchange exposure and the expected payment dates under those contracts.

- **Real interest rates.** Real interest rates are used in the calculation of Interest During Construction costs and are assumed to vary between 3.3% to 5.3%, as 10<sup>th</sup> and 90<sup>th</sup> percentiles respectively, with a mean of 4.3%. The nominal interest rate is the real interest rate plus the inflation rate, equating to a mean nominal interest rate of 7.3% in this instance. This is approximately Transpower's current cost of debt.

For the purposes of calculating the Expected End Cost, the mean of 4.3% is used. A figure of 4.5% is used for the MAC.

- **Inflation.** Transpower assumes inflation will vary between 2% to 4% per annum, as 10<sup>th</sup> and 90<sup>th</sup> percentiles respectively, with a mean of 3%.

For the purposes of calculating the Expected End Cost, the mean of 3% per annum is used. A figure of 3.2% is used for the MAC.

### Results of Expected Cost, Expected End Cost and MAC calculations

The Expected Cost of the Proposal, as estimated in 2008, is \$6.27 million.

This cost includes a scope allowance and represents Transpower's estimate of the cost of designing, purchasing, constructing and commissioning the Proposal, in current dollars. Transpower will not start recovering the costs of a stage of this Proposal until it is commissioned, i.e. 2011. The cost Transpower will look to recover at that time is higher, due to potential cost uncertainties, financing costs incurred throughout the construction period and inflation.

The Expected End Cost of the Proposal includes a price contingency, exchange rate variability allowance, the expected cost of foreign exchange hedging, inflation and Interest During Construction costs. For the purposes of calculating an Expected End Cost, all parameters (eg inflation) are assumed at their 50<sup>th</sup> percentile levels. This gives an Expected End Cost akin to a P50. The Expected End Cost for the Proposal is \$8.50 million.

The MAC for the Proposal is calculated using upper percentile estimates for the various parameters and results in a MAC of \$9.57 million. Transpower is seeking approval to recover the lesser of actual costs or the MAC.

There is a probability of exceeding the MAC (and in fact as shown below, the MAC is close to a P90 figure). If there are changes which are materially different to those assumptions used in deriving the MAC then this cost may be exceeded. In such a case, Transpower would apply for approval for the revised costs of the project in accordance with Rule 17.2.

Appendix Table 1 shows the break down of the MAC.

**Appendix Table 1: Maximum Approval Cost for the Proposal, \$ million**

\$NZ million	Estimated Cost	Expected Cost	Price contingency	Exchange rate variability	Exchange rate hedge	Inflation	IDC	TOTAL
Expected Cost	5.70	6.27						6.27
Expected End Cost	5.70	6.27	0.79	0.40	0.25	0.63	0.15	8.50
Maximum Approved Cost	5.70	6.27	1.36	0.69	0.30	0.76	0.18	9.57

For comparison, Transpower has calculated a P90 figure for the Proposal, using the same approach as use for past GUPs. The MAC and P90 are shown in **Error! Reference source not found.** below:

**Appendix Table 2: Maximum Approval and P90 Costs, \$million**

MAC	P90
9.57	9.22

### Summary of estimated Expected End Cost and Maximum Approval Cost

Transpower estimates the Expected End Cost, with variations accounted for, to be \$8.50 million and the Maximum Approval Cost of the Proposal is \$9.57 million in \$2011.