DECEMBER 2008

Grid Upgrade Plan 2008 Instalment 1

Part IV: Maungatapere Bus Security Investment Proposal

Keeping the energy flowing

TRANSPOWER

Transpower New Zealand Limited The National Grid

Executive Summary

The purpose of this Maungatapere Bus Security Investment Proposal is to obtain Electricity Commission (the Commission) approval to recover the full costs (up to $4.1 million) associated with installing a bus coupler at Maungatapere.

Proposal at a Glance	
What:	Upgrade to bus security on the Maungatapere 110 kV bus.
When:	Commissioning in 2010
How much:	Transpower is seeking approval for up to $4.1 million (2010$)

Background

At present, the Northland region and Rodney district are vulnerable to a loss of supply in the event the 110 kV Maungatapere substation bus trips. Such an event would result not only in a loss of supply to a large part of the Northland 110 kV and 50 kV networks (namely the Maungatapere, Kensington, Dargaville, Kaikohe and Kaitaia substations), but also result in a loss of supply at the Maungaturoto and Wellsford substations served by the 110 kV Henderson–Maungatapere A line.

Nature of proposal

The proposal consists of the installation of a bus coupler and the associated upgrade to the protection equipment at the Maungatapere bus. Whilst the latter is covered by an existing Transpower policy, the installation of a bus coupler is not, hence the requirement to apply to the Commission for approval of the project.

Similar bus coupler projects at other substations required to bring assets up to the Grid Reliability Standards (GRS) will be undertaken under a policy framework.

Options considered

Transpower considers there is only one reasonable alternative project for this project, being the Local Diesel Generation Option. This option consists of installing sufficient local diesel generation to meet expected peak demand at each of the potentially affected substations.

Application of the GIT

It should be noted that there is an inherent level of uncertainty in the input assumptions such as the demand and generation forecasts. As such, the reader should be careful not to infer a level of precision from the results of the GIT that does not exist. However, it is quite apparent from the GIT assessment that the Proposal – the Bus Security Upgrade – delivers by far the lower expected net market cost in comparison to the alternative project and is the preferred option.

Table 1-1: GIT Results, ranking of the Proposal and Base Case

Item	Base Case: Local Diesel Generation	The Proposal: Bus Security Upgrade
	Mean Present Value 2008$M	
Mean NPV Capital cost (A)	-518.2	-3.3
Fuel cost benefits (B)	0.0	0.4
Mean NPV cost (A+B)	**-518.2**	**-2.9**
Net Market Benefit (Option Costs - Base Case Costs)	**0.0**	**515.3**

Maximum Approval Costs

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 $3.4 million and the MAC of the Proposal is estimated to be $4.1 million.

This Document

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

- Part A sets out the actual proposal for which approval of cost recovery up to $4.1 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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Attachments

Ref	Title
A	Economic Report

PART A – The Proposal

This document represents Transpower's Maungatapere Bus Security Investment Proposal (the Proposal).

Transpower is seeking Electricity Commission (Commission) approval to recover the full costs associated with implementing the following:

- Install a bus coupler on the Maungatapere 110 kV bus.
- Upgrade the protection at the Maungatapere 110 kV bus to include:
    - bus zone protection,
    - circuit breaker fail, and
    - duplicate line protection.

Timing

Transpower will work towards commissioning the Proposal in June 2010, i.e, as soon as possible, as the asset does not meet the GRS at present. The construction programme for the Proposal is scheduled to start in early 2009 and aims to be completed in June 2010.

Costs

This application seeks Commission approval to recover the lesser of actual costs or $4.1 million, the estimated Maximum Approved Cost (MAC) of the Proposal. This amount is expressed in commissioning year New Zealand dollars exclusive of GST.

Appendix C sets out how Transpower has estimated the MAC.

PART B – Justification

1 Introduction

1.1 Purpose of the Proposal

The purpose of the Proposal is to obtain Commission approval to recover the costs associated with implementing a solution to ensure reliable electricity supply to the Maungatapere, Kensington, Dargaville, Kaikohe, Maungaturoto and Wellsford substations.

The purpose of this Part of the document, Part B, is to provide information for:

- persons who are likely to be substantially affected by the Proposal; and
- the Electricity Commission to assess compliance of the Proposal with the Rules.

1.2 Background to the Proposal

At present, the Northland region and Rodney district are vulnerable to loss of supply in the event the 110 kV bus located at the Maungatapere substation trips. Such an event would result not only in loss of supply to a large part of the Northland 110 kV and 50 kV networks (namely the Maungatapere, Kensington, Dargaville, Kaikohe and Kaitaia substations), but also result in a loss of supply at the Maungaturoto and Wellsford substations that are served by the 110 kV Henderson–Maungatapere A line.

Investment in bus security at the Maungatapere substation is required to ensure a reliable supply of electricity to the region described above. This has been highlighted in Transpower's 2008 Annual Planning Report[1].

A network schematic of the proposed Maungatapere 110kV bus configuration with the bus coupler is shown in Appendix B.

1.3 Nature of proposal

The proposal consists of the installation of a bus coupler and the associated upgrade to the protection equipment at the bus. Whilst the latter is covered by an existing Transpower policy, the installation of a bus coupler is not, hence the requirement to apply to the Commission for approval of the project.

Given that the proposed work is required to bring this asset up to the current GRS and that several other buses require similar work to meet the GRS Transpower will address future works under a policy framework.

1.4 Compliance with the GUIRP

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

However, for smaller projects, Transpower will abbreviate the process consistent with the principles that the analysis undertaken in applying the Grid Investment Test (GIT)

[1] Section 8.6.8, p.134.

is commensurate with the estimated capital expenditure required for the proposed investment.[2] This approach reflects one of the key principles of the GUIRP.[3]

1.5 Document structure

This document forms part of Transpower's 2008 GUP.

Part A of this document contains the investment proposal.

Part B describes the processes followed and information analysed by Transpower in reaching its decision to seek approval from the Commission to recover the costs associated with implementing the Proposal set out in Part A.

Accordingly, Part B is not part of the Proposal, but contains justification for it.

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

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

2 Needs Assessment and Type of Investment

2.1 Power systems analysis

Analysis of the New Zealand transmission system is routinely carried out by the Grid Development group at Transpower. Broadly speaking, the power system analysis forecasts the National Grid's capacity to transmit power throughout New Zealand under a range of future conditions. Analysis includes:

- power flow analysis to identify thermal constraints (the point at which assets become overloaded due to system contingency events); and
- voltage stability analysis to identify voltage collapse constraints.

In undertaking any power system analysis, Transpower considers and incorporates the following:

- assets comprising the transmission network;
- transmission upgrade projects being implemented;
- assumptions regarding future supply and demand;
- grid reliability standards that specify the minimum required level of supply security and reliability for the purposes of transmission planning and real-time system operation; and
- other relevant matters.

These factors were used in power system analysis for the North Isthmus area – the area north of the Hepburn Road substation, as shown in the map below - to identify any potential future power supply constraints.

[2] Clause 12, Schedule F4 of the Rules.
[3] Grid Upgrade Investment and Review Policy, June 2008, para 2.1.1(h).

Figure 2-1: North Isthmus Area

2.2 Conclusions of the power systems analysis

Based on the power system analysis undertaken by Transpower, the 'n-1' security standard on the core grid required by clause 4.2 of the Grid Reliability Standards (GRS) is not met at the Maungatapere substation. Maungatapere is considered part of the core grid as the Marsden–Maungatapere line is listed in the Core Grid Determination, set out in Schedule F3A.

An immediate solution must be found to ensure reliable electricity supply to the North Isthmus area. The area is supplied from the south by the 220 kV double circuit Henderson–Marsden A transmission line and the double circuit 110 kV Henderson–Maungatapere A line. From Maungatapere, the 110 kV double circuit lines continue to Kensington and Kaikohe, from where a 110 kV single circuit line continues to Kaitaia. There are also two 50 kV single circuit transmission lines that supply power to Dargaville from Maungatapere. In the event of the bus tripping at Maungatapere, there is total loss of supply at Maungatapere, Kensington, Dargaville, Kaikohe, Maungaturoto and Wellsford.

Transpower considers that the assumptions underpinning the power system analysis for the North Isthmus area (a prudent demand growth forecast coupled with the availability and reliable operation of key transmission and generation assets) represents a reasonable view of the future. Therefore, it is reasonable and prudent to plan for the solution described in the Proposal as soon as possible to meet Clause 4.2 of the GRS and to ensure a reliable supply of electricity to the North Isthmus area.

2.3 Type of investment

The Proposal is a "reliability investment":

- 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 (namely the bus at the Maungatapere substation).

3 Identification and Consideration of Options

3.1 Short list options

Under the Rules, the GIT requires that a reliability investment proposed by Transpower, that is necessary to meet the reliability standard set out in clause 4.2 of the GRS, must maximise the expected net market benefits or minimise the expected net market costs compared with a number of alternative projects[4].

Accordingly, Transpower must identify a number of options in addition to the Proposal that fall within the definition of "alternative projects" under the Rules. To identify options for consideration, Transpower has undertaken a process which included the following stages:

- confirming the need for the investment;
- identifying all options to address the identified need;
- assessing all the options to identify a short list of options that in the circumstances can reasonably be considered as alternative projects; and
- confirming the short-list of options.

This process resulted in the selection of the Proposal and the alternative project described below.

3.2 Alternative projects

Under the Rules[5], "alternative projects" are defined as:

> *""**Alternative projects**" means 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;*
>
> *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;*

[4] Clause 4.1, Schedule F4
[5] Clause 19, Schedule F4.

> *19.4. reasonably expected to provide similar benefits, in type but not necessarily in magnitude, to 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."*

In addition[6], the alternative projects to be considered in the GIT must be limited to:

> "…*those appropriate in number and technology given the cost magnitude of the **proposed investment**, the complexity of the required modelling and the urgency of the **proposed investment**.*"

Given:

- the estimated cost magnitude of the proposed investment is low (in the order of $3-4 million);
- the urgency of the project (Transpower considers that the relevant part of the power system does not, currently, meet the GRS),

Transpower considers it appropriate to consider only one alternative project for this project, being the Local Diesel Generation Option. This option consists of the installation of sufficient local diesel generation to meet expected peak demand at each of the potentially affected substations. Specifically, it consists of the installation of rented 10 MW diesel generators at each affected substation[7] in the North Isthmus area sufficient to meet forecast peak local demand.

3.3 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.

3.3.1 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. Specifically, the approach taken for the Proposal is consistent with international practice as being a

[6] Clause 11, *ibid*.
[7] Most of these substations are not on the core grid and so in theory it might be better to place the diesel generation at Maungatapere but then the actual configuration would be difficult to analyse consistently. Provided the spur line reliabilities are not considered, there will be little material difference between placing the diesel generation at Maungatapere and placing it at the various outlying substations.

prudent investment given the size, nature and importance of the North Isthmus area load.

3.3.2 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 Maungatapere substation concerns the core grid, any reliability investment must meet both clauses 4.1 and 4.2 of the GRS. Accordingly, Transpower undertook a power system analysis[8] 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 of June 2010, and will reduce expected unserved energy.

Transpower considers that both short list options meet the GRS as required by rule 13.4.1.1.

3.4 Base case

For the purposes of the GIT, the Rules also require that the Proposal and the alternative projects be assessed against a base case, which is defined[9] as follows:

> ***"Base case"** means the **market development scenarios** developed for the reasonable future state of the electricity industry without the **proposed investment** or any **alternative project**.*

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, and more particularly rule 4.2 of 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.

Given the existence of only one alternative project for this investment proposal, the Local Diesel Generation Option was selected as the reference case for the purposes of the GIT.

[8] Power system analysis involves a technical evaluation of the capacity of the power system over time to meet demand (and changes to demand over time). It literally models the power system, as a collection of individual items, each of which is represented in the model according to its manufacturer's specifications. The power system analysis produced a schedule of asset capital expenditures, including the year which the asset capital expenditures are required, that result in a power system able to meet the n-1 safety standard at times of peak demand.

[9] Clause 20 of Part F Section III Schedule F4

4 Application of the Grid Investment Test

4.1 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.

4.2 Analytical approach and market development scenarios

The economic analysis presented in this report differs in form, but not in substance, from that used for analysis of major transmission investment proposals such as the HDVC Upgrade. The difference in substance arises because the project's scale is much smaller, both in terms of cost and complexity. The Rules require that:

> *"The rigour and comprehensiveness of the analysis undertaken in applying this **grid investment test** must be commensurate with the estimated capital expenditure required for the **proposed investment**."* [10]

Transpower's economic analysis for the Proposal focuses on the capital cost effects of the short-list options, as these areas are the principle sources of market benefits and costs. Transpower considers that this approach is commensurate with the Rules given the estimated capital expenditure for the Proposal (in the order of $3-4 million).

Given that 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[11], that would materially impact on the GIT analysis, 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. 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.[12]

4.3 Application of the GIT

Table 4-1 presents the summarised rankings of the short list options from applying the GIT. A more detailed discussion of the results of the GIT is set out in the Economic Report attached to this Proposal as Attachment A.

[10] Clause 12, Schedule F4.
[11] Possible wind generation in the far North of the Northland region is considered speculative.
[12] See Reasons for Decision set out in Notice of Intention to Approve Transpower's North Island Grid Upgrade Proposal, para 6.3.22.

Table 4-1: GIT Results, ranking of the Proposal and Reference Case

Item	Reference Case: Local Diesel Generation	The Proposal: Bus Security Upgrade
	Mean Present Value 2008$M	
Mean NPV Capital cost (A)	-518.2	-3.3
Fuel cost benefits (B)	0.0	0.4
Mean NPV cost (A+B)	**-518.2**	**-2.9**
Net Market Benefit (Option Costs - Reference Case Costs)	**0.0**	**515.3**

The results show that the Proposal – the Bus Security Upgrade option – has by far the lowest expected net market cost of the two options. This is due to the substantial rental and operating costs required to provide sufficient local thermal generation at each of the affected substations.

It should be noted that there is an inherent level of uncertainty in the input assumptions such as the demand and generation forecasts. As such, the reader should be careful not to infer a level of precision from the results of the GIT that does not exist. However, it is quite apparent from the GIT assessment that the Proposal – the Bus Security Upgrade delivers by far the lowest expected net market cost and is the preferred option.

4.4 Sensitivity Analysis

Given the magnitude of the difference between the options in the GIT results, Transpower does not consider it reasonably necessary to conduct a sensitivity analysis[13]. Any plausible change in key parameters would still leave the Proposal being a more economic option than the alternative option. Even if local diesel generation capacity were to be purchased rather than rented this might only reduce capital costs for the alternative option by a third still leaving it several hundred million dollars more expensive than the Proposal.

4.5 Conclusion of the GIT analysis

The Proposal (the Bus Security Upgrade option) satisfies the GIT because:

- as a reliability investment, it maximises the expected net market benefit when compared with the alternative projects; and
- the results are sufficiently robust to any plausible change in key parameters of the analysis.

[13] Clause 17, Schedule F4.

5 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.

5.1 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.

5.2 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.

5.3 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.

5.4 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.

6 The Proposal meets the Rule requirements

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 in meeting the Grid Reliability Standards;
- 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.

7 Approval Amount of the Proposal

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 $3.4 million and the MAC of the Proposal is estimated to be $4.1 million.

Appendix C sets out how Transpower has estimated the MAC and describes the difference between the Expected Cost and the MAC.

Appendix A: Glossary

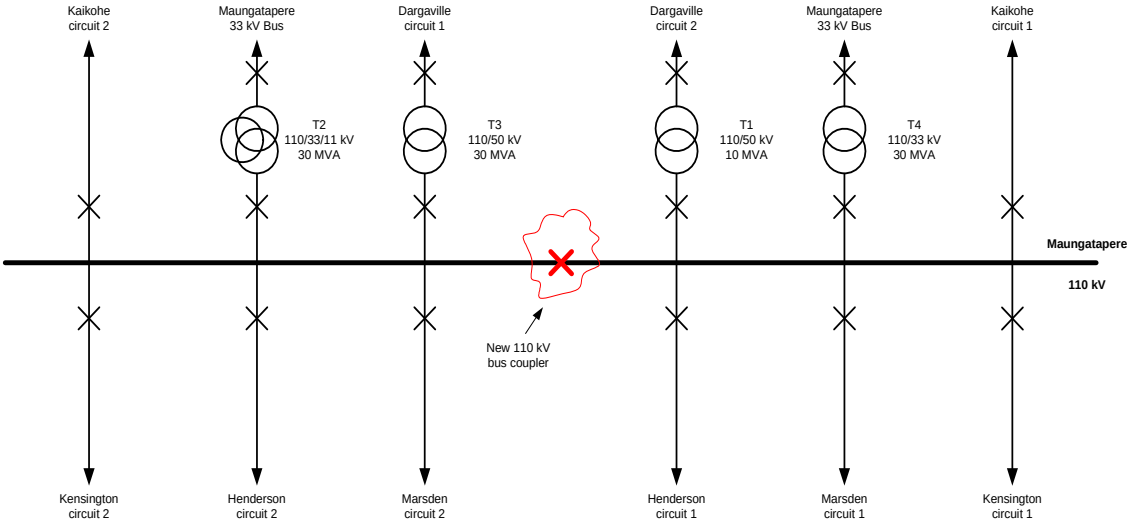
Term	Description
Alternative Project	Projects that are reasonable to consider as alternatives to the proposed investment in applying the Grid Investment Test (GIT), in accordance with rule 19, Schedule F4, Part F Section III, Electricity Governance Rules.
Commission	The Electricity Commission - a Crown entity set up under the Electricity Act to oversee New Zealand's electricity industry and markets.
expected unserved energy	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.
GEIP	**G**ood **E**lectricity **I**ndustry **P**ractice.
GIT	**G**rid **I**nvestment **T**est. A test for reliability investments and economic investments in the grid developed in accordance with rule 6 of section III of Part F, Electricity Governance Rules. 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.
GRS	**G**rid **R**eliability **S**tandards. Standards for reliability of the grid developed in accordance with rule 4 of section III of part F, Electricity Governance Rules. The standards themselves as currently developed are detailed in rule 4 of Schedule F3, section III of Part F.
GUP	**G**rid **U**pgrade **P**lan. A plan for grid expansions, replacements and upgrades, developed in accordance with rule 12 of section III of part F, Electricity Governance Rules.

GUIRP	Grid Upgrade and Investment and Review Policy
reliability investment	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.
Rules	The Electricity Governance Rules 2003. In the context of this document, it generally refers to Part F, Section III of the Electricity Governance Rules 2003 (as updated).
Transpower	Transpower New Zealand Limited, owner and operator of New Zealand's high-voltage electricity network (the national grid).

Appendix B: Bus Configuration with Bus coupler

The figure below shows the network schematic of Maungatapere 110 kV with the bus coupler.

Appendix Figure 1: Bus connection configuration with a bus coupler



Appendix C: Cost of this proposal

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

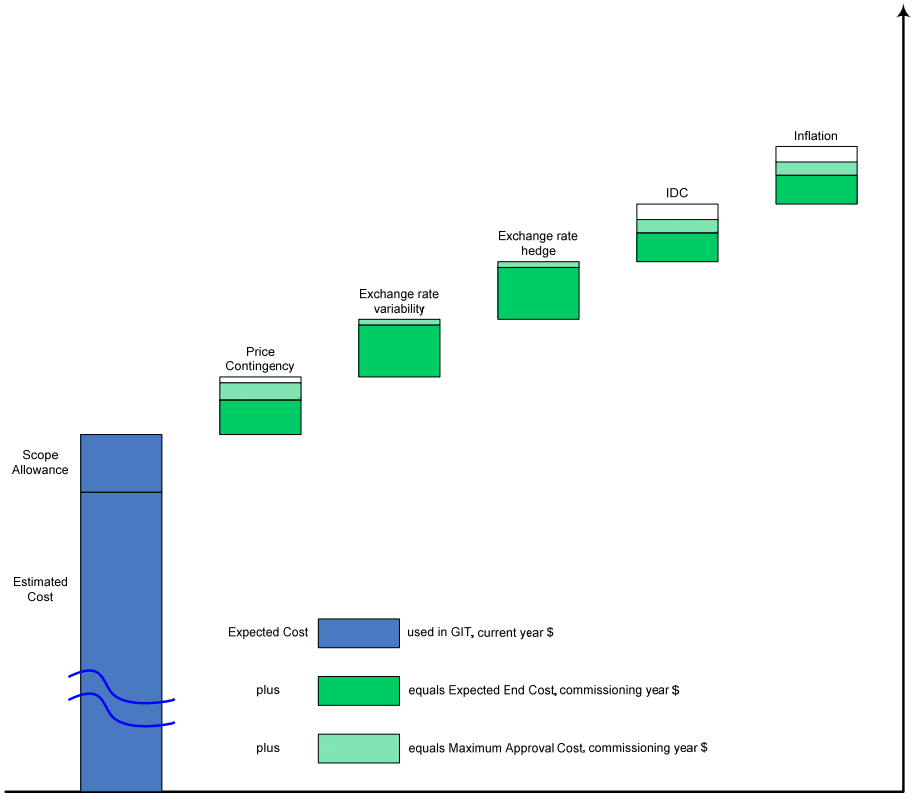
The Expected Cost of the Proposal, as used in the GIT, is estimated to be $3.4 million and the MAC of the Proposal is estimated to be $4.1 million. This section sets out how Transpower has estimated the MAC and describes the difference between the Expected Cost and the MAC.

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, similar to that used for the Wairakei Ring Proposal.

The relationship between the Expected Cost used in the GIT and the MAC is represented in Appendix Figure 2:

Appendix Figure 2: Relationship between Expected Cost and MAC[14]



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

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

- 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 dollars, whereas the approval amount is an estimate of the end cost of the project in nominal 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.

At the approval stage there is still uncertainty as to the details of the final solution to be implemented and the time when costs are approved and when they are finally incurred.

Appendix Figure 1 shows that the Expected Cost used in the GIT is the Estimated Cost plus Scope Allowance. The Expected End Cost takes into account price contingencies and all other expected sources of cost variation between the time when costs are approved and when they are incurred.

The MAC is higher than the Expected End Cost because it includes an upper range allowance for price contingencies and all other expected sources of cost variation[15]. Estimates are used to produce an overall MAC similar in magnitude to the previously calculated P90.

C.1 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 14 November 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 30 June 2010. 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

[15] Note that the upper range estimates are not the maximum for each variable

GIT analyses. The Scope Allowance is treated as a fixed percentage of Estimated Costs and is 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 equipment 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.

  For the purposes of calculating the Expected End Cost, the mid-point of this range is taken, i.e., +5% for the example above.

  For the purposes of calculating the MAC, the 90th percentile of this range is taken, i.e., +17% for the example above.

- **Exchange rate variations**. Transpower's general 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 the average exchange rate 20 business days either side of the Reference Date, 1 September 2008.

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

  For the purposes of calculating the Expected End Cost, the 50th percentile volatility variations are used.

  For the purposes of calculating the MAC, the 90th percentile volatility variations are used.

  Exchange rate hedge. As mentioned above, Transpower's general practice is to enter foreign exchange contracts to hedge foreign exchange movements, once contractual commitments are made. However, for smaller projects Transpower

may elect not to hedge these risks. This is the case for the Proposal. As a result, hedging costs for both the Expected End Cost and MAC are zero.

- **Real interest rates**. Real interest rates are used in the calculation of Interest During Construction costs and are assumed to vary between 4.2% to 6.2%, with a mean of 5.2%. The nominal interest rate is the real interest rate plus the inflation rate, equating to a mean nominal interest rate of 8.2% in this instance. This is approximately Transpower's current cost of debt.

  For the purposes of calculating the Expected End Cost, the mean of 5.2% is used.

  For the purposes of calculating the MAC, a figure of 5.7% is used.

- **Inflation**. Transpower assumes inflation will vary between 2% to 4% per annum, with a mean of 3%.

  For the purposes of calculating the Expected End Cost, the mean of 3% per annum is used.

  For the purposes of calculating the MAC, a figure of 3.5% per annum is used.

C.2 Results of Expected Cost, Expected End Cost and MAC calculations

The Expected Cost of the Proposal, as estimated in 2008, is $3.4 million. This cost includes an average scope allowance of 20%.

Transpower will not start recovering the costs of a stage of this Proposal until it is commissioned, i.e. 2010. The cost Transpower will look to recover at that time is higher, due to financing costs incurred throughout the construction period and inflation. Transpower's Expected End Cost, being the cost it will look to recover from commissioning is $3.9 million. An upper range figure, the MAC, has also been estimated. The MAC for the Proposal is $4.1 million and Transpower is seeking approval to recover the lesser of actual costs or the MAC.

Appendix Table 1: Costs of the Proposal $million

$NZ million	Estimated Cost	Expected Cost	Price contingency	Exchange rate variability	Exchange rate hedge	Inflation	IDC	TOTAL
Expected cost	2.8	3.4						3.4
Expected End cost	2.8	3.4	0.2	0.0	0	0.2	0.2	3.9
Maximum Approved Cost	2.8	3.4	0.3	0.1	0	0.2	0.2	4.1

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.

C.3 Summary of estimated Expected End Cost and Maximum Approval Cost

Transpower estimates the Expected End Cost of the Proposal to be $3.9 million and the Maximum Approval Cost of the Proposal to be $4.1 million.