

Reasons for Decision set out in Notice of Intention to Approve Transpower's Lower South Island Renewables Investment Proposal

Prepared by the Electricity Commission

[26 April 2010]

Executive summary

Proposal

1. On 30 November 2009, Transpower New Zealand Limited (**Transpower**) submitted the Lower South Island Renewables Investment Proposal (**proposal**) as part V of the 2009 grid upgrade plan.
2. The proposal is an “economic investment”, as defined in part A of the Electricity Governance Rules 2003 (**Rules**).¹

Rule requirements

3. The Rules were promulgated under the Electricity Act 1992. Section III of part F of the Rules provides for the review and approval of economic investments by the Commission.
4. In particular, rule 14.4 provides that, subject to rule 15, the Commission may approve an economic investment if the Commission is satisfied that Transpower has:
 - (a) applied the grid investment test (**GIT**) reasonably; and
 - (b) followed any agreed consultation process.
5. Rule 15 requires the Commission to publish notice of its intention to approve some or all of the investment proposals in a GUP. Under rule 15.2 certain parties are able to request a public conference. The purpose of a public conference is to provide a final opportunity for comment.²
6. If a public conference is requested, the Commission must consider whether it wishes to agree to that request. If it does not agree to hold a public conference, the Commission’s decision, as set out in the notice of intention, is final.

Has Transpower applied the GIT reasonably?

7. The Commission is satisfied that Transpower has applied the GIT reasonably.

¹ Unless otherwise stated, all references to rules in this paper are to rules in section III of part F of the Rules, references to schedules are to schedules in section III of part F, and references to clauses are to clauses in schedule F4 (Grid Investment Test).

² Rule 15.3.

Has Transpower followed any agreed consultation process?

8. The Commission is satisfied that Transpower has followed the agreed consultation process.

Intention to approve the proposal

9. The Commission is satisfied that the proposal satisfies the requirements of rule 14.4. On 26 April 2010, the Commission issued a notice of its intention to approve the proposal.
10. The purpose of this document is to:
 - (a) present the Commission's analysis as to whether the proposal meets the requirements of rule 14.4; and
 - (b) explain the reasons supporting the Commission's decision to approve the proposal.

Glossary of abbreviations and terms

2009 GUP	The grid upgrade plan submitted by Transpower on 17 December 2008
2008 SOO	The statement of opportunities published by the Commission in August 2008
AGC	Automatic Generator Control
GEM	Generation Expansion Model
GIT	The Grid Investment Test set out in schedule F4 of the Rules
GPA	Grid Planning Assumptions
GRS	The Grid Reliability Standards set out in schedule F3 of the Rules
GUP	Grid Upgrade Plan
LSI	Lower South Island
MAC	Maximum Approved Cost
MDS	Market Development Scenario
NPV	Net Present Value
NZAS	New Zealand Aluminium Smelters Limited
O&M	Operation and Maintenance
proposal	Transpower's Lower South Island Renewables Investment Proposal, being part V of Transpower's 2009 GUP
Rules	Electricity Governance Rules 2003
SDDP	Stochastic Dual Dynamic Programming
SPS	Special protection scheme
Transpower	Transpower New Zealand Limited

Contents

Executive summary	C
Proposal	C
Rule requirements	C
Has Transpower applied the GIT reasonably?	C
Has Transpower followed any agreed consultation process?	D
Intention to approve the proposal	D
Glossary of abbreviations and terms	E
1. The proposal	1
1.1 Background to the proposal	1
1.2 Purpose of the proposal	1
1.3 Proposal submitted as an economic investment	3
1.4 Overview of estimated costs	4
1.5 Approved amount	5
1.6 Timing of proposal	5
2. Analysis and information assisting Commission deliberations	7
2.1 Information requested and received	7
2.2 Directions under rule 14.3.2	7
3. Rule requirements	9
3.1 The Rules	9
3.2 The GIT	9
3.3 Determining whether Transpower has applied the GIT reasonably	11
3.4 Methodology for applying the GIT	11
Power system analysis	11
4. Analysis parameters	13
4.1 Introduction to GIT analysis parameters	13
4.2 Analysis period (clauses 23 and 27)	13
4.3 Market development scenarios (clauses 5, 6 and 28)	14
Modelling of proposal - generation assumptions	14
Conclusion	17
4.4 Base case (clauses 5, 8 and 20)	18

4.5	Value of unserved energy (clauses 8.3.4 and 8.4.3)	19
4.6	Net present value or real options analysis (clause 13)	19
4.7	Discount rate (clause 14)	19
4.8	Alternative projects	20
	Consideration of alternatives	21
	Exclusion of option 2	23
	Consultation on possible exclusion of option 2	26
	Conclusion on exclusion of option 2	27
	Special protection schemes	27
	Conclusion on alternatives	28
5.	Has Transpower applied the GIT reasonably? (rule 14.4)	31
5.1	Introduction	31
5.2	Costs	31
	Capital costs (clause 23.1) and O&M costs (clause 23.2)	32
	Testing costs (clause 23.3), commissioning costs (clause 23.4) and statutory compliance costs (clause 23.5)	32
5.3	Market benefits	32
	Fuel cost benefits (clause 27.1)	33
	Reliability benefits (clause 27.2)	34
	Demand-side management cost change benefits (clause 27.3)	34
	Deferral benefits (clause 27.4)	34
	Capital cost benefits (clause 27.5)	34
	O&M benefits (clause 27.6)	35
	Ancillary services benefits (clause 27.7)	35
	Loss benefits (clause 27.8)	35
	Statutory compliance benefits (clause 27.9)	35
	Real option benefits (clause 27.10)	35
	Competition benefits (clause 27.11)	35
	Terminal benefits and terminal costs (clauses 23 and 27)	36
	Non-quantifiable material market costs and benefits	36
	Sensitivity analysis	37
5.4	GIT results	38
	NPV analysis	38
5.5	Conclusion on GIT results	40
6.	Did Transpower follow any agreed consultation processes? (rule 14.4)	42
6.1	Compliance with rule processes	42

6.2	Agreed consultation processes	42
6.3	Conclusion on agreed consultation processes	43
7.	Decision	45
7.1	Rule criteria	45
7.2	Decision	45

Tables

Table 1: estimate of project costs - \$million 2015	4
Table 2: Transpower's short listed alternatives	Error! Bookmark not defined.
Table 3: summary of sensitivity analysis	37
Table 4: central GIT result	38
Table 5: sensitivity analysis	40

Figures

Figure 1: current configuration of lines subject to the proposal	2
Figure 2: schematic of proposed programme of works	3

1. The proposal

1.1 Background to the proposal

1.1.1 On 30 November 2009, Transpower New Zealand Limited (**Transpower**) submitted the Lower South Island Renewables Investment Proposal (**proposal**) as part V of the 2009 grid upgrade plan.

1.1.2 The proposal was submitted as an “economic investment”, as defined in part A of the Electricity Governance Rules 2003 (**Rules**).³

1.2 Purpose of the proposal

1.2.1 In simple terms, the purpose of the proposal is to allow increased generation investment in the Lower South Island (**LSI**) region, which is more economic than generation investment elsewhere. Transpower’s application of the GIT assumes that a significant amount of new renewable generation will be constructed in the LSI region whether or not the proposal goes ahead.

1.2.2 Transpower has applied for the Commission’s approval to recover the costs (\$170 million in 2009 dollars, \$197 million in 2015 dollars) associated with the duplexing and thermal upgrading of five line sections north of Roxburgh and south of Twizel.⁴

1.2.3 In particular, the proposal involves:

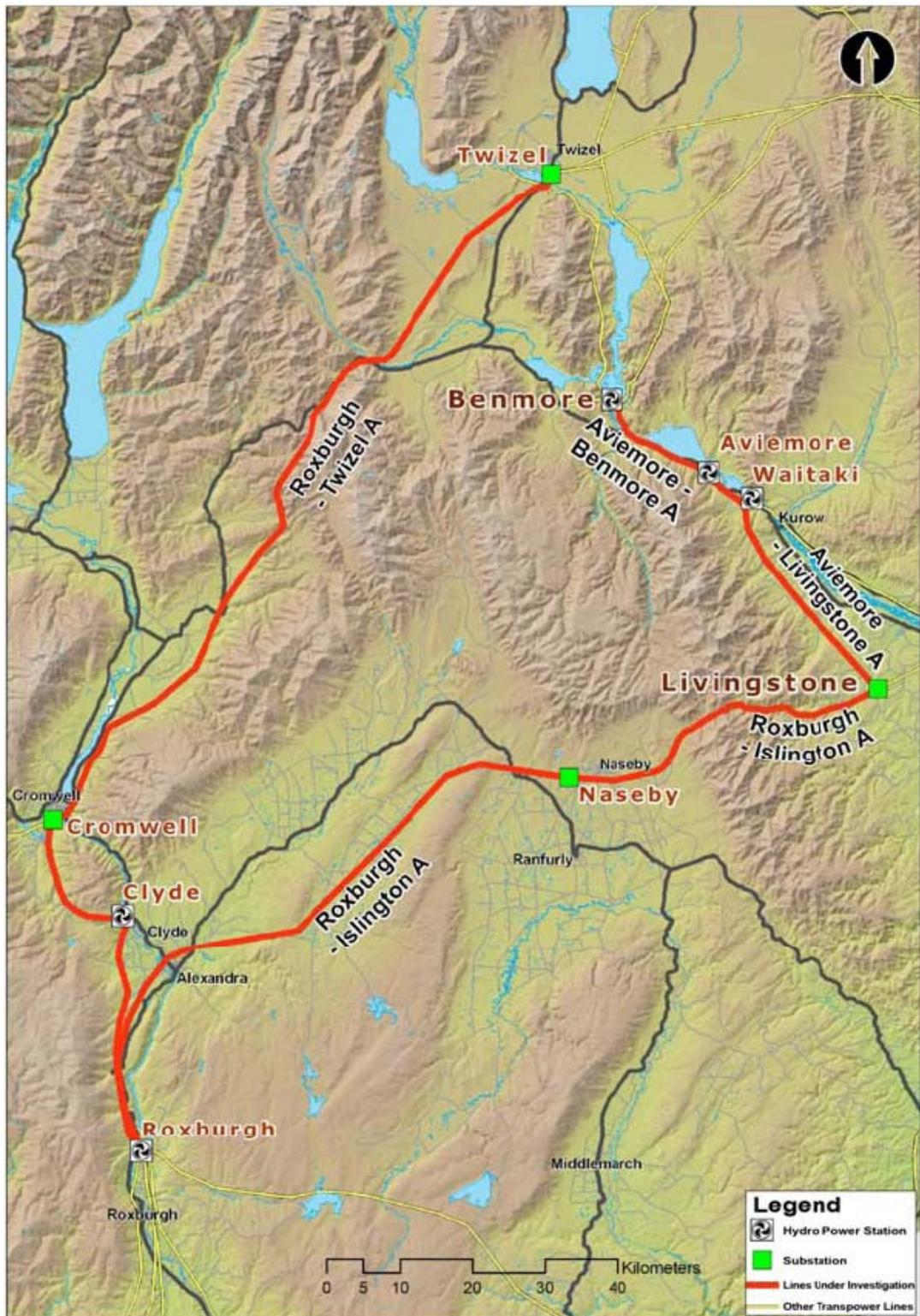
- (a) converting the Roxburgh to Livingstone section of the Roxburgh – Islington 220kV line to a duplex conductor configuration;
- (b) converting the Aviemore – Livingstone 220kV line to a duplex conductor configuration;
- (c) converting the Aviemore – Benmore 220kV line to a duplex conductor configuration;
- (d) converting the Roxburgh to Clyde section of the Roxburgh – Twizel 220kV line to a duplex conductor configuration; and
- (e) thermally upgrading the Cromwell – Twizel section of the Roxburgh–Twizel 220kV line to a 75°C rating.

1.2.4 Figure 1 below shows the current configuration of the lines involved.

³ Unless otherwise stated, all references to rules in this paper are to rules in section III of part F of the Rules, references to schedules are to schedules in section III of part F, and references to clauses are to clauses in schedule F4 (Grid Investment Test).

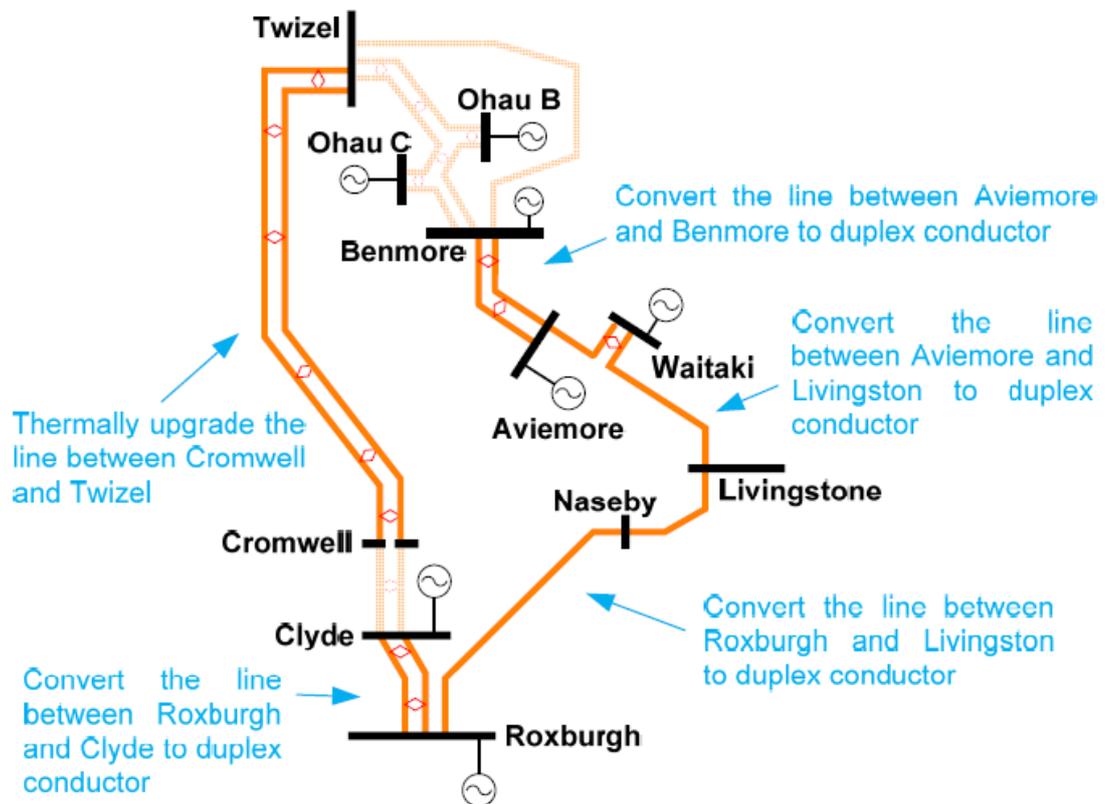
⁴ Application for approval – executive summary.

Figure 1: current configuration of lines subject to the proposal



1.2.5 Figure 2 below shows a schematic of the proposed programme of works.

Figure 2: schematic of proposed programme of works



1.3 Proposal submitted as an economic investment

1.3.1 The proposal was submitted by Transpower as an economic investment. The term “economic investments” is defined in part A of the Rules as follows:

“**economic investments**” means investments in the **grid** that can be justified on the basis of the **grid investment test** under section III of part F and are not **reliability investments**;

1.3.2 Reliability investments are defined in part A of the Rules as follows:

“**reliability investments**” means 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**;

1.3.3 Expected unserved energy is defined in part A of the Rules as follows:

“**expected unserved energy**” means 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**;

1.3.4 As discussed in paragraph 1.2 of this document, the proposal involves duplexing and thermal upgrading of five line sections north of Roxburgh and south of Twizel. While the proposal is an investment in the grid, the primary effect of the proposal is not to reduce expected unserved energy. Accordingly, the Commission agrees that the proposal is appropriately categorised as an economic investment.

1.4 Overview of estimated costs

1.4.1 Transpower is seeking approval from the Commission to recover the lesser of the actual costs or the estimated Maximum Approved Cost (**MAC**) of the proposal. Transpower estimates the expected cost of the proposal to be \$148 million in 2009 dollars and the MAC to be \$197 million in 2015 dollars.

1.4.2 Transpower's method of calculating the MAC is set out in appendix B of part B of the Application for Approval. Table 1 below shows a break down of the MAC.

Table 1: estimate of project costs - \$million 2015

Expected cost	Price contingency	Exchange rate variability	Interest during construction	Inflation	Maximum approval cost
148	14	1	7	27	197

1.4.3 In previous proposals submitted to the Commission, Transpower has sought approval to recover up to a P90 cost. For comparative purposes, Transpower has also calculated a P90 figure using the same approach it has used for previous proposals. The P90 figure calculated by Transpower is \$200 million.

1.4.4 Overall, Transpower's costing approach for the proposal is consistent with the approach it took for the HVDC Grid Upgrade Investment Proposal approved by the Commission on 25 September 2008.⁵

1.4.5 The Commission has considered the assumptions used by Transpower in its costings. The sensitivity analyses carried out by Transpower at the Commission's request indicate that the cost impact of these assumptions is negligible relative to the total size of the project.

⁵ Details are available at: <http://www.electricitycommission.govt.nz/opdev/transmis/hvdc/index.html>

1.5 Approved amount

- 1.5.1 The Commission's approval is intended to define accurately the maximum amount that can be recovered from designated transmission customers.
- 1.5.2 For this reason, the Commission intends to approve the actual costs of the proposal, up to a maximum of \$197 million in 2015 dollars. This effectively establishes the "book value" for the regulatory asset base.
- 1.5.3 Under rule 17.1, Transpower may recover approved costs in accordance with the transmission pricing methodology. The approved costs of a grid investment may not be revoked or amended except with the consent of Transpower (rule 17.2). In practice, the Commission would not expect to receive a request from Transpower to increase the maximum approved amount unless unforeseen circumstances arise or if significant risks arise that are not ordinarily anticipated in implementing a proposal of this size and complexity.
- 1.5.4 However, the Commission notes that Transpower has some room to move within the approved amount. That is because Transpower may recover the actual costs of the proposal up to the MAC, which were calculated taking into account the contingencies in Table 1. Accordingly, the Commission expects that Transpower will be able to manage a number of unforeseen project issues without having to seek an increase in the approved amount.

1.6 Timing of proposal

- 1.6.1 In respect of the timing of the proposal, Transpower states:⁶
- "Based on the benefit assessment, there is a strong case for commissioning between 2012 and 2015. The quantitative economic analysis suggests that the economic timing for commissioning of the project is approximately 2014, based on an average net benefit across the scenarios used."
- 1.6.2 Accordingly, Transpower has identified an electrical need date of 2015. This is largely based on the assumption that substantial amounts of renewable generation could be commissioned in the LSI region before that date.
- 1.6.3 Transpower also identified a number of other factors that it considers have an important impact on the timing of the proposal. These are set out in section 6.3 of part B of Transpower's Application for Approval.
- 1.6.4 In summary, Transpower considers that the detailed design of the proposal and specific discussions with landowners need to be begin almost immediately,

⁶ Application for approval – part B – section 6.3 – page 33.

because there are considerable timing risks in relation to access to property and outage windows.

- 1.6.5 Since there is a high chance that new generation in the LSI region will be intermittent generation, the Commission considers it reasonable to assume that such new generation would not mitigate the difficulty in finding outage windows for the transmission upgrade works to proceed.
- 1.6.6 A key assumption in Transpower's analysis of the proposal is that deferring the proposal would increase the costs of the transmission upgrades included in the proposal. Accordingly, the Commission requested that Transpower calculate the difference in cost between commissioning the proposal between 2012 and 2015, and deferring the proposal until 2020.
- 1.6.7 Transpower advised that, in a worst case scenario, it would have to erect temporary bypass lines to facilitate the upgrades if the outages required could not be secured. This may be the only option available to Transpower if construction is delayed beyond the proposed timeframe.
- 1.6.8 Transpower's high level cost estimates put the cost of erecting temporary bypass lines at around \$77 million, which would increase the total cost of the proposal by approximately 50 percent. Transpower state that this cost could be increased further because of the reduced timeframes in which Transpower can consult with landowners.
- 1.6.9 By way of example, Transpower referred to the costs of the Islington - Livingstone line duplexing work in 2006-2007, which under severe time constraints, increased by 20 percent (\$6 million) due to delays in Transpower's ability to secure access to property.
- 1.6.10 On the above basis, the Commission considers that a target commissioning date of 2015 is reasonable.

2. Analysis and information assisting Commission deliberations

2.1 Information requested and received

2.1.1 After receiving the proposal, the Commission sought further information from Transpower. Transpower provided additional information on the following dates:⁷

- (a) 29 January 2010 – Transpower provided responses on a number of issues regarding the modelling of the proposal;
- (b) 2 February 2010 – further MMA report;
- (c) 11 February 2009 – further sensitivity analysis;
- (d) 26 February 2010 – further evidence regarding relative generation costs and outage windows;
- (e) 18 March 2010 - the MAC cost spreadsheets; and
- (f) 9 April 2010 - revised P90 calculations.

2.2 Directions under rule 14.3.2

2.2.1 Under rule 14.3.2 the Commission may direct Transpower to consider modifying all or part of its application of the GIT, or to investigate and apply the GIT to alternative economic investments. The Commission has not exercised those powers in respect of the proposal.

⁷ This information is available on the Commission's website at:
<http://www.electricitycommission.govt.nz/opdev/transmis/gup/2009GUP/lsl>.

3. Rule requirements

3.1 The Rules

- 3.1.1 The Commission is required to consider and assess the proposal in accordance with the Rules.
- 3.1.2 As discussed in section 1.3 of this document, Transpower submitted the proposal as an economic investment. The Commission agrees that the proposal is an economic investment. Therefore, rule 14 applies to the proposal.
- 3.1.3 Rule 14.4 provides that, subject to rule 15, the Commission may approve an economic investment if the Commission is satisfied that:
- (a) Transpower has applied the GIT reasonably; and
 - (b) Transpower has followed any agreed consultation process.
- 3.1.4 Rule 15 requires the Commission to publish notice of its intention to approve some or all of the investment proposals in a GUP. Rule 15.2 provides that certain parties may request a public conference. The purpose of a public conference is to provide a final opportunity for comment.⁸
- 3.1.5 If the Commission is satisfied that the requirements of rules 14.4 and 15 are met, it may approve the investment proposal. If the Commission approves an investment proposal, Transpower is able to recover the approved costs of that investment from designated transmission customers in accordance with the transmission pricing methodology set out in section IV of part F of the Rules.⁹
- 3.1.6 This section sets out how the Commission has interpreted and applied the criteria for approval.

3.2 The GIT

- 3.2.1 The essence of the GIT is in clause 4, which states:

“4. A **proposed investment** satisfies the **grid investment test** if the **Board** is reasonably satisfied that:

⁸ Rule 15.3.

⁹ Rule 17.1. Under section 57MA of the Commerce Act 1986, the Commerce Commission must “take into account” a decision under the Rules that relates to or affects the quality standards or pricing methodologies applicable to Transpower before exercising any of its powers under Part 4A of the Commerce Act (which relates to the regulation of Transpower’s revenue requirements).

- 4.1. for a **proposed investment** that is necessary to meet the reliability standard set out in clause 4.2 of the **grid reliability standards**:
 - 4.1.1. the **proposed investment** maximises the **expected net market benefit** or minimises the **expected net market cost** compared with a number of **alternative projects**; and
 - 4.1.2. if sensitivity analysis is conducted, a conclusion that a **proposed investment** satisfies clause 4.1.1 is sufficiently robust having regard to the results of that sensitivity analysis; or
- 4.2. for any other **proposed investment**:
 - 4.2.1. the **proposed investment** maximises the **expected net market benefit** compared with a number of **alternative projects**;
 - 4.2.2. the **expected net market benefit** of the **proposed investment** is greater than zero; and
 - 4.2.3. if sensitivity analysis is conducted, a conclusion that a **proposed investment** satisfies clauses 4.2.1 and 4.2.2 is sufficiently robust having regard to the results of that sensitivity analysis.”

- 3.2.2 Clause 4.1 of the GIT applies to a proposed investment necessary to meet the *N-1* safety standard (set out in clause 4.2 of the grid reliability standards (**GRS**)). Clause 4.2 of the GIT applies to proposed investments that are not necessary to meet the *N-1* safety standard.
- 3.2.3 The proposal is not necessary to meet the *N-1* safety standard set out in clause 4.2 of the GRS. That is because the proposal is not necessary to ensure that the power system remains “whole” if a single credible contingency event occurs on the core grid. Therefore, clause 4.2 of the GIT applies.
- 3.2.4 The rigour and comprehensiveness of the analysis undertaken in applying the GIT must be commensurate with the estimated capital expenditure required for the proposed investment.¹⁰
- 3.2.5 In respect of the proposal, Transpower engaged experts, carried out modelling and analysis, and consulted with substantially affected persons. The Commission is satisfied that the level of analysis undertaken by Transpower in applying the GIT is commensurate with the estimated capital expenditure of the proposal.

¹⁰ Clause 12.

- 3.3 Determining whether Transpower has applied the GIT reasonably
- 3.3.1 In order to approve the proposal, the Commission must be satisfied that Transpower has applied the GIT reasonably.
- 3.3.2 In relation to the requirement that Transpower has applied the GIT reasonably, the Courts have considered the meaning of the requirement to act reasonably in a decision-making context.
- 3.3.3 Specifically, in administrative law, a decision-maker must act in a reasonable fashion and the decision must rely on some reasonable basis. To invalidate a decision as unreasonable, the decision must be so perverse, absurd, or outrageous in its defiance of logic that a reasonable decision-maker could not have contemplated such a decision being made.¹¹
- 3.3.4 The Commission's task in assessing the reasonableness of Transpower's application of the GIT is not to substitute its own views for the views of Transpower. However, it is open to the Commission, to use its own modelling and analysis to assess whether Transpower's GIT assessment is reasonable.
- 3.3.5 Therefore, this document explains the Commission's assessment as to whether Transpower has applied the GIT reasonably.

3.4 Methodology for applying the GIT

- 3.4.1 There are two main aspects to the analysis the Commission has used to determine whether Transpower has applied the GIT reasonably:
- (a) a power system analysis; and
 - (b) an economic analysis that involves quantifying various market costs and benefits of the proposal and the alternatives.
- 3.4.2 An explanation of the Commission's power system analysis is set out below. The Commission's comments on the quantification of costs and benefits are set out in section 4 of this document.

Power system analysis

- 3.4.3 A power system analysis assesses the physical effect on the electricity system of the proposal and the alternatives. Specifically, in relation to economic

¹¹ This principle is often referred to as "Wednesbury unreasonableness", after the leading case *Associated Provincial Picture Houses Limited v Wednesbury Corporation* [1948] 1 KB 223.

investments such as the proposal, a power system analysis must identify potential transmission network power flow constraints.

- 3.4.4 The Commission has reviewed Transpower's power system analysis in respect of the proposal.
- 3.4.5 As set out in section 1.3 of this document, there are two separate issues that drive the need for upgrading the transmission grid between Roxburgh and the Waitaki Valley:
 - (a) north power transfer constraints; and
 - (b) south power transfer constraints.
- 3.4.6 Transpower analysed a number of alternatives to the proposal that would relieve the north and south power transfer constraints on the transmission grid between Roxburgh and the Waitaki Valley. Those alternatives included building new circuits, series compensation, re-conductoring and/or thermal upgrades.
- 3.4.7 Transpower's analysis reduced the list of alternatives to two – options 2 and 8. Those alternatives are described further in section 4.8 of this document. Transpower then conducted further analysis of those two alternatives. This approach is consistent with that adopted for previous proposals, and the Commission considers that it is reasonable.

4. Analysis parameters

4.1 Introduction to GIT analysis parameters

4.1.1 The Commission has the discretion to determine a number of the analysis parameters for the purpose of applying the GIT. This section sets out the analysis parameters for the GIT adopted by Transpower, and provides the Commission's views on whether those parameters are reasonable.

4.1.2 The Commission reviewed the analysis parameters for the GIT adopted by Transpower in two ways.

4.1.3 First, the Commission verified the analysis undertaken by Transpower, by replicating some "threads" of the Generation Expansion Model (**GEM**) and Stochastic Dual Dynamic Programming (**SDDP**) modelling, and checking that the input data was consistent, both internally and with the stated modelling assumptions.

4.1.4 Second, the Commission sought to understand the "business case" of the proposal in simple terms, rather than by complex modelling. This allowed the Commission to determine whether the assumptions adopted by Transpower for its GIT analysis of the proposal, and Transpower's conclusion that the expected net market benefits of the proposal are maximised compared to the alternatives, were reasonable.

4.2 Analysis period (clauses 23 and 27)

4.2.1 Clause 23 (definition of "cost") and clause 27 (definition of "market benefit") require that the Commission calculate the present value of costs and benefits of a proposed investment or alternative project:

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

4.2.2 Clauses 23 and 27 mean that the Commission:

- (a) must take into account the present value of costs and benefits of the proposal and each alternative project that arise over the period of 20 years that commences with the commissioning of the proposal or alternative project; and

- (b) may, if significant market benefits or costs are expected to arise after that time, include those market benefits or costs in the NPV analysis by calculating the “then present value” of those future costs and benefits. The Commission has termed such costs and benefits “terminal benefits” and “terminal costs” respectively, and calculates them using a “terminal benefit calculation”.
- 4.2.3 Transpower states that transmission lines have an expected life of 30 or more years, and it is expected that there will be significant benefits arising from any upgraded transmission circuits during the period between 20 years and the end of their expected life. In order to assess these additional benefits, Transpower ran its SDDP modelling to 2042.¹²
- 4.2.4 The Commission considers that Transpower’s approach to the analysis period of the proposal is reasonable.
- 4.3 Market development scenarios (clauses 5, 6 and 28)
- 4.3.1 As the manner in which new generation will enter the New Zealand electricity market is uncertain, the GIT requires the costs of a proposed investment and its alternative projects to be estimated for a number of market development scenarios (**MDSs**) (i.e. reasonable future states of the electricity industry).
- 4.3.2 The MDSs include estimated future demand growth, generation investments and transmission investments.
- 4.3.3 The MDSs used in applying the GIT must be those scenarios the Commission outlined in the current statement of opportunities (**SOO**) unless the Commission has determined that others are more appropriate.¹³
- 4.3.4 The current SOO is the 2008 SOO (**2008 SOO**) published on 29 August 2008.
- 4.3.5 In preparing the proposal, Transpower reviewed and updated the generation scenarios in the 2008 SOO and sought feedback from stakeholders. Transpower also discussed the MDSs, and the weightings to be used in applying the GIT to the proposal, with the Commission.

Modelling of proposal - generation assumptions

- 4.3.6 As discussed in section 1.2.1 of this document, Transpower’s application of the GIT assumes that a significant amount of new renewable generation will be

¹² Application for approval - attachment B – section 2.8 - page 16.

¹³ Clause 6.1.

constructed in the LSI region whether or not the proposal goes ahead. This may be referred to as the proposal's "business case".

- 4.3.7 Accordingly, in Transpower's modelling of the proposal's base case (and the base case of some alternatives), the LSI region has insufficient transmission capacity to export the output of this new generation. This results in substantial amounts of spill, which in turn leads to high thermal fuel burn and unserved energy. As a result, in Transpower's application of the GIT, the alternatives with high LSI export capacity (including the proposal) have less spill and are more economic than the alternatives without high LSI export capacity.
- 4.3.8 That analysis is supported by Transpower's SDDP analysis. The SDDP outputs include hydro spill, and can also be used to infer wind spill (i.e. when wind farms in the LSI region fall below their normal output as a result of limited export capacity). In some of Transpower's SDDP study cases, there is a considerable amount of LSI spill – an average of over 1,500 GWh per annum after 2020. In the SDDP study cases where transmission augmentations significantly improve export capacity, spill can be seen to be reduced.
- 4.3.9 The substantial amount of spill identified by Transpower is the result of two assumptions made by Transpower:
- (a) in the modelling of the proposal and the alternatives (but not the base case), generation build schedules are optimised (using the GEM) based on an unconstrained grid. However, the calculation of benefits (using the SDDP model) considers transmission constraints that limit export from the LSI region. This mismatch leads to 'programmed spill'; and
 - (b) in the modelling of the base case, peak security constraints are applied in the GEM without consideration of intra-island transmission constraints. Essentially, the GEM model 'sees' a need for firm MW to meet national peak demand, and 'chooses' to build additional LSI hydro generation to provide this. In reality, if no transmission upgrades are built, there will come a point where additional LSI generation is unable to contribute to national peak demand. If this had been taken into account, the base case would have included less generation in the LSI region.
- 4.3.10 However, it is unlikely that developers would continue to install new generation in the LSI region if existing generation was frequently spilling due to transmission constraints. It is more likely that:
- (a) generators would site their plant elsewhere; or
 - (b) action would be taken to relieve the transmission constraints.
- 4.3.11 Either of the above options would come at a cost. In the first option, developers would choose generation options located elsewhere – which might be less

economic. In the second option, there would be a need for a deferred – but expensive – transmission upgrade.

- 4.3.12 In reviewing Transpower’s generation assumptions, the Commission identified three possible future states of generation investment in the LSI region. Those three states are:
- (a) little or no new generation investment will occur in the LSI region, whether or not the proposal goes ahead (“state one”);
 - (b) substantial new generation investment will soon occur in the LSI region, whether or not the proposal goes ahead (“state two”); and
 - (c) if the proposal is approved then some new generation investment will soon occur in the LSI region, but if the proposal does not go ahead, little or no new generation investment will occur (“state three”).
- 4.3.13 The Commission considers state one to be improbable. State one is not consistent with the grid planning assumptions (**GPAs**),¹⁴ which collectively indicate that some generation investment in the LSI region is likely to occur in the next few years if transmission capacity permits.
- 4.3.14 Transpower’s assumptions are similar to state two. However, the Commission considers that state two is also improbable. State two is not consistent with observed generator behaviour. Developers are understandably reluctant to construct new generation behind an export constraint.
- 4.3.15 The Commission considers that state three is the most likely future state of generation investment in the LSI region – i.e. if the proposal goes ahead, some new generation investment will soon occur in the LSI region, but little or no new generation investment will occur if the proposal is not approved.
- 4.3.16 However, the Commission’s analysis also shows that:
- (a) increasing transmission capacity between Roxburgh and Twizel (which is provided for in the proposal and state two) will enable more generation investment generation in the LSI region than would otherwise occur; and
 - (b) generation can be constructed in the LSI region at a lower total cost than generation constructed elsewhere in New Zealand.
- 4.3.17 As Transpower discusses in its application of the GIT, the key potential generation resources in the LSI region that could be accessed in the next few years are:
- (a) wind farms; and
 - (b) new hydro schemes on the Clutha and Waitaki rivers.

¹⁴ See section 4.3 of this document.

- 4.3.18 Transpower did not provide any substantial new information about the economics of these generation options, relative to other options elsewhere in New Zealand. However, the Commission is aware that:
- (a) there is the potential for very large wind farms to be constructed in the LSI region, which may be more economic than constructing generation elsewhere in New Zealand due to economies of scale; and
 - (b) the Clutha hydro schemes proposed by Contact Energy Limited, and North Bank Tunnel hydro scheme proposed by Meridian Energy Limited, may be the most cost-effective generation options available for large hydro projects.
- 4.3.19 In addition, the Commission carried out some further analysis using the GEM model, comparing several scenarios in which no new LSI generation was available, with matching scenarios in which LSI wind and hydro schemes were available. The capital costs of the LSI renewable generation options varied up and down, to reflect uncertainty.
- 4.3.20 That analysis showed that enabling the LSI renewable options provided substantial benefit. Even in scenarios in which those options were assumed to be 10% more expensive than the baseline assumption in the GEM, they yielded a net benefit that was significantly greater than the cost of the proposal.
- 4.3.21 A key reason for the benefit was that new LSI hydro, backed by storage, would provide firm capacity which would contribute to meeting peak demand. Both hydro and wind can also provide bulk low-cost energy.
- 4.3.22 On this basis, the Commission considers that Transpower's assumption that a significant amount of new generation will be constructed in the LSI region, regardless of whether the proposal proceeds, is immaterial to the result of the GIT analysis of the proposal.

Conclusion

- 4.3.23 In summary, the main changes made to the 2008 SOO scenarios, and the Transpower's reasons for the changes, are:¹⁵

“the timing of a collection of generation builds has been fixed up front. These are the same as those used for the Wairakei Ring analysis. Fixing a selection of generation up front reflects that some generation sites are already consented and developers are progressing toward construction, independent of what the theoretical costs of each generation site. The approach provides a methodology for linking actual generation

¹⁵ Application for approval – part B – section 5.2 – page 22.

developments with the economic cost drivers used to develop the longer term scenarios. In this case, it also provides a robust method for considering specific uncertainties that exist in regard to generation development and demand step changes within the region.

some information, primarily generation unit sizes, has been updated to reflect public announcements made by generation developers.

a change to the cost of the generic wind plants. The costs in the original SoO lead to the generic wind plants being constructed prior to known actual generation projects. Hence it was considered more appropriate to place a higher cost on these.”

- 4.3.24 While the Commission considers that the changes Transpower made to the 2008 SOO scenarios are immaterial to the result of the GIT analysis of the proposal, the Commission considers that the MDSs used by Transpower in applying the GIT are more appropriate than the MDSs in the 2008 SOO.

4.4 Base case (clauses 5, 8 and 20)

- 4.4.1 The GIT requires the market benefits and costs of a proposed investment or alternative project to be determined for each MDS for the future with that proposed investment or alternative project, by comparing that MDS with the corresponding MDS developed for the base case.¹⁶

- 4.4.2 Clause 20 of the GIT defines the base case 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**.

- 4.4.3 As a base case, Transpower has adopted a “do nothing” option, whereby the existing transmission assets are maintained but no new investment in transmission assets occurs as electricity demand and generation grows.¹⁷

- 4.4.4 The Commission notes that Transpower’s base case includes a substantial amount of new generation in the LSI region.¹⁸ However, as set out in section 4.3 of this document, Transpower’s assumption regarding new generation in the base case is immaterial to the result of the GIT analysis of the proposal. The Commission therefore agrees that a “do nothing” option is a reasonable base case.

¹⁶ Clause 5.

¹⁷ Application for approval – part B – section 3.2.3 – page 17.

¹⁸ See section 4.1 of this document.

- 4.5 Value of unserved energy (clauses 8.3.4 and 8.4.3)
- 4.5.1 Clauses 8.3.4 and 8.4.3 of the GIT require the value of unserved energy used in the GIT to be:
- (a) the value or values published by the Commission for this purpose from time to time; or
 - (b) if no such value or values is published by the Commission, \$20,000/MWh.
- 4.5.2 The Commission has not published a specific value of unserved energy and therefore the default value (of \$20,000/MWh) applies.
- 4.5.3 The value of unserved energy is critical when evaluating a reliability investment as approval of such an investment typically hinges on the avoidance of unserved energy costs (i.e. the existence of reliability benefits).
- 4.5.4 However, because the proposal is an economic investment, the reliability benefits of the proposal are immaterial.
- 4.6 Net present value or real options analysis (clause 13)
- 4.6.1 Clause 13 of the GIT requires that either standard net present value (**NPV**) analysis or real options analysis be applied in assessing the expected net market benefit of a proposed investment or alternative projects.
- 4.6.2 Traditional NPV analysis calculates the NPV of a proposed investment based on the benefits less the costs. Real options analysis attempts to value the flexibility that is inherent in many investment projects, which allows investment plans to be changed or abandoned as new information arrives. By responding appropriately to such new information, decision-makers are able to take advantage of new opportunities.
- 4.6.3 Transpower has used standard NPV analysis to assess the expected net market benefit of the proposal and alternative projects.¹⁹
- 4.6.4 The Commission agrees that a real options analysis is not practicable for analysing the proposal, and that Transpower's approach (using a standard NPV analysis) is reasonable.
- 4.7 Discount rate (clause 14)
- 4.7.1 The GIT requires the discount rate to be used in all NPV calculations to be:

¹⁹ Application for approval – attachment B – section 2.4 - page 14.

- (a) a discount rate determined by the Commission; or
- (b) if the Commission has not determined a rate, equivalent to a pre-tax real rate of 7%.

4.7.2 The Commission has not determined a discount rate. Accordingly, Transpower has applied a pre-tax real rate of 7% in evaluating the proposal.²⁰

4.7.3 Transpower has adopted as sensitivities discount rates of 4% and 10%.²¹ This is consistent with previous investment proposals.

4.7.4 The Commission agrees that the discount rates used by Transpower are reasonable.

4.8 Alternative projects

4.8.1 In order to assess whether the proposal satisfies the GIT, the proposal must be compared with a number of alternative projects.²²

4.8.2 Clause 19 specifies the criteria for the selection of alternative projects as follows:

“19. “**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;

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.”

²⁰ Application for approval – attachment B – section 2.4 - page 15.

²¹ Ibid.

²² Clause 4.2.1.

4.8.3 Clause 11 requires that the alternative projects used in applying the GIT are 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.

Consideration of alternatives

4.8.4 From a long list of options (which included transmission and non-transmission options), Transpower short listed eight transmission options.

4.8.5 Transpower states that new line options were not short listed due to their high cost, relative to the capacity required. The new line options also required upgrades of the existing lines to enable full use of the new line capacity, thereby further increasing the costs.²³

4.8.6 Table 2 below lists Transpower's eight short listed alternatives.

Table 2: Transpower's short listed alternatives

Short listed alternatives	Description of upgrade works	Expected cost	Expected net market benefit (\$m)
Base case	Do nothing	\$0m	0
Option 1	Thermal upgrades of Livingstone–Roxburgh and Aviemore–Benmore followed by duplexing and series capacitors	\$163m	304
Option 2	Duplexing of Roxburgh–Naseby–Livingstone–Aviemore–Benmore combined with the thermal upgrade of Roxburgh–Clyde–Twizel	Stages 1-3 - \$116m	-
Option 3	Duplexing of Livingstone-Roxburgh followed by thermal upgrade of Aviemore-Benmore and Clyde-Roxburgh	\$64m	241

²³ Application for approval – executive summary.

Short listed alternatives	Description of upgrade works	Expected cost	Expected net market benefit (\$m)
Base case	Do nothing	\$0m	0
Option 4	Installation of series capacitors at Cromwell. Thermal upgrading of Clyde–Roxburgh, Livingstone–Roxburgh, Cromwell–Twizel and Aviemore–Benmore. Duplexing of Clyde–Roxburgh and Livingstone–Roxburgh	Stages 1-3 - \$71m Stages 1-5 - \$163m	310
Option 5	Thermal upgrades of Livingstone–Roxburgh, Aviemore–Benmore and Clyde–Roxburgh followed by a new Roxburgh–Twizel single-circuit line	\$200m	259
Option 6	Thermal upgrades of Livingstone–Roxburgh, Aviemore–Benmore and progressive duplexing of Aviemore–Livingstone, and Livingstone–Roxburgh. Clyde–Roxburgh is thermally upgraded	Stages 1-2 - \$42m Stages 1-3 - \$101m	290
Option 7	Thermal upgrades of Livingstone–Roxburgh, Aviemore–Benmore and progressive duplexing of Aviemore–Livingstone, Livingstone–Roxburgh and Clyde–Roxburgh	Stages 1-2 - \$75m Stages 1-3 - \$132m	285
Option 8	Progressive duplexing of Aviemore–Livingstone, Clyde–Roxburgh, Aviemore–Benmore and Livingstone–Roxburgh. Thermal upgrading of Cromwell–Twizel	\$147m	335

Note: option 8 is the proposal

- 4.8.7 Option 2 (duplexing of Roxburgh–Naseby–Livingstone–Aviemore–Benmore combined with the thermal upgrade of Roxburgh–Clyde–Twizel) was Transpower’s preferred option when Transpower consulted on whether it has applied the GIT reasonably in July and August 2009.²⁴
- 4.8.8 However, Transpower subsequently excluded option 2 as an alternative project because:²⁵
- “... further analysis has determined that Option 2 will result in a failure to meet the Grid Reliability Standard for southward flow during a dry year, and therefore is not reasonably likely to proceed if neither the Proposal nor any other alternative project proceeds. The possibility of Option 8 replacing Option 2 as the preferred option was raised in the GIT consultation document.”
- 4.8.9 By excluding option 2 from the short listed alternatives, option 8 became Transpower’s preferred option and, therefore, the proposal. Accordingly, Transpower considered six alternatives (options 1, 3, 4, 5, 6 and 7) to the proposal in the Application for Approval.

Exclusion of option 2

- 4.8.10 As the estimated cost of option 2 is \$31 million less than option 8, and the expected net market benefit of option 2 is \$26 million more than option 8, the Commission carefully reviewed Transpower’s exclusion of option 2 as an alternative project.
- 4.8.11 Transpower’s analysis that “disqualifies Option 2 in favour of Option 8”²⁶ is set out in Attachment I of the Application for Approval. In summary, Transpower excluded option 2 from the short listed options because it concluded that a thermal upgrade of the Clyde – Roxburgh line would fail to meet the GRS in the case of southward flow in a dry year.
- 4.8.12 Whether a thermal upgrade of the Clyde – Roxburgh line would fail to meet the GRS hinges on the interpretation of clause 4.2 of the GRS and the definition of a “single credible contingency event”. Clause 4.2 of the GRS provides:

“4. For the purpose of clause 3, the grid satisfies the grid reliability standards if:

...

²⁴ Under rule 14.2.4.

²⁵ Application for approval – part B – section 3.2.2 – page 16.

²⁶ Application for approval – attachment I – section 1 – page 3.

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.”

4.8.13 A single credible contingency event is defined in part A of the Rules as:

“single credible contingency event” means an individual credible contingency event comprising any one of the following:

- (a) a single transmission circuit interruption;
- (b) the failure or removal from operational service of a single generating unit;
- (c) an HVDC link single pole interruption;
- (d) the failure or removal from service of a single bus section;
- (e) a single inter-connecting transformer interruption;
- (f) the failure or removal from service of a single shunt connected reactive component;”

4.8.14 In its analysis of option 2, Transpower considered that a single credible contingent event could result in an outage lasting up to five days. That is because, in Transpower’s view, five days is the maximum reasonable time for recovery from a single credible contingency event. The worst contingency for the overloading of each circuit is shown in Table 3.1 of Attachment I of Transpower’s Application for Approval.

4.8.15 Transpower listed the following events from its historical records as possible single credible contingency events that the LSI region could be exposed to:²⁷

“Conductor breakage or insulator damage (phase to ground fault) during a snowstorm. Transmission lines in the region traverse mountainous country, with much of both the Roxburgh-Naseby-Livingstone and the Roxburgh - Twizel lines at over 500m in elevation. The Roxburgh-Naseby-Livingstone reaches 935m over Danseys Pass, and the Cromwell- Twizel line reaches 1100m above Lindis Pass. In 2005 a broken insulator, probably from conductor bounce following snow unloading, took 14 hours to locate and repair on the Islington to Kikiwa 3 line. Line inspection by helicopter (to locate the fault) was not possible in whiteout conditions. While the Islington-Kikiwa line is higher, reaching 1800m, it is some hundreds of kilometres north of Lindis and Danseys Passes. In general, any failure that necessitates a visual inspection of a line under adverse weather conditions is likely to take 8 hours or more to locate and repair. An outage lasting 24

²⁷ <http://www.electricitycommission.govt.nz/opdev/transmis/gup/2009GUP/lsi-analysis>

hours or more is definitely possible if the asset has to be repaired in some combination of sub-zero temperatures, deep snow and high winds.

Circuit breaker explosion. Circuit breakers can explode, particularly on closing and are covered under the GRS if an associated bus section, circuit, transformer or shunt reactive component is also tripped. In December 2006 a circuit breaker exploded at Whakamaru and effectively created a phase to earth fault on the Whakamaru 220 kV bus. The Otahuhu-Whakamaru 1 circuit was out of service for 8 days.

Disconnecter Failure. Disconnecter contacts can fail to close, requiring the removal from service of the associated asset, which could be a transmission circuit, as well as a bus section during the repair. In 2007 a Otahuhu transformer T4 was out of service for 2 days following a disconnecter failure to close. The repair required an 8 hour outage of the 220 kV bus section C.

Protection Faults. Prolonged outages due to protection relay faults do occur. If the relay is associated with a circuit then the circuit has to remain out of service until the relay is replaced or repaired. This type of event occurred on the Berwick-Stratford 3 line in 1995, with the line out for 5 days 10 hours. Another on the Arapuni-Kinleith 2 line in 2002 lasted 5 days 1 hour.”

- 4.8.16 Transpower also noted that the System Operator considers the simultaneous loss of both circuits on a double circuit line to be a contingent event under certain bad weather conditions. This may occur on lines that have a history of simultaneous losses of both circuits. While not a GRS requirement, Transpower argued that this operational standard reflects the vulnerability of the lines in the LSI region to bad weather.²⁸
- 4.8.17 In summary, Transpower’s view is that if an event has happened somewhere on the grid in the past, and could occur on one of the circuits in the LSI region, it should be considered a “single credible contingency event”, as defined in the Rules.
- 4.8.18 Under Transpower’s approach, a prolonged outage on the Clyde – Roxburgh line is a “single credible contingency event”. Transpower considers that Manapouri may not be able to support the LSI region if such an event occurs in a dry year, That means that the power system would not remain in a satisfactory state as required by clause 4.2 of the GRS should option 2 proceed.
- 4.8.19 On that basis, Transpower concluded that option 2 does not meet the GRS, and is therefore not reasonably likely to proceed if neither the proposal nor any other alternative proceeds. Option 2 was therefore excluded as an alternative by Transpower.

²⁸ Ibid.

- 4.8.20 In comparison, Transpower does not consider that the failure of both circuits on the Clyde – Roxburgh line, which is provided for in option 8, to be a single credible contingent event. That is because the Clyde – Roxburgh line will be duplexed under option 8, and Transpower’s does not consider that the failure of both circuits on a duplexed line to be a credible event.
- 4.8.21 Accordingly, Transpower determined that option 8 meets the GRS, and becomes the proposal.

Consultation on possible exclusion of option 2

- 4.8.22 When Transpower consulted on its application of the GIT, Transpower noted that option 2 may be excluded from its short listed options. Transpower also asked interested parties to consider whether its proposed treatment of the Clyde - Roxburgh line (which is central to the exclusion of option 2) was reasonable.²⁹
- 4.8.23 None of the interested parties who made submissions on Transpower’s application of the GIT commented unfavourably on the exclusion of option 2 from Transpower’s short listed options or Transpower’s proposed treatment of the Clyde - Roxburgh line.
- 4.8.24 However, the Commission was interested in the possibility of local demand side response alternatives that could be added to option 2 as modelled projects to enable it to meet the GRS. In particular, the Commission wished to know whether there was a possibility of an agreement with New Zealand Aluminium Smelters Limited (**NZAS**), whereby NZAS would reduce demand in the event of a prolonged outage on the Clyde - Roxburgh line during a dry year. This would enable Manapouri to support the LSI region, and would mean that the GRS would be met if option 2 proceeded.
- 4.8.25 In this context, the Commission noted that NZAS may prefer option 2 over option 8, because the cost to NZAS of loss of supply under option 2 is likely to be less than the additional interconnection charges that would be passed through to NZAS under option 8.³⁰ Accordingly, NZAS would be incentivised to consider entering into a demand reduction agreement with the System Operator.
- 4.8.26 Accordingly, the Commission requested Transpower contact NZAS to further clarify its position regarding the exclusion of option 2 and a demand reduction agreement. However, in response, Transpower advised the Commission that NZAS would not consider a demand reduction agreement.

²⁹ Transpower’s GIT consultation documentation is available at: <http://www.gridnewzealand.co.nz/lwsi-renewables-publications>.

³⁰ Estimated to be approximately \$300k per annum.

Conclusion on exclusion of option 2

- 4.8.27 The Commission notes that:
- (a) no submitter on Transpower's application of the GIT commented on the exclusion of option 2 as an alternative or Transpower's proposed treatment of the Clyde - Roxburgh line; and
 - (b) a demand side response to enable option 2 to meet the GRS may not be available.
- 4.8.28 The Commission considers that the fact that an event has occurred in the past, does not mean that the event is a "credible" event. There must be a reasonable possibility of an event happening for the event to be credible.
- 4.8.29 The Commission considers that an event that causes a prolonged outage on the Clyde – Roxburgh line in a dry year with Manapouri unable to support the LSI region is unlikely. However, as detailed in section 4.8.15 of this paper, prolonged outages have occurred on lines similar to the Clyde – Roxburgh line, and it is a reasonable possibility that such an outage could occur in a dry year without Manapouri being able to generate.
- 4.8.30 Accordingly, the Commission considers that Transpower's view that option 2 should be excluded as an alternative because it is not reasonably likely to proceed if neither the proposal nor any other alternative proceeds is reasonable.

Special protection schemes

- 4.8.31 Transpower did not consider a special protection scheme (**SPS**) to be an alternative to the proposal.³¹
- 4.8.32 Transpower states that a SPS has been considered as part of a separate trial. A SPS (generation runback scheme) has been installed, but not yet commissioned, at Roxburgh to allow greater export out of the Lower South Island region as an interim measure until a grid upgrade can be implemented.
- 4.8.33 Transpower states that its analysis, prior to the commissioning of the SPS, identified that the benefits of the SPS were significantly reduced by inertial response and governor action of the generating units within the Lower South Island region. The reduction in line loading with run back generation at Roxburgh (or Clyde) following the loss of a circuit would be offset by other generation in the region increasing output in response to the drop in frequency following the run-back of Roxburgh or Clyde generation.

³¹ Application for approval – executive summary.

- 4.8.34 Transpower states that, to function effectively, a far more complex SPS that coordinates the response of all major South Island generation would be required. Consequently, Transpower did not consider an SPS to be an alternative to the proposal.
- 4.8.35 Transpower's main reason for not including an SPS in the short listed options is, in summary, that the technology is not mature enough. However, the Commission is aware that a similar SPS currently operates in Tasmania³² and the HVDC has had an operational SPS at Haywards since 1992.
- 4.8.36 Recently, Meridian and Contact also co-operated with Transpower regarding generator governor changes to increase South Island reserves during HVDC south transfer.
- 4.8.37 Even if a SPS is not an alternative to the proposal, the Commission was interested in Transpower including a SPS as a modelled project in the proposal's base case. That is because there is a high probability that a base case that includes a SPS as a modelled project would have a higher expected net market benefit than the proposal that does not include a SPS as a modelled base case, due to the significantly lower capital costs involved in implementing a SPS.
- 4.8.38 However, Transpower considers that a SPS needs to have an enhanced Automatic Generator Control (**AGC**) system that automatically re-dispatched all South Island generation after a line fault.
- 4.8.39 In summary, Transpower continues to consider that an SPS is not an alternative because it is not reasonably likely to proceed if neither the proposal nor any other alternative proceeds, because:
- (a) the technology required is unclear;
 - (b) the exact benefits are unknown;
 - (c) a SPS may not be in service in the required timeframe; and
 - (d) even if workable, a SPS would only defer further transmission investment.
- 4.8.40 The Commission agrees that Transpower's approach in not adopting a SPS as an alternative project is reasonable.

Conclusion on alternatives

- 4.8.41 Clause 11 of the GIT provides that the alternative projects used in applying the GIT must be limited to those appropriate in number and technology given the cost and magnitude of the proposed investment, the complexity of the required

³² Report by David Strong & Associates -

<http://www.electricitycommission.govt.nz/pdfs/opdev/transmis/renewables/phase2/SystemProtectionSchemes.pdf>

modelling, and the urgency of the proposed investment. Clause 12 of the GIT provides that the rigour and comprehensiveness of the analysis undertaken must be commensurate with the estimated capital expenditure required for the proposed investment.

- 4.8.42 Having regard to the estimated capital expenditure required for the proposed investment, and the observations of the Court of Appeal in *Major Electricity User's Group v Electricity Commission and Transpower New Zealand Limited*³³ (the Court noted that it cannot sensibly be suggested that all possible alternatives should be considered), the Commission considers that, while a broader range of alternatives could possibly have been analysed, the alternatives actually analysed by Transpower are reasonable.
- 4.8.43 The Commission continues³⁴ to encourage Transpower to explore generation dispatch analysis and a broad range of alternatives in respect of any future economic investment proposals to enable renewable generation.

³³ CA 205/2008, Grazebrook, Chambers, and Bargwanath JJ, 5 December 2008.

³⁴ The Commission having made similar comments in the context of the Wairakei Ring Investment Proposal: <http://www.electricitycommission.govt.nz/pdfs/opdev/transmis/gup/2008/wairakei-ring/reasons-for-decision.pdf>.

5. Has Transpower applied the GIT reasonably? (rule 14.4)

5.1 Introduction

5.1.1 This section summarises the key aspects of Transpower’s application of the GIT to the proposal and the alternatives.

5.1.2 Applying the GIT involves quantifying, to the extent practicable, the costs and benefits associated with the proposal and the alternatives considered. The following sets out Transpower’s conclusions in respect of these costs and benefits and the Commission’s comments (as applicable) on whether Transpower’s conclusions on the costs and benefits are reasonable.

5.2 Costs

5.2.1 Clause 23 defines “costs” as “the present value of the costs of a **proposed investment** or **alternative project** to those persons who produce, distribute, retail and consume electricity in New Zealand over a period of 20 years from the commissioning date...” including:

- “(a) capital costs incurred prior to the commissioning of the **proposed investment** or **alternative project** (as the case may be), including interest during construction” (clause 23.1 – **capital costs**);
- “(b) operating, maintenance and dismantling costs over the operating life of the **proposed investment** or **alternative project** (as the case may be)” (clause 23.2 – **O&M costs**);
- “(c) costs to **participants** associated with testing of the **proposed investment** or **alternative project** (as the case may be)” (clause 23.3 – **testing costs**);
- “(d) any additional amount, approved by the **Board**, that could reasonably be considered to be a cost related to the commissioning of a **proposed investment** or **alternative project** (as the case may be)” (clause 23.4 – **commissioning costs**); and
- “(e) costs of complying with or arising pursuant to all applicable existing and anticipated laws, regulations and administrative determinations” (clause 23.5 – **statutory compliance costs**).

Capital costs (clause 23.1) and O&M costs (clause 23.2)

- 5.2.2 Estimating the costs of proposed investment projects at an early stage of planning such projects can be very difficult. It is necessary to strike a balance between developing a realistic view as to what the likely costs will be and recognising the risk that additional costs could arise which have not been anticipated.
- 5.2.3 The Commission reviewed the capital cost information provided by Transpower in respect of the proposal and also reviewed Transpower's assessment of costs based on information already made available to the Commission, including previously supplied capital cost information for previous grid upgrade proposals.
- 5.2.4 Allowing for the accuracy levels implicit to preparing cost estimates from a desk-top design, the Commission is satisfied that the overall cost estimates for the temperature upgrade, duplexing, new line and series capacitor options that are included in the proposal and alternatives are reasonable.

Testing costs (clause 23.3), commissioning costs (clause 23.4) and statutory compliance costs (clause 23.5)

- 5.2.5 Clauses 23.3 and 23.4 of the GIT include the costs associated with testing and commissioning of a proposed investment or alternative project in the definition of "costs".
- 5.2.6 Clause 23.5 refers to costs associated with complying with existing or anticipated legislation.
- 5.2.7 Transpower included the testing costs, the commissioning costs and the statutory compliance costs of the proposal and the alternatives in its GIT analysis.
- 5.2.8 The Commission agrees that this approach is reasonable.

5.3 Market benefits

- 5.3.1 Clause 27 defines "market benefits" as "the present value of the benefits to those persons who produce, distribute, retail and consume electricity in New Zealand from a **proposed investment** or **alternative project** over a period of 20 years from the commissioning date..."³⁵ including:

"(a) changes in fuel cost of **existing assets, committed projects** and **modelled projects**" (clause 27.1 – fuel cost benefits);

³⁵ If significant market benefits or costs are expected to arise from the proposed investment or alternative project after that time, a terminal benefit calculation may be carried out to quantify these benefits or costs.

- “(b) changes in the value of involuntary **demand** curtailment” (clause 27.2 – **reliability benefits**);
- “(c) changes in the costs of **demand-side** management” (clause 27.3 – **demand side management cost change benefits**);
- “(d) changes in costs resulting from the deferral of capital expenditure on **modelled projects**” (clause 27.4 – **deferral benefits**);
- “(e) changes in costs resulting from differences in the amount of capital expenditure on **modelled projects**” (clause 27.5 – **capital cost benefits**);
- “(f) changes in costs resulting from differences in operations and maintenance expenditure on **existing assets, committed projects** and **modelled projects**” (clause 27.6 – **O&M benefits**);
- “(g) changes in costs for ancillary services” (clause 27.7 – **ancillary services benefits**);
- “(h) changes in losses, including local losses” (clause 27.8 – **loss benefits**);
- “(i) subsidies or other benefits provided under or arising pursuant to all applicable laws, regulations and administrative determinations” (clause 27.9 – **statutory compliance benefits**);
- “(j) the value of any material real options associated with the **proposed investment** or **alternative project**” (clause 27.10 – **real options benefits**); and
- “(k) subject to clause 10, **competition benefits**” (clause 27.11 – **competition benefits**).

Fuel cost benefits (clause 27.1)

- 5.3.2 Fuel cost benefits arise when a proposed transmission investment enables generation plant(s) with lower fuel costs to be dispatched, i.e. the proposed investment reduces possible out-of-merit-order dispatch.
- 5.3.3 Transpower states that there are benefits from differences in fuel costs and reductions in transmission losses (which reduce the amount of fuel consumed) associated with the proposal and the alternatives. Those differences have been included in Transpower’s GIT analysis. The Commission agrees that this approach is reasonable and the proposal is likely to yield significant fuel cost benefits.

Reliability benefits (clause 27.2)

- 5.3.4 Reliability benefits arise when there are differences in expected unserved energy between a proposed investment and an alternative project.
- 5.3.5 Transpower does not refer to reliability benefits in its Application for Approval. However, Transpower's SDDP analysis includes reliability benefits. These have been listed as "deficit costs" in the SDDP outputs and working spreadsheets. The Commission considers that Transpower's approach is reasonable.
- 5.3.6 The Commission notes that reliability benefits are minor in comparison to the capital cost benefits and the fuel cost benefits of the proposal.

Demand-side management cost change benefits (clause 27.3)

- 5.3.7 Transpower did not include demand-side management cost change benefits in its GIT analysis. However, the Commission agrees that these benefits are immaterial to the assessment of the proposal and that Transpower's approach is reasonable.

Deferral benefits (clause 27.4)

- 5.3.8 If a major grid investment is delayed by using other, less costly, means to ensure that the power system continues to meet the GRS, "deferral benefits" can result.
- 5.3.9 Transpower determined, and the Commission agrees, that there are no deferral benefits in respect of the proposal.

Capital cost benefits (clause 27.5)

- 5.3.10 Transpower states that there are benefits in capital reductions or deferrals arising from reductions in the need for, or deferral of, new generation (modelled projects), or new transmission investment (either alternative projects or modelled projects). Some of the capital expenditure savings result from a changing mix of new generation required.³⁶
- 5.3.11 These capital cost benefits have been included in the GIT analysis.
- 5.3.12 The Commission agrees that this approach is reasonable and the proposal is likely to yield significant capital cost benefits.

³⁶ Application for approval – attachment B – section 4.1 – page 19.

O&M benefits (clause 27.6)

- 5.3.13 Operational and maintenance benefits are incorporated in the GEM model and are therefore included in Transpower's GIT analysis. The Commission agrees that this approach is reasonable.

Ancillary services benefits (clause 27.7)

- 5.3.14 Ancillary services benefits occur if any existing contracted voltage support is not required when a transmission investment project is implemented.
- 5.3.15 Transpower states that ancillary services benefits have been partially included but not quantified.³⁷
- 5.3.16 The Commission considers that benefits from ancillary services are unlikely to distinguish between the proposal and the alternatives, and that Transpower's approach is reasonable.

Loss benefits (clause 27.8)

- 5.3.17 Loss benefits are incorporated in the GEM model and therefore are included in Transpower's GIT analysis. The Commission agrees that this approach is reasonable.

Statutory compliance benefits (clause 27.9)

- 5.3.18 The most likely statutory compliance benefit is that of reducing an emissions charge such as a carbon tax. This has been taken into account as it is reflected in the carbon charge component of generation costs in the MDSs. The Commission agrees that this approach is reasonable.

Real option benefits (clause 27.10)

- 5.3.19 Transpower has not taken into account any real options benefits. The Commission agrees that this approach is reasonable.

Competition benefits (clause 27.11)

- 5.3.20 Clause 10 of the GIT states that competition benefits may be included in the market benefits of a proposed investment or alternative project if the Commission

³⁷ Application for approval – attachment B – appendix A.1 – page 23.

reasonably considers it appropriate, provided that the benefits can be separately identified and calculated.

- 5.3.21 Transpower states that due to the difficulty in estimating competition benefits and the resultant uncertainty over their magnitude, Transpower has not quantified competition benefits other than those already reflected in its generation expansion modelling.³⁸
- 5.3.22 The Commission notes that the GEM does not, in fact, include competition benefits. However, the Commission agrees that, in the context of this proposal, Transpower's approach is reasonable

Terminal benefits and terminal costs (clauses 23 and 27)

- 5.3.23 The GIT requires that the present value of future costs and benefits to be included where significant market benefits or costs are expected to arise from a proposed investment or alternative project after the 20-year analysis timeframe (clauses 23 and 27 of the GIT). The Commission has termed these terminal costs and benefits.
- 5.3.24 Transpower analysed the proposal and alternatives out to 2042 and used this extended analysis period to calculate the terminal values at the end of the 20-year GIT period. This approach is consistent with that adopted for previous proposals, and the Commission considers that it is reasonable.

Non-quantifiable material market costs and benefits

- 5.3.25 Clause 9 of the GIT states:
- “where a **material benefit** or **cost** cannot be quantified, the direction of the **market benefit** or **cost** and likely magnitude of the **market benefit** or **cost** must be identified.”
- 5.3.26 Transpower states that it has conducted a qualitative assessment of operational, market services, consumer and community related benefits.³⁹
- 5.3.27 In terms of clause 9, Transpower has not identified the direction and the likely magnitude of such benefits. However, the Commission agrees that, in the context of this proposal, such benefits cannot be quantified and their impact is negligible.

³⁸ Application for approval – attachment B – section 4.4 – page 20.

³⁹ Application for approval – attachment B – section 4.5 – page 20.

Sensitivity analysis

- 5.3.28 Clause 16 of the GIT requires a sensitivity analysis to be applied in assessing the expected net market benefit and costs. Clause 17 lists a number of specific sensitivities that must be applied to test the robustness of results to changes in the underlying model assumptions, unless to do so is either not reasonably practicable or not reasonably necessary.
- 5.3.29 Table 3 below summaries the sensitivity analysis carried out by Transpower. The Commission agrees that this analysis is reasonable.

Table 3: summary of sensitivity analysis

Variable and clause in schedule F4	Comment
17.1—forecast demand	High and low as per the 2008 SOO.
17.2—the size, timing, location and operating and maintenance costs of the proposed investment or alternative project; and existing assets, committed projects and modelled projects	Not included
17.3—the capital cost of the proposed investment or alternative project	Capital costs of 80% and 120% of estimate
17.4—the timing of decommissioning, removing or de-rating decommissioned assets	Not reasonably necessary
17.5—the value of unserved energy	Not reasonably necessary
17.6 and 17.7—the discount rate used	4% and 10%
17.8—hydrological inflow sequences as defined in the statement of opportunities	Not reasonably necessary
17.9—generator and demand-side bidding strategies	Not reasonably necessary
17.10—key input variables in the calculation of competition benefits	Not reasonably necessary
17.11—carbon charge	Low 80%, high 120%
17.12—the probability of occurrence of an MDS	Not reasonably necessary
Additional sensitivities	
Exchange rate	10 year average
Property cost	200%

5.4 GIT results

NPV analysis

5.4.1 Transpower's GIT analysis results are presented in Table 4 below. The expected net market benefits of the proposal and the alternatives are each greater than zero. The proposal maximises the expected net market benefit compared with the alternatives.

Table 4: central GIT result

Item	Generation fixed benefits (A) (\$m)	Generation variable benefits (B) (\$m)	Transmission costs (C) (\$m)	Expected net market benefit (A+B-C) (\$m)
Base case	0	0	0	0
Option 1	32	360	87	304
Option 3	32	283	73	241
Option 4	32	361	82	310
Option 5	32	405	178	259
Option 6	32	311	53	290
Option 7	32	315	62	285
Option 8	32	444	140	335

Note: Benefits and costs are in \$2009

5.4.2 The sensitivity analysis results are presented in

Table 5 below and are expressed as mean NPVs for the proposal (option 8) and the alternatives.

Table 5: sensitivity analysis

Expected net market benefit	Option						
	1	3	4	5	6	7	8
Base results (\$m)	304	241	310	259	290	285	335
Sensitivity							
Discount rate 4%	593	474	597	577	532	530	695
Discount rate,10%	160	123	163	102	164	158	154
Capital 80%	317	252	323	290	297	293	360
Capital 120%	290	230	298	227	283	276	310
10yr average exchange rate	305	241	312	258	290	284	335
High demand	386	351	442	417	460	454	556
Low demand	454	378	442	387	369	366	446
Property costs 200%	300	238	308	250	287	283	330
Carbon cost 80%	289	147	294	242	275	269	319
Carbon cost 120%	354	196	357	316	328	323	396

5.5 Conclusion on GIT results

5.5.1 As set out in section 3, a proposed investment satisfies clause 4.2 of the GIT if the Commission is reasonably satisfied that the proposed investment:

- (a) minimises expected net market cost compared with possible alternative projects; and
- (b) the expected net market benefit is greater than zero; and
- (c) the conclusion in (a) above is sufficiently robust having regard to the results of the sensitivity analysis.

5.5.2 Although the Commission considers that some aspects of Transpower's GIT analysis could have been carried out differently, the Commission is satisfied that the proposal:

- (a) minimises expected net market cost compared with possible alternative projects; and
- (b) the expected net market benefit is greater than zero; and
- (c) the conclusion in (a) above is sufficiently robust having regard to the results of the sensitivity analysis.

5.5.3 Therefore, the Commission is satisfied that the proposal satisfies clause 4.2 of the GIT.

5.5.4 The Commission is satisfied that Transpower has applied the GIT reasonably.

6. Did Transpower follow any agreed consultation processes? (rule 14.4)

6.1 Compliance with rule processes

6.1.1 Rule 14.4 requires that Transpower has “followed any agreed consultation process”.

6.1.2 The Rules do not require a consultation process to be agreed. However:

- (a) clause 14.2.1 requires the Commission and Transpower to agree to a timetable (not a process) for consultation and approval of economic investments; and
- (b) clause 14.2.3 requires the Commission and Transpower to consult (but not agree) on a process for consultation with persons that the Commission thinks are representative of the interests of persons likely to be substantially affected by economic investments and content of draft grid upgrade plans.

6.1.3 The Commission considers that rule 14.4 refers to any agreement, between Transpower and the Commission, arising out of either clause 14.2.1 or clause 14.2.3.

6.2 Agreed consultation processes

6.2.1 In January 2008 Transpower and the Commission agreed on a process and timetable for consultation regarding the proposal. However, with Transpower’s resources concentrating on other projects, a revised timetable was agreed in May 2008.

6.2.2 In August 2008, Transpower advised the Commission that it wished to defer the proposal for further investigation.

6.2.3 In March 2009, Transpower re-initiated discussion with the Commission regarding the proposal and a further revised timetable was agreed to in July 2009.

6.2.4 At Transpower’s request, in November 2009, a further timetable was agreed to (**the November 2009 timetable**).

6.2.5 As set out in the November 2009 timetable, Transpower:

- (a) consulted with substantially affected parties on its assumptions, approach and long list of option between 28 May 2008 and 18 June 2008, and on its

application of the GIT and short listed options between 27 July 2009 and 14 August 2009; and

(b) submitted the proposal as required on 30 November 2009.

6.2.6 The November 2009 timetable was revised again in March 2010, as the Commission sought further information from Transpower to ascertain whether Transpower had applied the GIT reasonably. Transpower complied with the revised timetable.

6.3 Conclusion on agreed consultation processes

6.3.1 In summary, the Commission is satisfied that Transpower has complied with the agreed consultation process in terms of rule 14.4.

7. Decision

7.1 Rule criteria

7.1.1 Rule 14.4 provides that, in order to be able to approve an economic investment, the Commission must be satisfied that:

- (a) Transpower has applied the GIT reasonably; and
- (b) Transpower has followed any agreed consultation process.

7.1.2 On the basis of the information provided, the Commission considers that the proposal satisfies the GIT.

7.1.3 The Commission considers that this conclusion is robust having regard to the sensitivity analysis carried out. Accordingly, the Commission considers that Transpower has applied the GIT reasonably.

7.1.4 The Commission is satisfied that Transpower has followed the agreed consultation process and therefore the proposal meets the requirements of rule 14.4.

7.1.5 This means that, under rule 14.4, the Commission has the discretion to approve the proposal.

7.2 Decision

7.2.1 The Commission is satisfied that the proposal meets the criteria for consent set out in rule 14.4. The decision of the Commission is to approve the proposal, with the maximum amount which may be recovered by Transpower being \$197 million in 2015 dollars.