TRANSPOWER

North Island 400 kV Upgrade Project

Investment Proposal

Part V – Project Costs

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1 Summary

Transpower is seeking Electricity Commission approval for all costs incurred by Transpower in the implementation of the proposed investment.

This Part contains the estimated capital costs of the 400 kV project. Transpower has submitted cost estimates in good faith and expects to be able to recover actual costs reasonably incurred in relation to the approved project through the transmission pricing methodology. The costs contained in this document are estimates only.

The estimated costs for Transpower's 400 kV project including transmission works, property and project management is approximately $622 million.

Category	Item	Real Capital Cost Estimates $m (2005)	Estimated Nominal costs $m
Investigations	Preliminary engineering, environmental and property work to establish preferred route and lodge NoR.	20	26
Property	Acquisition of property rights	97	133
Environmental	Acquisition of designations and resource consents	11	15
Transmission works	400 kV line Whakamaru to Otahuhu	120	167
	Substations – Otahuhu	66	128
	– Whakamaru	33	
	Cable	84	119
Dismantling	Arapuni to Pakuranga Line	4	4
Project Management		25	30
Total		**460**	**622**

2 Background

Transpower has submitted cost estimates in good faith and expects to be able to recover actual costs reasonably incurred in relation to the approved project through the transmission pricing methodology.

If the actual project costs are greater than the estimated cost included in this submission and Transpower was unable to recover these costs, Transpower would incur an economic loss. Forecasting errors could lead to windfall losses and could deter efficient investment. While considerable effort is made to ensure estimated costs represent the expected efficient investment, inevitably such forecasts are subject to imperfect foresight.

It would therefore be inappropriate to establish a final set of project costs for recovery 5 years out from commissioning of an approved investment. Such an approach would create unacceptable commercial risks for Transpower, and for electricity consumers. Transpower does not believe it is the Government's intention that this be the case.

3 Approach to Estimating Costs

Current cost estimates are based on conceptual designs. It is envisaged detailed design for the 400 kV assets will be carried out under some form of "turnkey" or "engineer, procure and construct" contract. Costs will become more certain as the project progresses through its various stages, and as risks are mitigated as illustrated in Figure 3-1 below.

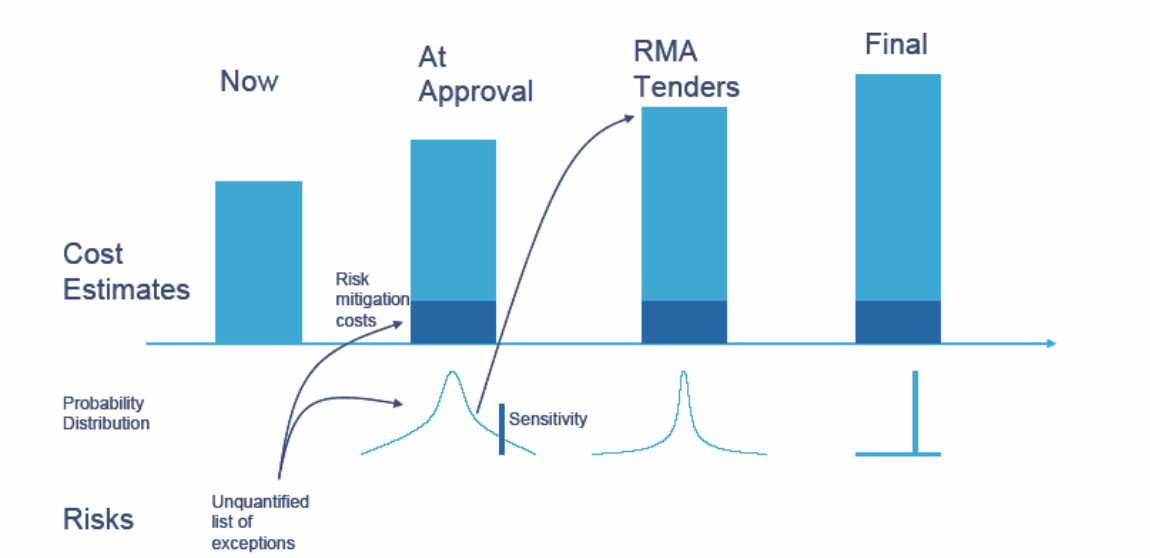

Figure 3-1: Relationship Between Project Stage and Accuracy of Cost Estimates

In estimating project costs Transpower's focus has been to establish an appropriate conceptual design for the capital equipment, preparing order of magnitude costs and identifying major sources of risk. Assumptions used in preparing cost estimates are discussed below.

As the project progresses scenario analysis techniques will be used to quantify expected variations, and establish a risk profile for the costings. This process will allow the refinement of risk mitigation strategies and the establishment of appropriate bounds for sensitivity analysis. For clarity, Transpower expects to be able to recover the costs of risk mitigation in addition to direct project costs.

A number of the cost risks (described below) relate to environmental costs and to specifics of market conditions and commercial requirements at the time tenders are let. It is clear that aspects of the costs cannot be finalised until the route is certain. For example, costs for cable trenching and foundations are sensitive to assumptions about soil depth and type. Approval of the project under the Resource Management Act and the letting of tenders will lead to increased engineering certainty and hence greater certainty over costs.

Subsequent to RMA approval and the letting of tenders, unavoidable circumstances may produce further variations in costs.

For clarity, operating and maintenance costs are not included in this Part in any detail as they do not form a part of the project capital costs. However, for completeness a description of the basis for estimating operating and maintenance costs has been included in Section 4.

4 Basis for Costs

This section sets out Transpower's basis for the cost estimates of each major component of the proposed investment. It also includes information on factors that have been specifically excluded from the estimates. Costs may vary from the estimates provided due to changes in the general assumptions (contained later in this Part), or to factors excluded from the cost estimates.

As discussed in the introduction to this part, costings for the preliminary design provided are subject to a high degree of uncertainty which will reduce as the project progresses.

4.1 Capital costs

4.1.1 Lines

The length of the transmission line has been assumed to be the proposed Western route which is approximately 200 km. The northern termination point is approximately 9 km (by cable route) south of Otahuhu. Variation to these lengths is possible once the final route is established.

Tower outlines and conductor selection are based on preliminary design criteria. Design criteria for transmission lines are discussed in Part I of this submission.

The number of towers and the composition of various different tower types are based on a preliminary tower spotting and are subject to finalisation of the alignment of the centre line as well as the suitability of individual tower positions.

The quantities of all other main materials such as insulators, conductor fittings, and foundations were derived from the tower quantities. The conductor lengths were based on the route length with a 3% allowance for sag and wastage.

Foundation installation rates are based on preliminary designs assuming average soil conditions over the whole route.

Exclusions:

Mitigation of step and touch voltages will be required for tower sites close to sensitive third party installations and other structures such as fences, sheds, swimming pools etc. Estimation of these costs is possible only after finalisation of tower sites.

Allowances for construction of new access tracks, bridges and upgrading of existing bridges/tracks can only be made after finalisation of tower sites.

4.1.2 Substations

Preliminary design of the NI 400 kV substations is based on the following key assumptions:

a) The 400 kV terminal stations will be located at Otahuhu and Whakamaru; and

b) A new and physically separate 220 kV switchyard extension is required at Otahuhu to provide diversity. This arrangement ensures that supply from the south into Otahuhu and supply from Otahuhu to key loads in the Auckland area are diversified across two physically separate "switchyards".

The 400 kV terminal stations at Otahuhu and Whakamaru will be designed to facilitate future expansion for any of the identified future generation scenarios.

Exclusions:

Substation cost estimates exclude:

- Escalation of transformer costs due to high international demand;
- Required upgrading of bridges and roads for 400/220 kV transformer access;
- Upgrading transformers, buswork, circuit breakers, switchgear, protection systems, earthing, etc at existing substations for increased fault duty;
- Fault limiting equipment to ensure Distribution Companies' equipment fault duty is not exceeded;
- Purchase of adjoining properties and additional substation land should this be necessary;
- Transitional configurations to allow for continuity of 220 kV power flow;

A transportation feasibility assessment has been made for the route from Port of Auckland to Otahuhu and Whakamaru for the 500 MVA 400/220 kV transformers. This assessment has identified a minimum of six bridges that must be analysed in detail to assess the cost to upgrade these bridges to allow the heavy haulage train to traverse the bridges. The worst case scenario is total replacement but strengthening or the use of bailey bridges may be feasible subject to specific investigation of each bridge. As the actual bridge strengthening requirements are unknown, costs have been excluded from the substation cost estimates.

4.1.3 Cable

Preliminary investigations have been carried out into suitable cable installation arrangements to determine corridor width required and identify potential cable routes between the transition station and Otahuhu substation. For the purpose of preparing cost estimates a length of 9 km was used.

To provide the required cable ratings, nominal trench dimensions of 1500mm wide by 2300m deep would be required with thermally controlled bedding/ backfill materials being required from the floor of the trench to just below the surface. This is a slightly "deeper than normal" burial depth to facilitate crossing of the trench alignment by other underground services and to increase the security of these important cables by reducing the likelihood of "dig ins" and damage caused by other service providers.
Exclusions:

Cable costs exclude:

- Additional costs to circumvent buried infrastructure
- Additional costs of special structures required to cross streams and the like.

4.2 Property Costs

4.2.1 Easements

Transpower's estimates of compensation for easements are based on the easement fee methodology for assessing compensation payable under the Public Works Act 1981. These are based upon analysis of market transaction data from 1 January 2003 for the broader area within which both the proposed east and west routes have been identified. The relationship between the rating value and sale price has been assessed and applied to the rating values for the identified properties to estimate the land value for each parcel of land.

The easement fee methodology has been successfully adopted in compensation assessments for a range of transmission line build and upgrade projects up to 220 kV lines, but has not been used on 400 kV lines. As a consequence Transpower has necessarily relied on increasing the compensation estimates, relative to the smaller transmission line developments, through an increase in the various factors that impact on land value e.g. increased corridors of effect and increased value loss factors. As a consequence of this and other limitations of the cost modelling Transpower has used the upper end range of the easement cost estimates.

From 2005 easement costs have been increased by 1% per annum to reflect movements in market prices in excess of inflation.

4.2.2 Environmental Costs

Costs have been estimated for securing a designation and resource consents pursuant to the RMA. These estimates are limited to Council processing costs, costs to Transpower of engaging specialist professional and legal advice, Transpower staff, and attending various hearings and court appeals. They do not attempt to allocate value to the environment or any environmental degradation resulting from the project.

Economic costs of securing environmental approvals are closely linked to the likely timeliness of securing designation. Where greater adverse environmental effects are likely to occur, there is an increased requirement for input from technical specialists, and additional consultation (to fully document and identify ways in which to mitigate adverse effects), reporting, compensation, and property negotiation periods. These commitments carry an additional economic cost.

4.3 Operating and Maintenance Costs

The operating and maintenance costs used in the Part IV economic analysis were estimated as:

- $300,000 per annum for new high voltage transmission lines
- 1% of capital cost for substation assets

- $750 per annum per circuit km of underground cable, i.e. $13,500 per annum for two 9km circuits.

5 Assumptions

The following general assumptions have been made in preparing capital cost estimates for this investment:

Cost of Plant and Materials

Material prices are based on budgetary prices obtained from manufacturers/suppliers for approximate quantities estimated from preliminary designs. They are exclusive of economies of scale for purchasing.

Cost of Labour

Installation rates are based on average wage rates and productivity levels in New Zealand and Australia on medium to large projects. Skilled Labour market conditions could dramatically change these estimated rates.

Real costs

Capital cost estimates are in 2005 NZ dollars. No allowance has been made for escalation of prices due to inflation or market conditions.

Project Management Costs

Internal and external project management costs have been assumed at 8% of overall project costs based on experience of large projects.

Allowances for detailed engineering and contractor's project management costs have been based on past experience and are subject to contract type (Engineer,Procure, Construct or Erect only) and market conditions at the time of tendering.

Project Financing Costs (Interest During Construction)

Project financing costs or interest during construction have not been included in the cost estimates. Instead, it has been assumed that these costs can be expensed during project implementation.

Exchange Rates

Budgetary costs have been obtained in the currency of origin and have been converted to $NZ using the 5-year forward exchange rates tabled below.

Currency	2010[1]
NZD/USD	0.5640
NZD/AUD	0.8558
NZD/EURO	0.4343
NZD/SEK	3.9749
NZD/CHF	0.6197
NZD/CAD	0.7286

When determining a suitable spot foreign exchange rate for costing purposes, the current two year average spot rate is calculated for the applicable currency. This rate is compared to the current spot rate and the lower of the two rates is used as the

[1] ANZ National Bank, 23 March 2005.

‘advised spot rate’. For future payments out to five years, the current forward foreign exchange points are applied to the ‘advised spot rate’.

These rates are updated on a quarterly basis, or if there is a significant movement in the underlying currency. This methodology is appropriate and is consistent with accepted market practice. It also ensures that future payments are priced off derived forward rates not spot rates.

Hedging

The cost of hedging exchange rates and commodity prices has been included in the cost estimates only to the extent that these are represented in forward rates and prices used to prepare the estimates. It has been assumed that any additional costs of hedging can be expensed during project implementation.

Project Time Frame

Costs have been prepared according to the Project Timeline outlined in Part 1. Delays in the project are likely to increase time dependant costs (most particularly project management and environmental approval costs) and to increase the risk associated with other cost estimates (particularly those affected by factors that vary over time such as exchange rates).

6 Summary of Cost Estimates

Table 6-1 below presents two equivalent sets of costs for the proposed investment – the real capital cost estimate and the estimated nominal cost.

- The real capital cost estimate reflects the costs from the perspective of an investor today examining the economic commitment involved in a project from a market benefit perspective. It has been prepared using mid-range cost estimates, and excludes financing costs. The estimate is in real (constant) terms and is expressed in 2005 dollars.

- The estimated nominal cost reflects the costs from the perspective of the asset owner at the time the assets are commissioned, i.e. it reflects the value that will need to be included in the regulated asset base and recovered through regulated charges (including funding costs). The estimated nominal cost figures also include allowances for variation in price and scope. Costs are nominal (dollars of the day) at the time the project is commissioned.

Category	Item	Real Capital Cost Estimates $m (2005)	Estimated Nominal costs $m
Investigations	Preliminary engineering, environmental and property work to establish preferred route and lodge NoR.	20	26
Property	Acquisition of property rights	97	133
Environmental	Acquisition of designations and resource consents	11	15
Transmission works	400 kV line Whakamaru to Otahuhu	120	167
	Substations – Otahuhu	66	128
	– Whakamaru	33	
	Cable	84	119
Dismantling	Arapuni to Pakuranga Line	4	4
Project Management		25	30
Total		**460**	**622**

Table 6-1: Estimated Capital Expenditure for 400 kV Grid Augmentation from Whakamaru to Otahuhu

The timing of capital expenditures (in $2005) is shown in Figure 6-1. Initial expenditures are focused on the acquisition of a route, with expenditure in the final two years focused on major capital items and cable installation. Expenditure in the final year of the project amounts to 41% of total project costs.

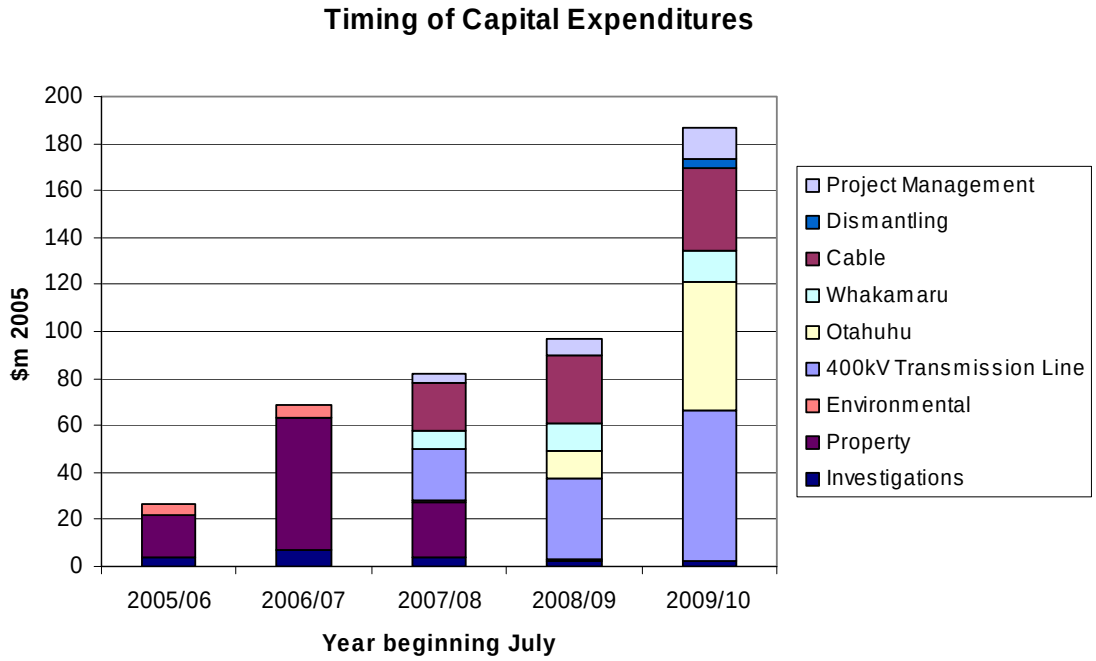

Figure 6-1: Anticipated Incidence of Expenditure on the Proposed 400 kV grid Augmentation project

7 Contingencies

The capital cost estimates provided in the earlier sections of Part V have been prepared to be consistent with the economic methodology described and applied in Part IV. As a consequence the costs differ from those ordinarily presented in business cases (and equally from the type of costs upon which revenue recovery might be based). Furthermore, the costs presented are based on preliminary design work and are order of magnitude costs.

The purpose of this section is to provide a bridge between the project capital costs, and those that might ordinarily be presented in a business case. They are, necessarily, indicative figures. As noted in Section 2, it is envisaged that detailed design for the 400 kV assets will be carried out under some form of "turnkey" or "engineer, procure and construct" contract. Such an arrangement is likely to have a bearing on, amongst other things the design, timing and currency of project expenditures, and therefore the scale of actual costs.

In short this analysis should not be seen as a substitute for the scenario based risk profiling which must take place during the next stage of project implementation.

7.1 Price Contingencies

7.1.1 Inflation Adjustment

Capital cost estimates been calculated in real (2005) dollars in order to maintain consistency with the real discount rate used in the calculation of expected net market benefits, to simplify the calculation of market benefits and costs and to provide greater transparency in the comparison of the proposed transmission investment with non-transmission investment options. The use of real or nominal costs should have

no impact on the outcome of the economic analysis in expected net market benefit terms provided the treatment of inflation is consistent throughout the analysis.

Transpower wishes to recover the actual (nominal) costs of the proposed 400 kV investment. Even at modest rates of inflation over five years the difference between real and cost figures can be substantial. Nominal costs have been estimated by applying a 3% inflation rate to the expected expenditure programme. Given the expected timing of costs the difference between real 2005 dollars and nominal costs is approximately $39 million (or 8.6%). Figure 7-1 below shows the relative impact on major capital items.

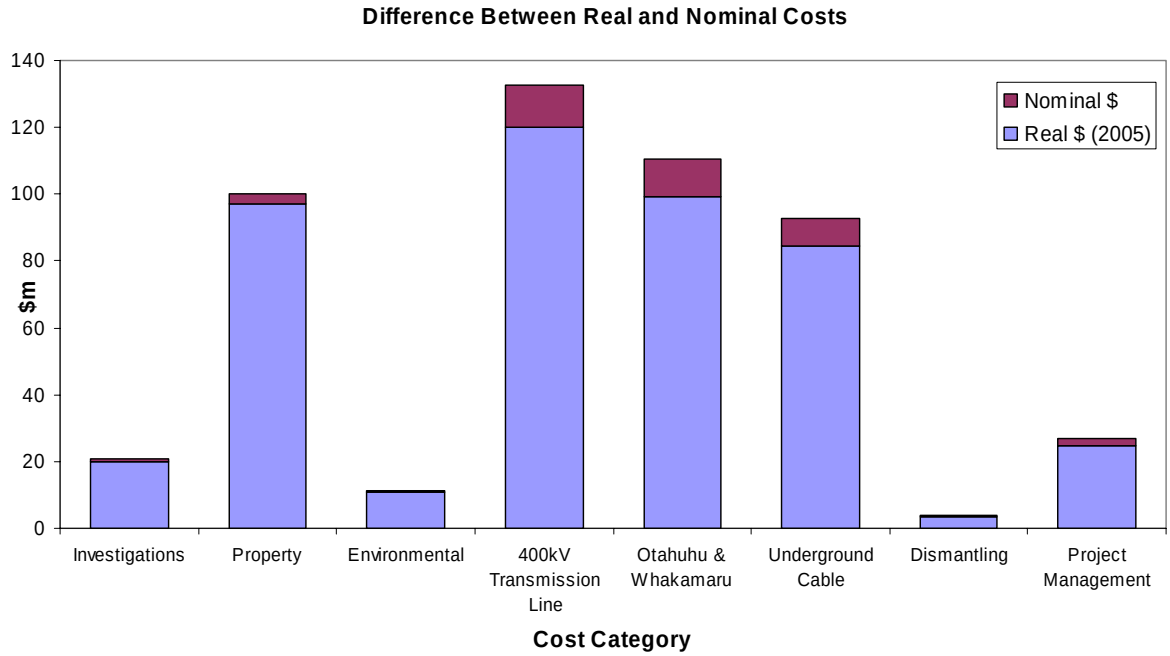

Figure 7-1: Estimated Capital Costs in Nominal Terms

7.1.2 Exchange Rate Adjustment

In preparing the capital cost estimates Transpower has used 5 year forward exchange rates to reflect the rates at which the foreign currency denominated components of the investment might be hedged.

Figure 7-2 shows the proportion of nominal capital costs denominated in the currencies of countries from which the capital works are expected to be sourced. Approximately 54% of the project costs are denominated in New Zealand dollars.

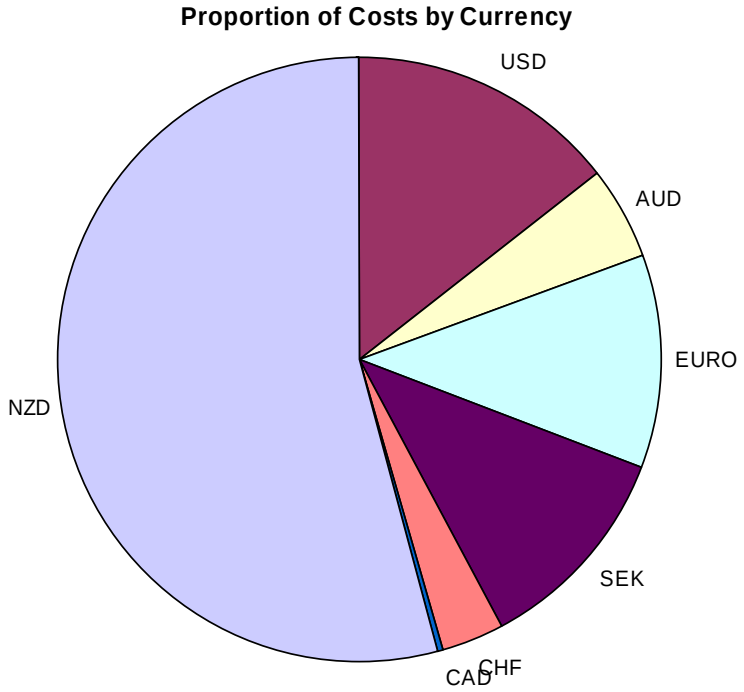

Figure 7-2: Proportion of Expenditure in Various Currencies

While the exchange rates used in preparing Tranpower's cost estimates are forward rates against which Transpower could hedge, it is important to understand the sensitivity of estimated costs to changes in the exchange rate assumptions.

As an alternative to the forward rates assumed in the capital cost estimates, the NZD was assumed to depreciate against the USD from 0.70 NZD per USD to 0.60 in 2010, with a similar level of depreciation against the other main currencies. Rates used in the sensitivity are shown in Table 7-1 below.

	2005/6	2006/07	2007/08	2008/09	2009/10	2009/10
Exchange Rate	Alternative Exchange Rate Assumption					Cost Estimate Assumption
Nzd/usd	0.700	0.675	0.650	0.625	0.600	0.564
Nzd/aud	0.888	0.856	0.825	0.793	0.761	0.856
Nzd/euro	0.504	0.486	0.468	0.45	0.432	0.4343
Nzd/sek	4.585	4.421	4.257	4.094	3.930	3.975
Nzd/chf	0.766	0.738	0.711	0.684	0.656	0.620
Nzd/cad	0.814	0.784	0.755	0.726	0.697	0.729

Table 7-1: Alternative Exchange Rate Assumption

Adoption of the alternate exchange rate assumptions reduced the nominal capital cost of the 400 kV proposal by $6 million.

7.2 Interest During Construction

Interest during construction has been omitted from the capital cost estimates used in the economic analysis because it is not consistent with the measurement of national benefit[2].

Transpower wishes to recover the actual costs of the proposed 400 kV investment, including a return on capital invested during the commissioning of the project. As noted in Section 4, Transpower's preference is to recover these costs during implementation of the project. An estimate of the scale of nominal interest during construction costs implied by the preliminary cost estimates has been prepared, using a 10% pre-tax nominal discount rate[3]. This amounts to $64 million over the period of project disbursements.

7.3 Physical Contingencies

High level estimates of physical contingencies have been estimated for major components of the capital spend using Monte Carlo simulation, in conjunction with the estimates provided, and any information on the likely cost impact of exclusions identified in Section 3. Note however that these contingencies are not intended to cover variations in design or specification.

Lines

Approximately 5% of cases in the Monte Carlo simulation generated project costs higher than $144 million. Deducting from this the preliminary cost estimate of $120 million gives a physical contingency for transmission line costs of $24 million, or 20%. This figure must also be grossed up for inflation, exchange rate and interest during construction, producing a final contingency estimate of $28 million in nominal terms.

Substations

Approximately 5% of cases in the Monte Carlo simulation generated project costs higher than $115 million. Deducting from this the preliminary cost estimate of $99 million gives a physical contingency for substation costs of $16 million, or 16%. This figure must also be grossed up for inflation, exchange rate and interest during construction, producing a final contingency estimate of $17 million in nominal terms.

Underground Cable

Approximately 5% of cases in the Monte Carlo simulation generated project costs higher than $101 million. Deducting from this the preliminary cost estimate of $84 million gives a physical contingency for transmission line costs of $17 million, or 20%. This figure must also be grossed up for inflation, exchange rate and interest during construction, producing a final contingency estimate of $20 million in nominal terms.

[2] In a national cost/benefit framework the opportunity cost of an investment to society is represented though the discount rate. Interest during construction represents the opportunity cost of an investment to providers of funds, and is in essence a value transfer paid by beneficiaries to investors to ensure that the investment takes place. As a general principle such value transfers should net out of the economic analysis.

[3] This is consistent with the 7% pre-tax real discount rate applied in the economic test, adjusted for 3% inflation.

It should be noted that this contingency does not cover variation in the length of the underground cable.

Easements

Easement costs were prepared by a qualified external expert. To ensure consistency with the approach taken in preparing those estimates no allowance is made here for further contingent amounts.

7.4 Summary

Table 7-2 provides a summary of the various contingent amounts that have been discussed in this section.

	Real Cost excluding Contingencies $m 2005	Impact of Inflation $m	Exchange Rate Variation $m	Interest During Construction $m	Physical Contingency $m	Nominal Cost including Contingencies $m
Investigations	20	1		5		26
Property	97	3		33		133
Environmental	11	0		4		15
Lines	120	13	-1	8	28	167
Substations	99	11	-4	4	17	128
Underground Cable	84	8	-1	7	20	119
Dismantling	4	0		0		4
Project Management	25	2		3		30
TOTAL	**460**	**39**	**-6**	**64**	**65**	**622**
Note: Figures may not total exactly due to rounding						

Table 7-2: Relationship between Project Costs in Real and Nominal Terms

The difference between estimated capital costs and nominal costs including contingencies is approximately $162 million. However interest during construction and inflation (which do not affect the economic merits of the project) represent $104 million of this difference. Physical contingencies are 14% of real capital costs, but it should be noted that these cover only a limited number of potential variations in project costs.

Transpower wishes to recover the actual costs of the proposed 400 kV investment. The nominal cost estimate including contingencies represents a good faith estimate of what those actual costs might be. However it would be inappropriate to establish a final set of project costs for recovery at this stage.