OTAHUHU SUBSTATION DIVERSITY PROJECT

APPLICATION FOR INCREASE OF MAJOR CAPEX ALLOWANCE

Transpower New Zealand Limited

September 2012

Keeping the energy flowing

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1 Executive Summary

1.1 Background

On 12 June 2006, an equipment failure at our Otahuhu substation resulted in a widespread loss of electricity supply to Auckland and Northland. At the time of the outage we were considering future developments at Otahuhu to facilitate the 400 kV transmission line from Whakamaru to Auckland (the North Island Grid Upgrade Project).

The highly costly outage significantly increased the urgency of the work planned at Otahuhu in advance of the North Island Grid Upgrade Project. To this end, we gave an undertaking to the Minister of Energy to proceed with urgency on actions to increase security of supply.[1]

Our investigation of options to increase diversity and improve the reliability of supply into Auckland and Northland led to the submission of a Grid Upgrade Plan (GUP) to the Electricity Commission on 11 December 2006 (within 6 months of the outage event). We proposed to establish a new GIS/AIS 220kV switchyard at Otahuhu within an approval cost of $99 million (P90) in 2009 year dollars.

Given the urgency of the project and our desire to commission the new switchyard at the earliest opportunity, our submission was based on relatively high-level cost estimates. While the Electricity Commission was considering its decision, we proceeded to further develop the design of the switchyard. The proposal was approved on 31 August 2007.

This was only the second of twenty GUPs[2] approved by the Electricity Commission under Part F of the Electricity Governance Rules and the first project of its size and type undertaken for many years. As a result, we did not anticipate many of the “brownfield” issues that arose from working in an existing, older substation such as relocation of unidentified underground services, the extent of stormwater filtration required, and extensive integration required with existing in-service substation facilities.

As evident within the body of this application, the most significant component of the project, the GIS at a cost $64.2 million came in close to budget when taking into account the effect of foreign exchange and inflation.

We have now completed the new 220 kV switchgear facility at our Otahuhu substation which is physically and geographically separate from the existing switchyard. Circuit connections have also been diversified between the two switchyards so that a major failure in either one does not result in a total loss of supply. The last asset for this project was commissioned in November 2011.

We have incurred costs of $106.1 million on the Project, $7.1 million in excess of the major capex allowance (P90) of $99 million. We originally sought to recover the overspend by way of application to the Electricity Commission in July 2010 when the project was 96% complete. The advice we received was to submit it to the Commerce Commission when the project was 100% complete.

[1] Refer correspondence between David Parker and David Gascoigne attached in Appendix A.

[2] Of these twenty GUPs, there are three forecast to exceed the respective approval costs.

While the final cost is seven per cent greater than the P90 submitted in the GUP, use of this higher cost would not have altered the recommendation and approval of the decision to build the new substation at Otahuhu.

1.2 This application

This is an application for an amendment to the major capex allowance for the Otahuhu Substation Diversity Project (the Project). This application is being submitted pursuant to the Transpower Capital Expenditure Input Methodology Determination[3] (the Capex IM).

We have incurred costs of $106.1 million on the Project, $7.1 million in excess of the major capex allowance (P90) of $99 million. A number of factors have contributed to this increased expenditure and these are discussed in detail within the body of this application. In summary, the key factors are:

- unforeseen environmental requirements for stormwater filtration facilities
- the need to relocate existing underground utilities services which were not detailed and in some cases not identified on drawings of the site
- a significant underestimate of the cost to install four 220 kV transmission towers
- complex and challenging design and installation enabling works for secondary systems, including protection, SCADA and communications
- exchange rate fluctuations associated with the design/build contract for the major construction component of the Project
- the need to award a contract to complete the construction enabling works prior to completing the detailed design (and associated scoping of the necessary works) due to the urgency required to mitigate the single point of failure risk to Auckland
- the unexpected need to include the costs of a property easement
- an underestimate of Interest During Construction (IDC) due to an over-simplified "rule-of-thumb" calculation.

While many of these factors relate to the planning and estimation phase of the Project, it should be noted that an independent review of the costs by Parsons Brinckerhoff Associates (**PB Associates**) post-GUP submission concluded that its own cost estimates were close to those submitted and the remaining differences were well within the accuracy levels of the estimates.[4]

The GUP provided for an approved expenditure of $99 million in 2009 dollars. This was the P90 estimate. The P50 capital cost for the Project was estimated at $94 million in 2009 dollars. The difference between the P50 and P90 costs reflects the value of the uncertainty associated with price, exchange rate variability, inflation and financing costs.

Given that the Project required extensive construction work on a "brownfield" site, the 5% difference between P90 and P50 costs, and the 10% scope allowance in the P50 was unrealistically low in hindsight given the level of budget uncertainty and lack of detailed investigations at the time of the GUP submission.

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[3] Transpower Capital Expenditure Input Methodology Determination [2012] NZCC 2, dated 31 January 2012.

[4] *Otahuhu Substation Diversity Project: Review of the Capital Cost Estimates for Transpower's Proposal of 11 December 2006*, Parsons Brinckerhoff Associates (May 2007), section 4. A copy of this report is available at http://www.ea.govt.nz/industry/ec-archive/grid-investment-archive/gup/2005-gup/otahuhu-substation-diversity-proposal-history.

Once the construction phase had begun, we implemented project governance and project cost management processes that were assessed by an independent external review to be robust, and successfully developed innovative scope refinement processes to control costs and scope creep.[5] This supports our view that project cost management following the commencement of the construction phase was not a factor in total Project costs exceeding the major capex allowance, and that the Project was executed efficiently.

As discussed in detail within this application:

- we consider all Project costs are reasonable and have been efficiently incurred
- this project is still preferred among the options presented in the GUP despite the cost overrun
- from Project delivery, detailed budgets were established based on a more developed scope of works, and we managed the Project implementation efficiently, seeking to minimise Project costs through competitive tendering and other project cost management initiatives
- we responded to the emergence of unforeseen factors in a prudent and efficient manner, actively minimising associated costs while working towards delivering the approved major capex project outputs anticipated by the GUP.

Against this backdrop, we:

- request the Commission amend the major capex allowance for the Project to $106.1 million to enable recovery (and receive a return) on all actual costs incurred for this Project
- consider it is consistent with the Capex IM and the purpose of Part 4 of the Commerce Act for the Commission to amend the major capex allowance for the Project.

[5] Refer Appendix D - Transpower – Otahuhu Diversity Project: Independent Quality Assurance Health Check Review, Independent Quality Assurance New Zealand (2009), at page 3.

2 Project Identification and Specifications

The key project specifications that formed part of the Electricity Commission-approved GUP were for the Project to:

- remove all over-crossings of the existing substation at Otahuhu
- install bus section circuit breakers in the existing 220kV switchyard
- procure, construct, commission and operate a new 220kV gas insulated switchgear (GIS) switchyard and a new air insulated switchgear (AIS) switchyard at Otahuhu, connected and adjacent to, but geographically separated from, the existing switchyard
- transfer approximately half of the circuits from the existing switchyard to the new switchyards
- obtain designations, and resource consents necessary for the above
- plan for commissioning of the new switchyard by 2009.

The only material work to be completed is the removal of some redundant assets, namely one span over the 110 kV bus that remains. This overhead section is to remain as a contingency measure to cover for a potential cable failure. The removal was scheduled for the later of, either:

- approximately 1 year following the successful commissioning of the above cable circuit
- the commissioning of the cable section from Pakuranga to Albany as part of the NAaN project in order to provide additional security to Northland and North Auckland.

The cost of this outstanding work, estimated at $0.1 million, is included in the current project cost.

The Electricity Commission approved expenditure on the Project of $99 million or the actual cost, whichever was the lesser. Approval was given on the basis of a 90th percentile cost estimate which was made up as shown in the table below.

Table 2-1: Otahuhu Substation Diversity Project P90

Category	Cost $m (2006)	Contingency $m (2006)	Exchange rate variation $m (2006)	Interest during construction $m (2006)	90% cost limit $m (2006)	Inflation	90% cost limit $m (2009)
Design	1	0	0	0	1	0	1
Enabling works	7	1	0	1	9	1	10
Substation works AIS	7	1	0	0	8	1	9
Substation works GIS	30	3	2	2	37	4	41
Transmission lines/cabling	24	2	1	1	28	3	31
Project management	6	0	0	0	6	1	7
Total	75	8	3	4	89	10	99

3 The amendment sought

3.1 Quantum of proposed amendment to major capex allowance

The total expenditure on the Otahuhu Substation Diversity Project is $106.1 million. Accordingly, we have incurred an additional $7.1 million above the major capex allowance of $99 million.

We request the major capex allowance for the Project be increased by $7.1 million to enable recovery of the $106.1 million total cost incurred in relation to the Project.

3.2 Calculations showing how the quantum of the proposed amendment was calculated

The GUP estimate was prepared using component costs from our cost estimating tool wherever possible. For costs not covered by the cost estimating tool, high-level cost estimates were used.

3.3 Post-GUP approval planning

While the Electricity Commission was considering the GUP, we proceeded to further develop the design, scope and cost of the project by way of a Solution Study Report (SSR). This formed the basis of the budget that was included in the internal business case, known as the Project Approval Document (**PAD**), which was prepared following the Electricity Commission's GUP approval.

The PAD budget was lower than the GUP P50 estimate by $9.4 million (in 2006 dollars) and was broken down into different expenditure categories than those provided in the GUP.

It was the PAD budget that was used by the implementation manager to manage the delivery of the project and to this end, a meaningful direct comparison between the individual categories of expenditure in the GUP cost estimates and the actual costs incurred is not possible.

Given that the project was managed to the PAD budget, it is appropriate that the comparison of actual costs be shown against the PAD budget.

Table 3-1 below shows the difference between the PAD budget and actual costs.

The third column shows the PAD budget in $2006 – this is the budget to which the project was managed. Given this, where we describe the overspend in detail, it is this budget we are comparing the actual expenditure to – as shown in columns four and five.

Column six shows the PAD budget in approximate 2009 year dollars –effectively the PAD budget adjusted for the CPI movement between June 2006 and June 2009. This allows a useful comparison to the actual capital spend, most of which occurred in 2009. This comparison is shown in the final column.

Table 3-1: PAD budget as compared with actual expenditure (NZ $m)

	Overspend Category/ Adjustment to PAD Estimate	PAD Budget 2006 $	Actual	Overspend relative to PAD	Adjusted PAD to 2009 $	Overspend relative to adjusted PAD
A	Enabling Works Civil General	3.5	11.0	7.5	3.8	7.2
	Stormwater Drainage	0.1	3.1	3.0	0.1	3.0
	Wastewater	0.3	1.8	1.5	0.3	1.5
	Underground Services Relocation	0.2	1.8	1.6	0.2	1.6
	Warehouse Building Relocation	1.2	1.5	0.3	1.3	0.2
	Earthworks and General	1.8	2.9	1.1	2.0	0.9
B	Transmission Line Deviations	2.4	4.2	1.8	2.5	1.7
	220 kV tower piled foundations	0.1	2.4	2.4	0.1	2.4
	Other work	2.3	1.8	-0.5	2.5	-0.7
C	Enabling Works Secondary Equipment Design & Install	2.8	7.7	4.9	3.0	4.6
D	EW Transition Station & Cable Termination Design & Install	3.2	7.1	3.9	3.4	3.6
	Cable terminations	1.2	2.1	0.9	1.3	0.8
	Transition Stations	1.6	3.9	2.3	1.8	2.2
	AIS switchyard works	0.3	1.0	0.7	0.3	0.7
E	Enabling Works Procurement	3.4	3.9	0.5	3.7	0.2
	Protection equipment	0.6	1.0	0.4	0.6	0.4
	Other procurement	2.8	2.9	0.1	3.1	-0.1
F	Design Build GIS/AIS & EHV Cable	58.2	64.2	6.0	62.9	1.3
G	Land Easement	0.0	1.2	1.2	0.0	1.2
H	Interest During Construction	3.2	6.9	3.7	3.5	3.5
	TOTAL	76.6	106.1	29.5	82.8	23.3

3.4 Assumptions made in the calculations

The figures provided in Table 3-1 above reflect actual costs incurred by Transpower (plus an estimate for incomplete works).

The PAD budget has been adjusted to 2009-year dollars for comparison purposes in Table 3-1 above.

The property easement value included in Table 3-1 above (and discussed more fully in Section 6.8) is from an independent valuation and hence is based on standard valuation principles.

3.5 Evidence in support of the calculations

An Excel spreadsheet, *Otahuhu_MCA_Increase_Calcs_Sep12.xlsx*, detailing the actual costs incurred against the PAD budget, has been provided to the Commerce Commission as part of this application. Another spreadsheet, *GIT recalc 20120820.xlsx*, has been provided showing the GIT results for the project updated with actual costs.

Supporting detail by work package, contract price schedule items, contract variations, and related documentation is also available if required by the Commission.

3.6 Proposed P50

The proposed P50 is the same as outlined in the original GUP, being $94 million. Given that this is not an application for an increase in the MCA to cover future expenditure, a proposed P50 for this application is not relevant.

3.7 Calculations, key assumptions and supporting evidence used to determine proposed P50, by reference to specified P50

The calculations, key assumptions and supporting evidence used to determine the proposed P50 are also addressed in the original GUP.

4 Progress of the project

4.1 The planning processes undertaken

4.1.1 Background to planning for the Project

The GUP was submitted to the Electricity Commission under some urgency following the outage in June 2006 which resulted in a loss of supply to most of Auckland. The failure of an overhead earth wire crossing over the existing AIS switchyard at Otahuhu caused the outage. The outage illustrated the criticality of the existing substation.

As a prudent owner and operator of the grid, we agreed with calls for the vulnerability of the Otahuhu substation to High Impact Low Probability (HILP) events to be addressed as a matter of highest priority. The correspondence attached as Appendix A provides background as to the circumstances in which we undertook planning for this Project.

4.1.2 High level design

As a first step in the planning process, we undertook high-level design to establish the scope and initial costing of the Project. To meet the tight Project timeframes, cost estimates from the North Island 400 kV Grid Upgrade Project (**NIGU Project**) were used as a basis for some elements of the Otahuhu Diversity Project.

As an example, the initial requirement for the NIGU Project included 400 kV terminal stations (and their associated 220 kV stations) at Otahuhu and Whakamaru substations. Investigations for various 400 kV and 220 kV substation arrangements at Otahuhu commenced in 2004 so in 2006, when it was decided the reliability of the existing 220 kV Otahuhu substation had to be increased, we were able to draw on this.

Some issues associated with constructing a 400/220 kV terminal substation at Otahuhu had therefore been identified and many of these had been investigated by external consultants. These included geotechnical investigations, relocation of buildings, relocation of manholes and sewers, earthworks, etc. Investigations by external consultants considered engineering aspects and also provided preliminary cost estimates. These investigations were however specific to 400/220 kV terminal station options and not the Otahuhu Diversity Project 220 kV options.

4.1.3 Cost estimation methodology

As part of the NIGU Project, a cost estimating tool was developed to enable costing of the 400/220 kV substation options. This tool was peer reviewed by Mott MacDonald (Brighton) and Burns, Roe Worley (Australia) and updated as appropriate.[6] The cost estimating methodology was discussed with, and component costs used in the cost estimating tool were given to, the Electricity Commission.

The methodology used to prepare the 400 kV and 220 kV substation project costs for the NIGU Project was generally as follows:

[6] Transpower can provide the Commission with an internal Transpower report (Transpower Report ADG-S-039 of June 2006), should the Commission wish to understand more about this peer review.

- The substations were broken down into a number of discrete building blocks and component costs were established for each building block. Component costs included the cost of the primary plant item(s), minor procurement items and a percentage mark-up to cover the design/build contractor's design, project management and installation costs.
- For primary plant, actual procurement costs for similar/identical plant purchased by Transpower were used wherever possible. This was limited to 220 kV air insulated switchgear (AIS) equipment.
- Where recent actual costs were not available, budgetary costs for primary plant were obtained from suppliers typically used by Transpower.
- The average of the primary plant actual and/or budgetary costs was included in the component costs.

The above methodology only covered standard substation building blocks and did not cover variable costs such as civil works, relocation of buildings and underground services, deviation of transmission lines, etc. Estimated costs for such items were input separately into the cost estimating tool for inclusion in the total estimate.

4.1.4 GUP cost estimates

The methodology described above was generally used to develop the GUP estimate for the Otahuhu 220 kV Diversity Project. The GUP estimate was prepared using component costs from the cost estimating tool wherever possible. For costs not covered by the cost estimating tool, high-level cost estimates were used.

Standard building block costs were used to estimate the cost for the new 220 kV GIS, extensions to the existing 220 kV AIS, and the 220 kV cables.

- For components not listed in the cost estimating tool, estimated costs were input as separate items. Costs from previous projects were used wherever possible. Time did not however allow for these costs to be investigated and estimated in detail by external consultants.
- For the "Enabling Works" (site clearance and earthworks, relocation of Wastewater Services manhole, relocation of Contact's sewer, relocation of buildings and relocation of existing transmission lines crossing the site), estimated costs were either derived from the preliminary cost estimates prepared for the 400 kV NIGU Project or included as a provisional cost (PC) sum. Again, time did not allow the costs to be reinvestigated and re-estimated by external consultants.

4.1.5 Post-GUP approval planning

Following GUP approval, an internal project approval was prepared in the form of the Project Approval Document (**PAD**). The PAD included a more detailed cost estimate based on a Solution Study Report completed after the GUP was submitted.

This PAD budget was the budget that the Project was managed to once the Project proceeded to construction and the detailed design was prepared.

4.2 Resource management and other regulatory consents

We obtained the following consents as part of the Project:

- A permit for the diversion and discharge of stormwater, issued in accordance with sections 14 and 15 of the RMA 1991 and in accordance with the provisions of the Proposed Auckland Regional Plan: Air, Land and Water (October 2004).
- Land use consent: Sediment control associated with earthwork for enabling works (permit No. 34991). This consent was issued in accordance with Auckland Regional Plan Rule 5.4.2.1.
- Land use consent: Installation and operation of substation. This consent was issued by the Manukau City Council.

In addition, we submitted the GUP to the Electricity Commission for approval under Part F, Section III of the Electricity Governance Rules. On 31 August 2007, the Electricity Commission approved the GUP for the Project.[7]

4.3 Property and access rights obtained or being sought

We entered into a formal agreement with Contact Energy Limited (**Contact**) for access rights over their land to:

- undertake a minor relocation of 110 kV tie lines
- construct a temporary by-pass line
- upgrade/divert Transpower's existing stormwater system off Contact's land
- assist in the re-location of a Manukau City Council sewer pipe.

We entered a sale and purchase agreement with Manukau City Council to initially occupy, and following Council subdivision thereof, acquire land for the purposes of the Project. Occupation and ownership of the land allowed us the necessary rights to construct and deviate our existing transmission lines across the land, and to construct and connect a new stormwater system into the public network.

The land cost attributable to the Project was determined by obtaining a property valuation of the easement on the land that would have been required had we not become the owner.

4.4 Construction completed to date

The final asset completed as part of this Project (the cable section of the Southdown circuit) was commissioned on 20 November 2011.

The project is not fully 'closed out' as we are dealing with some handover items and may be for some time yet. None of these affect serviceability of the assets and associated costs are relatively minor as they are largely the contractor's liability.

The only material work to be completed is the removal of one span over the 110 kV bus. This overhead section is to remain as a contingency measure to cover for a potential cable failure. The removal was scheduled for the later of, either:

[7] The Major Electricity Users Group (MEUG) filed to the High Court for a judicial review in November 2007 which was rejected in March 2008. An appeal to the Court of Appeal was dismissed in December 2008.

- approximately 1 year following the successful commissioning of the Otahuhu to Southdown cable circuit
- the commissioning of the cable section from Pakuranga to Albany in the NAaN project to provide additional security to Northland and North Auckland.

The cost of this outstanding work, estimated at $0.1 million, is included in the project total cost.

4.5 Construction and labour contracts and arrangements made

4.5.1 Major contracts entered into by Transpower

There were three main contracts involved in this Project:

- the design contract with AECOM (formerly Maunsell)
- the Enabling Works Construction Contract with Transfield
- the Design/Build Construction contract with AREVA.

4.5.2 Project management processes

Following completion of the "development" phase of the Project, we prepared a Project Management Plan (**PMP**) to support the delivery phase of the Project. The PMP was written for Project participants from Transpower and the three main contractors – AECOM, Transfield and Areva. It encompassed project plans, processes and systems for planning, monitoring and managing the delivery of the Project through to operational acceptance. A copy of the PMP is attached as Appendix B.

In addition, an Enabling Works Construction Cost Management Procedure was developed to define the process by which Transpower and Transfield managed contract costs on the Enabling Works Construction Contract for the Project. This procedure included ongoing management of change through scope refinements or variations as well as payments processing and forecasting. A copy of the Enabling Works Construction Cost Management Procedure is attached as Appendix C.

4.5.3 Independent review of project management processes

We sought an independent 'Health Check Review' of the ongoing project cost management processes implemented by Transpower approximately a year after the award of the enabling works contract. This review was conducted by IQANZ. A copy of the IQANZ report accompanies this application as Appendix D.[8]

The IQANZ report states:

- "In summary, this is a large and complex project that is being well run by an experienced and capable project team." [9]
- "Robust cost control procedures for scope refinements and contract variations are in place."[10]

[8] Transpower – Otahuhu Diversity Project: Independent Quality Assurance Health Check Review, Independent Quality Assurance New Zealand (2009).

[9] IQANZ Report, at page 3.

- "The Project budget has been appropriately mapped back to the project work breakdown structure."[11]
- "We find cost control and reporting to be robustly governed and managed by the project."[12]

Accordingly, we consider that the ongoing project cost management processes implemented and followed after the commencement of the construction phase were reasonable and not a contributing factor to the Project costs exceeding the major capex allowance. That is, known project costs were efficiently managed, and scope refinements and variations to deal with inevitable unforeseen factors and other refinements and variations typical for a construction project of this scale were assessed by an independent review to be robust.

4.6 Any testing processes

We have conducted standard testing processes on the assets commissioned as part of this Project, in accordance with Transpower standards, manufacturers' specifications and good electricity industry practice.

Most of the assets that have been commissioned under this Project have been in service for more than two years and all are delivering the grid outputs that form the basis of the GUP without incident.

[10] IQANZ Report, at page 3.

[11] IQANZ Report, at page 28.

[12] IQANZ Report, at page 28.

5 Current and forecast expenditure

5.1 General

Almost all of the capital expenditure for this Project which we wish to recover has been incurred. No significant additional material expenditure for this Project is anticipated by Transpower other than an estimated $0.1 million for removing redundant assets as described in Section 4.4.

Set out below is a description of the forecast major capex (and how this was calculated), and the actual major capex we incurred, for the Project.

5.2 Forecast major capex

5.2.1 Background

A detailed explanation of both the background to the cost estimation process and the methodology we used to forecast the expenditure for the Project is set out earlier in Section 4.1.

It is our view that the scope and price contingencies made in the cost estimates used in the GUP did not reflect the true uncertainty associated with the level of design on which those estimates were based. Given where we were in the early stages of design, many of the factors that resulted in the overspend which relate to construction works on a "brownfield" site were reasonably unforeseeable. However, our cost estimate did not accurately reflect this and in hindsight, a larger contingency should have been included to reflect the level of budget uncertainty at that early stage of investigations.

It should also be noted that the type and scale of these works had not been undertaken by Transpower in its recent history so we had very little upon which to base our assessment of the risks, as borne out by the unrealistically small difference between the P50 and P90 forecast costs.

5.3 Baseline budget and cost breakdown during the planning stages of the Project

The original GUP approved by the Electricity Commission included an estimated "P90" cost for the project of $99 million. This comprised (in 2006-dollars):

- a base estimate of $75 million
- contingencies of $8 million
- exchange rate risk of $3 million
- interest during construction (IDC) of $4 million
- inflation of $10 million to bring the cost to 2009 dollars.

A high-level cost estimate was prepared as input to the GUP using the cost estimation process as described in Section 4.1.

The capital cost estimates used in the GUP were reviewed, at the Electricity Commission's request, by Parsons Brinckerhoff Associates (**PB Associates**). As part of this review, PB Associates prepared its own estimates based on information available to PB Associates at

the time. PB Associates concluded that its cost estimates were close to those submitted by Transpower and the remaining differences are well within the accuracy levels of the estimates.[13]

5.4 Further refinement of Project works and budget

Table 5-1 below shows the high-level timeline associated with the Project.

Table 5-1: Project History

Date	Project Status
12 June 2006	Equipment failure of shackles at OTA causes widespread outage in Auckland and Northland
December 2006	Transpower submits GUP application
May 2007	Interim approval of GUP
May 2007	Request for public conference
August 2007	Final approval from EC
August 2007	SSR conceptual design completed
August 2007	PAD Budget
November 2007	Judicial review of EC decision filed by MEUG
December 2007	Enabling design and construction contracts for civil site works awarded
March 2008	High court rejects judicial appeal and EC's final decision stands
October 2008	All major contracts awarded. Project 21% complete. Re-estimate for Board submission for additional funding
May 2010	96% of assets commissioned
November 2011	Fully commissioned

As can be seen in the timelines, we continued to develop the design of the Project while the GUP was being considered by the Electricity Commission.

Following Electricity Commission approval, we prepared two core project documents:

1. The Solution Study Report dated 31 August 2007 included more developed scope and some changes (e.g. different cable routes) whilst still delivering the same project outputs included in the GUP.
2. A Project Approval Document (**PAD**) was prepared for internal Transpower approval, based on the Solution Study Report.

The PAD included a more detailed cost estimate of $76.6 million (including contingency and IDC but not inflation) which was lower than the GUP P50 estimate by $9.4 million**.** Inflation was not included because it was not standard practice to adjust for inflation when reporting actual expenditure compared to budget.

[13] *Otahuhu Substation Diversity Project: Review of the Capital Cost Estimates for Transpower's Proposal of 11 December 2006*, Parsons Brinckerhoff Associates (May 2007), section 4. A copy of this report is available at http://archive.electricitycommission.govt.nz/opdev/transmis/gup/otahuhudiversity.

The PAD budget was prepared using a conceptual design as documented in the SSR and before detailed design was complete and the detailed scope of work for the Project was fully developed. This was of much greater significance for accurate cost estimating than would have been the case if the Project had been a new build at a 'green field' site where parametric estimates based upon other similar projects would have been more accurate. Furthermore, as the works were carried out on a "brownfield" site, we were confronted by unforeseen site-specific factors that were not adequately taken into consideration in the scope contingencies when preparing the estimates used in either the GUP or the PAD budget.

Due to development of the design over the period between GUP and PAD estimate preparation, there were significant differences in the level of detail between the two estimates and they were not reconciled to identify and explain variances at a detailed level.

The PAD budget was used as the baseline budget to support ongoing Project cost management rather than the less detailed budget used for the GUP approval. The PAD budget was mapped to the 'activity' based project work breakdown structure comprising 87 individual 'Work Packages'. PAD budgets are a control mechanism within Transpower, and do not reflect fully the probability of unforecast contingency expenditure.

Throughout the Project, the cost forecast was reviewed monthly, revised as required and all change amounts and reasons were recorded and reported to a project governance group.

5.5 Overview of total Project cost history

Project cost estimates at five key stages in the project development and execution phases were as per the table below.

Table 5-2: Project cost history

Date	Description/Project Status	Amount	Variance to PAD[14]
December 2006	GUP P90	$99m	-
August 2007	PAD Budget[15]	$76.6m	-[16]
December 2007	Enabling design and construction contracts awarded	$81.6m	$4.9m
October 2008	All major contracts awarded. Project 21% complete. Re-estimate for Board submission for additional funding	$100.3m	$23.7m
May 2012	Final Cost	$106.1m	$29.5m

[14] The comparison here is between actual costs and the PAD budget outlined in Table 3-1.

[15] Does not include allowance for inflation.

[16] As the PAD budget did not include an allowance for inflation, it is not meaningful to compare this PAD budget amount against the GUP P90.

As indicated in Table 5-2, we were aware of the majority of the overspend against the P90 estimate by October 2008, at which time the work was already 21% complete. At this point we could not have stopped and followed another option as the GIS contract letter of acceptance was dated 5 May 2008.

We investigated various means of remaining within the approved budget; however, other than ensuring effective cost and contract management,[17] there was little in the way of mitigation options available to significantly reduce cost from that time.

The Transpower Board was briefed on the situation at the November 2008 meeting and approved additional funding based upon the revised cost forecast.

5.6 Evaluation of budget estimates

There was effectively an independent check on the construction cost elements of the PAD budget through the competitive RFP process for establishing the Enabling Works Construction contract which was awarded to Transfield and the Design Build contract which was awarded to Areva.

5.7 Major capex incurred to the date of the application

The major capex for the Project incurred to the date of the application is $106.1 million. As noted earlier, we do not anticipate incurring additional material expenditure for this Project.

5.8 Difference between the major capex allowance and the major capex incurred

Given that the PAD budget was based on the more refined scope of works for the Project, and was the actual budget that the Project was managed to, it is a far more meaningful comparator.

Table 5-3: PAD budget vs. actual expenditure (NZ $m)

	Overspend Category/ Adjustment to PAD Estimate	PAD Budget 2006 $	Actual	Overspend relative to PAD	Adjusted PAD[18] 2009 $	Overspend relative to adjusted PAD
A	Enabling Works Civil General	3.5	11.0	7.5	3.8	7.2
B	Transmission Line Deviations	2.4	4.2	1.8	2.5	1.7
C	Enabling Works Secondary Equipment Design & Install	2.8	7.7	4.9	3.0	4.6
D	EW Transition Station & Cable Termination Design & Install	3.2	7.1	3.9	3.4	3.6
E	Enabling Works Procurement	3.4	3.9	0.5	3.7	0.2
F	Design Build GIS/AIS & EHV Cable	58.2	64.2	6.0	62.9	1.3

[17] See Section 4.5 for a discussion of the project management processes established by Transpower, and a summary of the key conclusions of an independent review of these project management processes.

[18] This column is adjusted for the CPI movement between June 2006 (the date of the 2006 PAD prices) and June 2009 (the year of greatest project expenditure).

	Overspend Category/ Adjustment to PAD Estimate	PAD Budget 2006 $	Actual	Overspend relative to PAD	Adjusted PAD[18] 2009 $	Overspend relative to adjusted PAD
G	Land Easement	0.0	1.2	1.2	0.0	1.2
H	Interest During Construction	3.2	6.9	3.7	3.5	3.5
	TOTAL	76.6	106.1	29.5	82.8	23.3

The most significant overspend occurred in the Enabling Works categories A to D in the above table which cost $29.9 million against an original budget of $11.9 million.

Categories E and F cover enabling works procurement and design/build work with budget $61.6 million and final cost $68.1 million. As explained in more detail in the following section, most of the expenditure in excess of the estimate can be attributed to escalation from budget in $2006-dollars versus actual payment largely made in $2009-dollars.

The key reasons for actual Project costs exceeding the major capex allowance are explained in detail. Supporting detail by work package, contract price schedule items, contract variations, related documentation and PAD budget are available if required.

6 Reasons for the application

6.1 Overview of factors that caused Project costs to exceed the major capex allowance

There are a number of reasons that contributed to our actual Project costs exceeding the major capex allowance. In summary, these were:

- unforeseen environmental requirements for stormwater filtration facilities
- the need to relocate existing underground utilities services which were not detailed and in some cases not identified on drawings of the site
- a significant underestimate of the cost to install four 220 kV transmission towers
- complex and challenging design and installation enabling works for secondary systems, including protection, SCADA and communications
- exchange rate fluctuations associated with the Design/Build contract for the major construction component of the Project
- the need to award a contract to complete the construction enabling works prior to completing the detailed design and associated scoping of the necessary works due to the urgency required to mitigate the single point of failure risk to Auckland
- the unexpected need to include the costs of a property easement
- an underestimate of Interest During Construction (IDC) due to an over-simplified "rule-of-thumb" calculation.

In addition, the urgency of the Project delivery timetable required the award of the enabling works construction contract prior to completion of the detailed design and associated scoping of the works. This resulted in multiple scope variations and ultimately an underestimate of the Project costs.

The enabling works for the Project required significant earthworks, transmission line deviations, and other works relating to secondary equipment, transition stations and cable terminations. These enabling works are indicated as categories A to E in Table 5-2. Project costs relating to each of these categories are discussed in more detail below.

The earthworks component of these works was constrained by the construction season, so in order to achieve our target project delivery timeframe, we had to award the enabling works construction contract in December 2007, while work on the detailed design and project scope carried on in parallel.

These contracts[19] were awarded through a competitive RFP process.

Awarding the enabling works construction contract ahead of detailed design was particularly problematic due to the site being a "brownfield site". The complexities of working around, and integrating with, existing in-service facilitates, make accurate cost estimation very difficult in the absence of detailed design.

In this section we describe each of these key factors in more detail, by cost category listed in Table 5-3.

[19] Copies of the material contracts can be provided to the Commission if necessary.

6.2 Category A - Enabling Works Civil General Overspend

($11m expenditure against budget of $3.5m)

This category covers the civil engineering and building site works required to establish the new switchyard and associated infrastructure for the GIS building and AIS equipment. It excludes:

- cable terminations and transition stations work (covered under category D)
- cable trough construction (covered in the Design/Build works under category F).

Cost history for the enabling works civil general category of Project costs is shown in the table below.

Note that the August 2007 PAD costs are in 2006 dollars whereas the bulk of costs were incurred in 2009. Table 3-1 above shows the PAD costs, for this and subsequent tables, adjusted for the CPI movement from June 2006 to June 2009.

Table 6-1: Enabling Works Civil General

Date	Description	Amount	Variance to PAD
August 2007	PAD Budget	$3.5m	-
December 2007	Main design and construction contracts for civil site works award	$4.9m	$1.4m
October 2008	Construction underway – re-estimate for Board submission for additional funding	$9.7m	$6.1m
May 2012	Final Cost	$11.0m	$7.5m

The RFP process included pricing from three contractors.

The vast bulk of the spending in excess of the original estimate was not identified at the time we awarded the Enabling Works construction contract to Transfield.

Expenditure in excess of the estimate was identified 10 months later when design and civil construction were 20% complete. As detailed below, the factors that caused the overspend in this category could not have been reasonably foreseen at the time we put together the PAD budget.

This category of Project costs can be subdivided into five subcategories as follows, with PAD budget and final cost as shown.

Table 6-2: Subcategories of Enabling Works Civil General

Description	PAD Budget	Actual	Variance[20]
Stormwater Drainage	$0.1m	$3.1m	$3.0m
Underground Services Relocation	$0.2m	$1.8m	$1.6m
Wastewater	$0.3m	$1.8m	$1.5m
Warehouse Building Relocation	$1.2m	$1.5m	$0.3m
Earthworks and General	$1.8m	$2.9m	$1.1m
Total	$3.5m	$11.0m	$7.5m

[20] Variance is the comparison between the PAD budget allowance and actual costs.

Below we explain further the key factors for the variation between estimated costs and actual costs for each of the subcategories of works.

6.2.1 Unforeseen environmental requirements for stormwater filtration facilities

($3.1 million expenditure against budget of $0.1m)

The requirement to treat stormwater runoff for contamination was not anticipated when we prepared the cost estimates for the Project. The PAD budget allocated $0.1 million for stormwater drainage works. These works cost $3.1 million.

The initial scope of work for the Project involved little change to the surface water runoff characteristics of the existing site in terms of both topography and permeability. Some paved surfaces and a GIS building roof were to be added which would have increased the peak runoff; however, most of the area to be developed (i.e. new switchyard) is covered in highly permeable isolation chip above a subgrade of in situ material.

For this reason, in the SSR it was anticipated that only minor stormwater drainage works would be required with surface drainage discharged directly into an existing retention pond adjacent to the site. The PAD budget reflected this with a single nominal lump sum cost line item.

However, substantially more works were required than anticipated to obtain and comply with the conditions of, the necessary resource consent. In particular, stormwater filtration facilities were required to treat contaminated runoff from the galvanised equipment installed in the switchyard. This included supply and installation of a large underground tank structure for storage and filtration. Substantial underground stormwater reticulation plus a new discharge point under the adjacent motorway was also required. These were required by the Auckland Regional Council (ARC) and Manukau City Council (now Auckland Council).

Transpower deals with stormwater discharge at all substation sites, but not usually at the scale encountered at Otahuhu. There are several discharge locations over the whole Otahuhu site. However, there were no existing discharge consents for this site before the Project, so there was little information about the stormwater systems and location of discharge.

The requirement to treat stormwater runoff for contamination was not anticipated based on the original scope of the works and Transpower's previous experience with stormwater discharge.

Had we identified and included specific provision for the underground stormwater infrastructure required for the GIS building, and the relocation of a warehouse and car park, this would only have increased the overall cost estimate by approximately $0.6 million. However, expenditure for this budget item was still vastly underestimated due to the unforeseen filtration system requirements. The remaining $2.4 million of overspend could not have been reasonably foreseen based upon the information available at the time.

The areas at the Otahuhu site now owned by Transpower and Contact were formerly collectively owned by ECNZ. In the ECNZ split, Transpower became the owner of

the area now housing the Otahuhu warehouse and substation. Contact became the owners of property at Otahuhu including the land where a cooling pond is located. We hold an easement across the Contact land for various services including stormwater drains. During the course of the Project, Contact advised they did not want runoff from the new development going directly into an existing cooling pond as it would breach their resource consent conditions, and if we were to discharge through their cooling pond it could put their operation at risk i.e. the amount of new impervious surfaces to be created as part of the Otahuhu diversity project would require 'controlled' runoff.

We challenged the environmental requirement for contamination treatment in October 2007 when we became aware of the stormwater issue. However, the challenge was unsuccessful and we were required to undertake these additional works to meet resource consent conditions.

We had to investigate new discharge points and we worked with Manukau City Council and New Zealand Transport Agency to assess if the new Highbrook interchange stormwater system could be used to discharge stormwater (an alternative to discharging through Contact's land). Other discharge site options were also looked at but would have required extra piping and pumps to ensure discharge as they all lead to the Tamaki River.

Further, the Otahuhu site was viewed by the Auckland Regional Council (ARC) as one with potentially high levels of heavy metal contamination likely to be discharged from the stormwater system. The council required us to undertake monitoring of the discharge in terms of contamination levels.

We considered installing a filter system as a mitigation measure; however, before making this decision we sampled the discharge from the site to ascertain the likely level of contamination. The results from the tests showed high levels of copper and zinc above the ARC guidelines. Several different treatment systems were assessed to ensure only areas requiring treatment were treated and ensure the most cost effective system was installed to meet the legal requirements of the Resource Management Act.

These works were competitively tendered under our scope refinement process.

6.2.2 Relocation of underground utilities services

($1.8m expenditure against budget of $0.2m)

During construction, several underground utilities services were found that had not been identified in the SSR. As a result, the Project incurred significant cost to investigate and deal with this issue.

The approved scope of work for the Project included installing over 2 km of 220 kV underground cable troughs around the site, plus other underground services. The Otahuhu substation is large and old with many underground services and a number of owners. Design and installation was necessary to accommodate or relocate existing services. These included Vector-owned power cables, water mains, telecommunications fibre, stormwater pipes and oil interceptor pipes.

Following the submission of the GUP, the process of developing the SSR identified the presence of some of these underground services. However, not all underground services were identified, and in many instances for those that were, exact locations and depths could not be ascertained in advance. Determination of the precise location of all services was not within the scope of the SSR and, as it transpired, not possible as underground services were discovered that were unknown even to their owners.

It was assumed that most existing services could be built around and the PAD budget included a lump sum provision for services relocation (mainly for water supplies) of $0.2 million.

With subsequent detailed design and identification of exact location of existing services, substantial relocation of several services was required to accommodate the new cable troughs. This included relocation of Vector-owned power cables at 11 locations. This was carried out by Vector at a cost to the Project of $0.7 million.

Based on the information available at the time of the GUP and PAD budgets, the costs associated with underground services relocation were not reasonably foreseeable.

The PAD budget assumed that most services would not require relocation was incorrect. However, quantifying and accurately estimating this work would have required both site investigations to establish the exact location of services and detailed design work.

All works were competitively tendered, and those that fell under the enabling works contract were subject to a scope refinement process as set out in the Enabling Works Cost Management Procedure document attached as Appendix C.

6.2.3 Waste water

($1.8m expenditure on budget of $0.3m)

An 800mm diameter sewer main runs 12m underneath the site of works. It had a manhole located inside the new switchyard. This was unacceptable to us and the owner of the sewer, Watercare. There was also a sewer from the adjacent Contact Energy Otahuhu Power Station into this manhole which required relocation to another manhole.

The SSR identified the need to remove this manhole and replace it with 2 new ones outside the switchyard which were required to maintain required distances between manholes. This was budgeted at $0.3 million.

All aspects of this work were technically challenging, time consuming and expensive. A specialist subcontractor for this type of work (Brian Perry Ltd) carried out the required works and we consider they performed well in difficult circumstances.

The original contract price for the work was $0.5 million. The contract was subject to several substantial contract variation claims which we challenged. The final cost we paid was finally resolved by engaging an independent expert, Clive Tilby, to review and recommend a fair settlement. His recommendation was accepted by both

parties and his advice was that it was a reasonable cost for the actual work required.[21]

The cost of this type of work is inherently difficult to estimate. While the PAD figure was $0.2 million lower than the original contract price, it was of the same order. This suggests that the cost incurred due to the "unknowns" could not have been reasonably foreseeable prior to undertaking the work.

6.2.4 Warehouse Building Relocation

($1.5 m expenditure on budget of $1.2m)

The new substation switchyard site had one existing building (the 'K Shed'). This was part of a warehouse facility including other buildings and outdoor storage space adjacent to the site. The original project scope included removing the K Shed from the switchyard site and building replacement covered storage.

The SSR investigated four options for K Shed removal and replacement with cost estimates ranging up to $2.6 million.

The PAD budget of $1.2 million was based upon removing the K Shed and replacing it with a 15 metre lean-to structure on an existing building, but there was little specific design information available at the PAD budget stage.

Installing an addition to an existing building is inherently more difficult to accurately estimate than constructing a new stand-alone facility and as little design information was available for the PAD budget, the total expenditure of $1.5 million for this item is considered to be reasonable.

6.2.5 Earthworks and General

($2.9m expenditure on a budget of $1.8m)

The earthworks scope included work to establish the platform for a new AIS switchyard and GIS building including parking and access. Existing land was largely an undeveloped grass paddock.

The PAD budget estimate comprised three high-level line items for topsoil stripping, bulk earthworks and roading with assessed quantities and rates. This assumed cut to fill balance with no cut to waste or imported material being required. The original construction contract price was consistent with this.

However as detailed design was developed and work proceeded on site there were many changes and issues resulting in 89 contract scope refinements and variations that substantially increased the total cost. This included requirements for a retaining wall, concrete nib wall, additional fencing, additional earthworks and imported clean fill material, disposal of contaminated soil and substantially more car park and roading work than initially assumed. Based upon the information available at the

[21] A copy of Mr Tilby's recommendation can be provided to the Commission if required.

time most of these were not reasonably foreseeable when the PAD estimate was prepared.

Completion of detailed design and more detailed site investigations as input to the PAD estimate would have increased the accuracy of the cost estimate for this item.

6.2.6 Conclusion

The overspend for general civil enabling works was the result of a number of factors.

The principal contributing factors were the environmental requirements for stormwater filtration, and the need to relocate a large number of underground services, neither of which could have been reasonably foreseen at the time the GUP estimate or the more detailed PAD estimate.

The remainder of the general civil enabling works overspend resulted from scope changes in the waste water, general earthworks and warehouse building relocation aspects. While the scope of the actual works differed from that which was allowed for in the GUP and the PAD, the actual costs incurred were in all cases reasonable and the works were performed in the most cost effective manner possible using cost and scope control procedures that were assessed by an independent review to be robust.

We consider all Project costs in this category are reasonable and have been efficiently incurred and an amendment to the MCA to allow full recovery is therefore justified.

6.3 Category B - Transmission line deviations

($4.2m expenditure against budget of $2.4m)

This element of the Project covers the design, installation and project management of the deviation of existing 110 kV and 220 kV transmission lines around the new switchyard location to allow construction to proceed on the GIS building and AIS installation. It does not include procurement of transmission line towers, conductor and fittings which is discussed in 'Category E - Enabling Works Procurement' below.

The PAD budget of $2.4 million for this category was exceeded by $1.8 million to reach a final cost $4.2 million (a 79% increase).

Table 6-3: Transmission Line Deviations

Date	Description	Amount	Variance
August 2007	PAD Budget	$2.4m	-
December 2007	Enabling design and construction contracts for civil site works awarded	$3.4m	$1.1m
October 2008	Design contracts awarded – re-estimate for Board submission for additional funding	$4.0m	$1.7m
May 2012	Final Cost	$4.2m	$1.8m

6.3.1 Underestimation of 220 kV tower installation cost

($2.4m expenditure against budget of $0.1m)

The expenditure in excess of the estimate is entirely due to an underestimate of the cost to install four 220 kV towers. The PAD budget provision for this category was only $0.1 million and the actual cost we incurred was $2.4 million. The total final cost of other items in this category was less than the PAD budget amount.

The 220 kV tower installation cost was dominated by foundation works, being 87% of the cost. The high cost of tower foundation works was due to weak in situ materials at all four sites. This necessitated deep piled foundations rather than simpler and cheaper shallow pads. The piled foundations as designed and constructed included 20 metre deep bored cast in situ reinforced concrete piles with permanent casings.

The PAD budget for these works was based upon another project, which did not contemplate such deep bored pile foundations.

Foundation requirements were known at the time of SSR preparation or shortly thereafter as they were included in the original installation contract scope and price.

This information was therefore reasonably foreseeable at the time the PAD budget was prepared and a more accurate estimate of this work should have been included in the PAD budget.

In summary, the actual cost and complexity of deviating transmission lines around the new switchyard location was substantially greater than originally anticipated, as seen with the cost of tower foundations. We consider that the costs were reasonable and efficiently incurred given the competitive tendering of the works and the use of cost and scope control procedures that were independently reviewed as being robust.

The other items of actual expenditure for this category of costs came in under the PAD budget (as indicated in Table 3-1).

We consider all Project costs in this category are reasonable and have been efficiently incurred and an amendment to the MCA to allow full recovery is therefore justified.

6.4 Category C - Enabling works secondary systems design and install

($7.7m expenditure against budget of $2.8m)

This category includes the design, installation and project management of enabling works secondary systems including protection, SCADA and communications. It does not include equipment procurement (covered in category E).

Most of this expenditure was for the design and installation of electrical protection systems. The SSR included only a high-level outline of the protection scope with three line items in the PAD estimate.

The enabling works protection design and installation effort was complex and challenging largely due to integration with, and modifications required to, the existing system as well as providing for interfaces to the GIS protection included in the Design Build contract. Its full scope and complexity was not appreciated at SSR

stage, nor when the construction contract was awarded, or even when the detailed design contracts were established in 2008. It only became progressively apparent as the work proceeded, and therefore could not have been reasonably foreseen at estimate stage.

As shown in the estimate history in Table 6-4 below, the forecast cost only increased moderately upon construction contract award. This included contractor installation cost estimates superseding PAD estimate based upon the competitive RFP process. This demonstrates that while the PAD estimate ultimately proved to be inadequate, independent contractors with the same limited information (or design information) estimated the cost at a similar level.

Once the protection design contracts had been established in 2008 there was a better understanding of scope reflected by the $2.2 million increase in cost forecast from December 2007 to October 2008.

However, the final cost was an additional $2.3 million above the October 2008 estimate.

Table 6-4: Enabling works secondary systems – design and build

Date	Description	Amount	Variance
August 2007	PAD Budget	$2.8m	-
December 2007	Construction contract awarded	$3.2m	$0.4m
October 2008	Design contracts awarded – re-estimate for Board submission for additional funding	$5.4m	$2.6m
May 2012	Final Cost	$7.7m	$4.9m

The enabling works secondary systems involved in the Project underwent many changes over the life of the Project, as illustrated by a large number of variations and scope refinements to the design and construction contracts. The design contracts included 79 secondary system variations and the construction contract included 102 secondary system scope refinements or variations.

When establishing contract packages for the work in late 2007, we considered awarding a separate secondary systems contract after an initial contract comprising civil site works, transmission line deviations, AIS equipment works and transition stations.

This would have allowed time to develop a detailed protection design and award an installation contract based upon competitive fixed price tenders. However, this approach would not necessarily have reduced costs since the risk of the unknown would have been factored into the contract price. It would also have added a significant degree of complexity by creating additional work interfaces between contractors.

In summary, the enabling works and secondary systems design and install was not adequately provided for in the PAD budget, largely due to the complexity of integrating these works with the existing systems that were already in place. Nevertheless the robust project management processes and use of competitive tendering ensured that design and install of these secondary systems was achieved in the most cost effective manner possible.

We consider all Project costs in this category are reasonable and have been efficiently incurred and an amendment to the MCA to allow full recovery is therefore justified.

6.5 Category D - Enabling works transition station and cable termination

($7.1m expenditure against budget of $3.2m)

This expenditure category includes enabling works line termination and AIS switchyard primary equipment works. It excludes related protection work, procurement of associated primary equipment and the 220 kV cabling work.

The PAD budget of $3.2 million for this category was exceeded by $3.9 million giving a final cost of $7.1 million. Estimate history is shown below in Table 6-5:

Table 6-5: Enabling works station and cable termination

Date	Description	Amount	Variance
August 2007	PAD Budget	$3.2m	-
December 2007	Construction contract awarded	$3.8m	$0.6m
October 2008	Construction commenced – re-estimate for Board submission for additional funding	$4.4m	$1.2m
May 2012	Final Cost	$7.1m	$3.9m

This category of Project costs is subdivided into three subcategories as shown in Table 6-6:

Table 6-6: Subcategories of the enabling works station and cable termination

Description	PAD Budget	Actual	Variance
Cable Terminations	$1.2m	$2.1m	$0.9m
Transition Stations	$1.6m	$3.9m	$2.3m
AIS Switchyard Works	$0.3m	$1.0m	$0.7m
Total	$3.2m	$7.1m	$3.9m

6.5.1 Cable Terminations

($2.1m expenditure against budget of $1.2m)

There are four cable terminations located in the existing AIS switchyard. They comprise the electrical and structural transition between 220 kV cables and the AIS bus.

Each cable termination comprises standard AIS equipment including circuit breakers, current transformers, voltage transformers, disconnectors, surge arrestors plus a gantry structure and foundations and support posts for the equipment items.

We have sound historical knowledge of installation costs for such equipment. The awarded contract price for cable termination installation did not vary significantly from the PAD estimate providing support that the PAD estimate was reasonable for this work.

However, following contract award there were 61 construction contract scope refinements and variations primarily due to the constraints and requirements of constructing the cable terminations within the existing switchyard. These contributed to an increase of $0.9 million or 75% over the PAD budget. This included $0.2 million to relocate equipment to accommodate the Southdown cable termination in order to maintain acceptable vehicle access through the switchyard. This issue was not identified until detailed design was carried out and could not have been reasonably foreseen at the time of PAD estimate preparation.

6.5.2 Transition Stations

($3.9m expenditure against budget of $1.6m)

There were five new transition stations located outside the existing and new AIS switchyards comprising the transition from overhead 220 kV transmission lines to underground cables for connecting to the new GIS.

Each transition station includes a gantry to terminate the overhead lines, electrical connections from lines to the cables, surge arrestors, earthing, platform with crushed rock surface and fencing.

The PAD estimate was developed to a relatively detailed level of breakdown for the transition stations with each transition station separately identified and included 15 price schedule items. The total PAD estimate was $1.6 million. The original contract price based upon similar information was, however, significantly higher at $2.1 million – an increase of $0.5 million. There were further increases of $1.8 million during construction to the final cost of $3.9 million.

The $0.5 million variance from PAD estimate to original contract price was due to two transition stations (Henderson and Southdown). The other three had very similar PAD estimates and contract prices.

The primary reason for the Henderson variance was that the PAD estimate did not include a second emergency gantry required at this transition station. This was identified in the SSR and should have been included in the PAD estimate.

The main reason for the Southdown variance is that significant tower modifications and transmission line works were required for this transition station. This was not specifically included in the PAD estimate – but should have been.

The post contract award cost increases for transition stations of $1.8m included 73 variations to the construction contract for a variety of reasons but with a common underlying cause that many of them lacked a detailed design when the contract was awarded. For example, the SSR did not identify a need for transition station lighting but it was determined that this was required at the detailed design stage.

6.5.3 AIS Switchyard Works

($1.0m expenditure against budget of $0.3m)

The project required some additions and modifications to the existing switchyard in addition to the installation of cable terminations as described above.

The SSR identified as the major item for this work the installation of two new bus section circuit breakers (CB478 and CB488). In addition, the works included relocation of a circuit to a different circuit breaker, which was a relatively minor item.

The PAD budget estimate for the bus section CB work was $0.3 million comprising six line items for standard equipment such as circuit breakers, disconnectors, current transformers and foundations. The contract award price for these items was very similar. There were, however, 12 contract variations with additional cost primarily attributable to changes required to integrate with existing switchyard infrastructure. The final cost was $0.5 million – an increase of $0.2 million.

The circuit relocation was not specifically identified in the PAD estimate but the original contract price for this work was only $0.04 million based upon re-termination and removal of redundant primary equipment. The actual scope of work was varied to include removal of redundant structures and foundations at an additional cost of $0.1 million.

An underrated existing disconnector (DS847) in Contact Energy's switchyard also needed to be replaced. This was not expected and not identified until late in the project. The associated cost was $0.1 million.

The $0.3 million balance of expenditure in excess of the estimate on this item was generally a consequence of integrating the new project assets into the existing switchyard. Again, these costs were not reasonably foreseeable at the time the SSR was prepared, given the high-level nature of these estimates.

In summary, the PAD budget did not fully account for the cost of constructing cable terminations within the existing switchyard, and the works associated with the five new transition stations and the works associated with the AIS Switchyard. Nevertheless the use of competitive tender processes and robust cost and scope control procedures ensured that the actual costs associated with these works were reasonable and efficiently incurred.

We consider all Project costs in this category are reasonable and have been efficiently incurred and an amendment to the MCA to allow full recovery is therefore justified.

6.6 Category E – Enabling Works Procurement

($3.9m expenditure against budget of $3.4m)

This category of Project costs covers the procured equipment supplied for enabling works construction. This included transmission line towers, transmission line fittings, primary equipment such as circuit breakers, disconnectors, CTs and VTs and secondary equipment including protection and communications equipment.

This category had a relatively modest increase from the PAD budget of $3.4 million to final cost $3.9 million, being $0.5 million in excess of budgeted amount or a 15% variation.

Protection equipment procurement accounted for most ($0.4 million) of this increase from a PAD estimate of $0.6 million to a final cost of $1.0 million. As discussed

above in relation to cost category C, the SSR and PAD estimate only included a high-level outline of protection scope and protection procurement requirements were under estimated as was design and installation. There were 136 protection relay equipment items procured for the project – this was not envisaged when the SSR was prepared.

Other than protection equipment, the overall cost of procurement items was close to the PAD budget (i.e. within 3%) and taking account of escalation from base 2006-dollars to when most of the equipment was procured in 2009 it was within budget.

In summary, there was only a relatively modest increase from the PAD budget for enabling works procurement costs, and all these costs were reasonable and efficiently incurred, by virtue of competitive tendering and cost control processes.

We consider all Project costs in this category are reasonable and have been efficiently incurred and an amendment to the MCA to allow full recovery is therefore justified.

6.7 Category F –Design/Build Contract for GIS/AIS and EHV Cable

($64.2m expenditure against budget of $58.2m)

This was the single largest component of the total Project works (being the Design/Build contract for the construction of the new GIS/AIS substation and 220 kV cabling). The actual cost was higher than budgeted owing to exchange rate fluctuations from the time of the award of the contract and inflation. Contract variations all came within the PAD budget.

The cost history for this component is shown in Table 6-7 below:

Table 6-7: Cost history for Design/Build contract for GIS/AIS substation and 220 kV cabling

Date	Description	Amount	Variance
August 2007	PAD Budget	$58.2m	-
October 2008	Re-estimate for Board submission for additional funding	$62.1m	$3.9m
May 2012	Final Cost	$64.2m	$6.0m

Unlike the enabling works components of the Project (items A, C, D and E in Table 3-1), this package of work was carried out on the basis of a fixed price design/build contract awarded following a competitive tender.[22]

The PAD budget estimate for this category of expenditure, based on June 2006 prices, was $58.2 million and we incurred a final cost of $64.2 million. Of this, $1.6 million is attributable to exchange rate fluctuations after the award of the design/build contract – particularly the strong Euro in 2009.

[22] A Tender Evaluation Report for this tender process can be provided to the Commission if considered necessary for its consideration of this application.

The remaining variance of $4.4 million is due to inflation between the PAD price date and when the expenditure occurred, the bulk of which occurred in 2009.

While the GIS/AIS design/build Contract (DB1) was a 'Fixed Price' contract, the contractor was very aggressive with variation claims. This demanded considerable effort by the Transpower Engineer to Contract (ETC) to negotiate claims to minimise project cost while being fair to the contractor and maintaining reasonable working relationships.

Transpower successfully negotiated 63 contract claims with the contractor over the duration of the contract. At the completion of the works there were five claims that were unresolved totalling $4.75 million.

After significant effort on our part, the five claims were finally settled on 25 March 2011. Four were rejected and the fifth was settled for $0.113 million. We consider this to be a very good outcome in terms of the original $4.75 million claim value and it demonstrates our prudent contract cost management practice on this project.

Overall the total value of contract variations was $3.4 million or 6% of original contract price. There were many issues and challenges with this contract and in that context we consider this level of total variations to be very reasonable, while also demonstrating good contract cost management.

Overall our view is that:

- competitive tendering of this work along with a low level of subsequent contract variations means the work was completed for a fair market price;
- there were many contract issues and claims and the total number of contract variations is low for a Design/Build contract of this nature, and overall very reasonable in that context. This indicates well defined original scope with little or no 'scope creep' and good contract cost management;
- the costs incurred for this category of works were reasonable and efficiently managed. As noted earlier, we developed a Project Management Plan that included robust processes for managing project costs and scope refinements and variations.

We consider all Project costs in this category are reasonable and have been efficiently incurred and an amendment to the MCA to allow full recovery is therefore justified.

6.8 Category G – Land easement

($1.2m expenditure against $0m budget)

The Project proposal indicated that the proposed GIS switchyard did not require the purchase of additional property. However, realigning one of the lines into the substation required two new towers to be placed on adjacent land owned by the Manukau City Council which would have required an easement over a portion of it. In addition, the project required some space for temporary staging purposes.

During discussions, the Council offered to sell the entire block to us at a cost of $6.02 million plus GST. We accepted the offer with the view that this provided the most

effective way for us to obtain the access and easements required, with the option of reselling if not further required. If the Council sold the block to another party, the Project would have incurred significant time delay while the required access and easements were negotiated for work to proceed.

The intention at the time was to on-sell the land as it was not part of the approved Project and its costs could not be recovered because the Electricity Commission did not allow any temporary use of land to be included in the project costs.

We are now considering keeping the land for future developments at Otahuhu and have applied for approval for the purchase.[23] However, given that part of the purchase cost is attributable to the Project, we have agreed with the Commerce Commission that the value of the easement should be included in the Project costs. We have obtained a retrospective valuation of the easement as at December 2007 when the property was bought, which came to $1.2 million.

We consider all Project costs in this category are reasonable and have been efficiently incurred and an amendment to the MCA to allow full recovery is therefore justified.

6.9 Category H - Interest During Construction

($6.9m expenditure against $3.2m budget)

Interest During Construction (IDC) was underestimated in the PAD because of an over-simplified approach to the calculation.

The PAD budget IDC estimate of $3.2 million was calculated simply as 4.8% of the base estimate. This was an overly-simplified way to calculate IDC as it did not take account of the phasing of expenditure until capitalisation or that the duration of the project extended to more than 1 year. The rate is also lower than our actual IDC rate (intended to reflect that expenditure does not all occur at the start of the year).

The December 2007 IDC cost forecast was $1.7 million higher than PAD budget at $4.9 million based upon the monthly expenditure forecast, the IDC rate at the time (7.5% per annum) and the expected capitalisation date of March 2010.

The final IDC cost was $6.9 million. The increase of $2.0 million over the December 2007 forecast was primarily due to increased overall Project costs with secondary reasons being an increased IDC rate later in the project (e.g. 7.65% in December 2009) and later capitalisation date of May 2010 for most of the Project assets.

The original PAD budget estimate of IDC did not take account of expenditure phasing and whilst being a simple and reasonable approximate estimate for shorter duration projects, it caused a significant under estimate of IDC by $3.7 million on this Project.

The need for an appropriate allowance for IDC is a foreseeable cost component of a major capex project. In this case, in hindsight a more appropriate IDC rate and project phasing should have been used in the PAD calculation.

[23] Grid Upgrade Plan 2009, Instalment 7, Part X: Recovery of Otahuhu Land Purchase Cost

The impact of IDC on overall project costs is an inevitable consequence of the nature of the Project – that is, higher than anticipated base costs for a multi-year project, with costs unevenly spread over the duration of the Project.

We consider all Project costs in this category are reasonable and have been efficiently incurred and an amendment to the MCA to allow full recovery is therefore justified.

7 Information about the effect of the amendment application

7.1 Description of the implications of the proposed amendment will have on the Otahuhu project outputs

The proposed amendment has no implication for the project outputs. The approved outputs are still appropriate because they deliver the diversity of supply required.

7.2 Net electricity market benefit

The expected net market benefit (ENMB) of the Project estimated in the GIT was negative $54.3 million. A recalculation of this with actual costs and the effect of the later timing of the Project compared to the GIT comes to negative $61.8 million which would rank it second behind extending the existing switchyard (the reference case) but within 2% of it. Table 7-1 shows a revised ranking of the GIT options with actual costs for the Project (GIS).

Table 7-1: Ranking of GUP Alternatives (NPV)

	Extend Existing Switchyard	**2nd AIS Switchyard**	**GIS Switchyard**
	2006 dollars (million)		
Capital Cost	75.8	85.2	82.5
Consenting & noise abatement	0.0	0.5	0.0
Operations & Maintenance	1.9	2.8	2.1
Total cost	77.7	88.5	84.6
Saved Expected Unserved Energy	10.3	19.8	16.5
Terminal value	2.9	1.7	2.1
Terminal benefit	4.0	4.0	4.1
Total benefit	17.2	25.6	22.8
Expected Net Market Benefit	(60.5)	(62.9)	(61.8)

For purposes of comparison, we have assumed that commensurate cost increases and delays would also have occurred with the AIS option but that they would not have occurred for the reference case: extending the existing switchyard.[24] While the reference case option comes ahead of the Project when using actual costs, it should be noted that some benefits attributable to the GIS option were not specifically included in the GIT analysis although the GUP made reference to them, namely:

- Property costs. For the reference case and AIS option, the cost of new land required to replace the existing switchyard in the future was estimated at $7.7 million (ref section 8.5 of the GUP).

[24] The $1.2 million easement cost would have been required for all options.

- Immunity to site-wide, high impact, low probability events, for example severe weather that affects all AIS switchgear and bus work. The annualised NPV of this was estimated at $1 million (ref section 8.3 of the GUP).

Taking these benefits into account the GIS option would still be the highest ranking option, by $7.5 million, using actual costs.

7.3 No change to the assets to be commissioned

Approval by the Commission of the proposed amendment to the major capex allowance will not result in a change in the assets to be commissioned by Transpower for this Project.

7.4 No change to the functional capability of the grid

Approval by the Commission of the proposed amendment to the major capex allowance will not result in a change in the functional capability of the grid.

7.5 No change to any relevant service provided by a third party (for non-transmission services)

Approval by the Commission of the proposed amendment to the major capex allowance will not result in a change in any services provided by a third party (for non-transmission services).

7.6 No implications for other approved major capex projects

We do not consider the proposed amendment will have any implications for other major capex projects.

The cost estimation process has undergone continuing development since this project was costed. In particular, more consideration now tends to be given to the risk profile around project item scope.

8 Evaluation of the application

8.1 Application is consistent with the Capex IM

We believe that this application is itself consistent with the Capex IM. In particular:

- This application has been submitted to the Commission in accordance with clause 3.3.4(1) of the Capex IM.
- We have complied with clause 7.4.2 of the Capex IM. Specifically:

  (a) This application has been sent to the Commission before the last working day of the September after the disclosure year in which the Project was first commissioned (being before the last working day of September 2012);
  (b) The application contains the information specified in Schedule H Division 1 of the Capex IM.

8.2 The proposed amendment promotes the long-term interests of consumers and more generally the purpose of Part 4 of the Commerce Act 1986

We consider that this application for an increase in the maximum capex allowance for the Otahuhu Substation Diversity Project promotes the purpose of Part 4 of the Commerce Act, being to promote the long-term benefit of consumers in markets where there is little or no competition and little or no likelihood of a substantial increase in competition, by promoting outcomes that are consistent with outcomes produced in competitive markets.

We note that:

- The Commission considers this central purpose is to be achieved by promoting outcomes consistent with those produced in workably competitive markets, such that the regulatory objectives set out in paragraphs (a) to (d) of section 52A(1) of the Commerce Act are achieved.[25]
- The individual price-quality path (of which the Capex IM provision for ex-post amendment to the maximum capex allowance for major capex project forms part) promotes the long-benefit of consumers by providing incentives to invest, by allowing us to fully recover and earn a return an appropriate return on its investments, consistent with section 52A(1) of the Commerce Act.[26]
- The Capex IM regime implicitly recognises that accurately estimating the costs for Transpower's major capex projects is a difficult exercise, and therefore the Capex IM provides for both an ex-ante assessment of estimated costs, and an ex-post assessment of actual costs.
- The objective of the individual price-quality path to promote the long-benefit of consumers by providing incentives to invest, is therefore best achieved by allowing Transpower to be confident in its ability to recover reasonable and

[25] Commerce Commission, Individual Price Quality-Path (Transpower) Reasons Paper, 22 December 2010, paragraph 1.2.23.

[26] Commerce Commission, Individual Price Quality-Path (Transpower) Reasons Paper, 22 December 2010, paragraph 1.2.24.

efficient actual costs incurred in our major capex projects, as determined on the basis of an ex-post assessment of actual costs.

In the case of the Otahuhu Diversity Substation Project, once the Project commenced and more detailed budgets were established based on a more developed scope of works, we have managed the Project implementation efficiently and have sought to minimise Project costs through competitive tendering of the key components of the Project and other project cost management initiatives.

We have responded to the emergence of unforeseen factors in a prudent and efficient manner, actively minimising associated costs while working towards completing this important project and delivering the approved major capex project outputs.

In summary, we are of the view that the long-term benefits of consumers are promoted by allowing us to fully recover and earn a return on our investment in the Otahuhu Diversity Substation Project, as this incentivises us to prudently invest in necessary upgrades of the grid, by allowing us to fully recover our investments, where those investments have been undertaken efficiently.

8.3 Data, analysis, and assumptions are fit for purpose

We also consider that the data, analysis, and assumptions underpinning the proposal are fit for the purpose of the Commission exercising its powers under Part 4 of the Commerce Act, including consideration as to the accuracy and reliability of data and the reasonableness of the assumptions and other matters of judgement.

Office of Hon David Parker
Minister of Energy
Minister Responsible for Climate Change
Minister for Land Information

13 June 2006

Mr David Gascoigne
Chair Transpower Ltd
PO Box 1021
Wellington

Dear David

I am writing following the major power outage in Auckland yesterday, 12 June.

As you are aware, the consequences of the outage were severe, and are not acceptable in a major urban centre such as Auckland.

I understand that you will be undertaking an internal review of the events of yesterday.

In addition, I am asking that you provide an urgent report to me, by 23 June, addressing the following matters:

1. The reasons for the failure of the earth-wire that appears to have been the trigger for the subsequent problems.

   Was the cause a weather event beyond the range that such wires are designed to withstand? If so, is the design standard appropriate? If not, what was the cause of the wire snapping?

2. The reasons why the failure of the earth-wire had such severe and widespread consequences for power supply into Auckland.

   My understanding is that the system should be robust to a single event such as an earth-wire snapping.

   If part of the answer is that the system is unacceptably vulnerable to failure at a single substation – Otahuhu – please provide at least initial thoughts on what might be done to reduce this risk in both the short-term [e.g. via changes to operational and maintenance practices] and in the medium-term [e.g. via additional investment].

Following receipt of your report, I will seek independent advice on your conclusions and any proposed further actions.

I am particularly concerned to ensure that any learnings from the events of yesterday are rapidly applied so that ongoing risks to security of supply are minimised.

Yours sincerely

David Parker

cc:
Minister of Finance
Minister of State-Owned Enterprises
Electricity Commissioner

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David Gascoigne
Tel. 04 495 7000

22 June 2006

David Parker
Minister of Energy
Parliament
Parliament Buildings
Wellington

Dear Minister

As requested in your letter of 13 June, I am writing to report on our review of the power outage in Auckland on 12 June and to address points raised in your letter.

I will summarise the findings of our independent reports on the outage in this letter, and attach both the Sinclair Knight Merz (SKM) and PriceWaterhouseCoopers (PWC) independent reports for your information. As you will be aware the SKM report is an incident review and the PWC report is a review of our operational response to the incident.

We undertook to provide two reports because there are two parts to the story in respect of the events on the day; one report concerns the equipment failure causing the outage and the steps taken to repair our equipment (the SKM report) and the other report concerns the operation of our power supply to the Auckland region and how that was managed (the PWC report).

Our responses to both reports are attached, including our recommendations to reduce the vulnerability at the Otahuhu substation in the short term.

Also included is an outline of our proposed changes to planned upgrades in the medium term. These proposals, which we discussed briefly with you during our meeting on 21 June, are specific to the Auckland area and are additional to our 400kV proposal - as you will be aware that proposal is now being revised for re-presentation to the Electricity Commission.

There are key points I wish to make about the events of 12 June as well as about the future security and reliability of supply to Auckland.

The outage of 12 June was a rare and catastrophic event; but underlines the importance of having a robust, flexible National Grid to provide for the long term security of electricity supply, not only to Auckland but to all of New Zealand.

Transpower is proceeding quickly to undertake actions identified in reports on the outage, and these remedial actions will contribute to greater security of operations. Transpower managed this serious situation effectively, and with no loss of life, particularly within the challenging environment on the day.

However, the Otahuhu Substation is an old facility, with old technology. And it is the sole link leading to Auckland. There is much that needs to be done regarding this issue, and we need to proceed with urgency.

Transpower wishes to work consultatively with government and with regulators to achieve acceptable outcomes for plans to upgrade the national grid. As an integral part of that, it is Transpower's objective to provide greater reliability in the short term to Auckland and the surrounding area.

We look forward to working in partnership with all parties to resolve any issues in respect of these plans.

Yours sincerely

David Gascoigne

David Gascoigne
Chairman

1. Background

Set out below is an abbreviated timeframe of the events on 12 June, including an overview of conditions at the time. On the 12th of June severe weather conditions were experienced throughout the country and in the South Island in particular. These conditions were causing considerable additional management issues in both our National Co-ordination Centres (NCCs) and Regional Operational Centres (ROCs). While these issues had no direct bearing on the outage at Otahuhu, as they concern the supply of electricity throughout the grid and not the grid infrastructure itself, they added complexity to an already challenging operational environment.

2. Timeline

3 am	In the early hours of 12 June it became evident that heavy snow loads were causing an increase in line tripping in the South Island and that it would be a busy day to ensure adequate load control. Additionally, by early morning a Maui Gas contingency was declared, which essentially means that the adequacy of supply for generation was a key concern.
8:32 am	Major tripping at Otahuhu substation causes 1000 MW of supply lost and power outages in Auckland.
8:33 am	Transpower contractors dispatched to the site. Crews confirm two earthwires had broken, dropping onto three 110kV buses and one 220kV line below them. This resulted in the fault which contributed to disruption to the major portion of electricity supply to Auckland. Within 30 minutes lines maintenance contractors arrive to begin planning and recovery actions to remove fallen earthwires. Weather conditions were extreme and appropriate methods and timeframes were required to ensure that work could be carried out safely. Going up the tower to retrieve broken earthwire was difficult in high winds. The power supply continues to be maintained to West Auckland, North Shore and Northland, and also Takanini Wire and Otahuhu.
10:44 am to 1:40pm	Transpower reconfigures network to begin re-supply, which was progressively restored by Vector throughout the afternoon.

3. The SKM Incident Report

The SKM report finds that high winds triggered the failure of connection equipment at Otahuhu Substation that led to the failure of two earth wires and loss of load – this occurred because of poor condition of the connection equipment (shackles). Transpower's maintenance schedule and records have been checked and found to be adequate, but the report states that Transpower's maintenance contractors should have identified the poor condition of the shackles and replaced them. We note that in the contractors' assessment of the equipment, carried out in 2003, that these shackles did not show signs of corrosion sufficient to warrant replacement.

4. Actions

The purpose of the report and investigation of the incident is to apply learnings from the events of 12 June. Accordingly, actions we are completing in the short term include:

(completed)

- Inspection of all earthwire terminations at Otahuhu substation
- Inspection and replacement of all earthwire terminations on the Henderson Otahuhu 220kV transmission line
- Inspection of similar plant at Penrose substation
-

(scheduled)

- All other Auckland substation earthwire attachments re-inspected, starting 26 June.
- All other New Zealand substation termination re-inspections starting 26 June
- All New Zealand sites re-inspected by the end of July 2006.

Transpower will review the maintenance schedule for aging equipment to determine if the maintenance regime is appropriate. This may require a move from a condition based assessment to a time based assessment for particular older equipment.

5. The PWC Operation Response Report

Transpower commissioned PWC to provide an independent assessment of the operational performance of Transpower in managing events leading up to, during and following the Auckland incident of 12 June.

This report enables Transpower to review our decision making processes and response performance and, in particular, our ability to manage these types of emergencies and continue to operate the power supply to the rest of New Zealand while ensuring minimal delays to the restoration of service to Auckland.

The key findings of the PWC report conclude that Transpower operational staff performed well throughout the unfolding situation on the day, particularly given extreme weather conditions in the South Island that resulted in a significant increase in operational activity.

Management and staff were able to overcome problems and continue to operate the Wholesale Electricity Market. Some of the delays in restoring power in Auckland were outside Transpower's control and also likely to be weather related.

However, there are learnings for Transpower, in the management of internal systems. Transpower will be taking further action to assess and apply the recommendations in the PWC report.

6. Security of Auckland Supply –Transpower Proposals

As you will be aware, Transpower's current upgrade proposals will improve reliability of supply to Auckland and Northland regions.

The 400kV project from Whakamaru to Auckland provides significant strengthening of supply into the Auckland region. This proposal has been rejected by the Electricity Commission and Transpower has indicated that we are now in the process of revising the proposal to operate initially at 220kV, migrating to 400kV over time.

Our concern with the amended staged proposal is the timeframe. We believe reliability of supply will be affected if Transpower's line is not built by the earliest possible date and favour

building the line by 2011. But even if we present our revised and rephased proposal on the basis of implementation in 2011 we do not believe our proposal will meet the requirements of the Grid Investment Test (GIT) as currently applied by the Electricity Commission.

7. Supplementary Proposals for Improved Reliability

Transpower has also developed supplementary proposals that specifically address reliability of supply into Auckland. These projects do assume, however, the completion of the initial phase of the staged 400kV project on time, that is, by 2011.

These include:

- 220kV projects currently under consultation through our Request for Information (RFI) that reinforce supplies into Penrose, the CBD, Wairau Road and Albany
- Projects to improve voltage control in the Auckland area, including provision of an SVC voltage controller at Albany and capacitor banks at various locations.

The following pages outline how these proposed projects could be advanced to achieve improved reliability in the shorter term.

8. Improve Reliability of Otahuhu Substation

Transpower is concerned about the heavy concentration of transmission lines and switching equipment at the Otahuhu substation. This issue was recognised in the proposal to develop a 400kV supply into Auckland. The 400kV proposal included:

- The development of a separate 220kV substation at Otahuhu
- Separation of the new 400kV plant from this new 220kV substation; and
- Adoption of industry best practice substation design for both the 220kV and 400kV equipment.

The options outlined below details how these plans could be advanced as separate proposals.

Option 1: The 220kV substation, as proposed in the 400kV project, should be built as soon as possible at the proposed site approximately 70m away from the existing Otahuhu substation. This substation would comprise:

- Reliable switching arrangements (1.5 circuit breakers per circuit – a significant improvement from the current substation design);
- Gas insulated switchgear (GIS); and
- Rearrangement of existing 220kV circuits to route at least half of the existing circuits through the new substation.

This new substation would reduce the reliance on the existing, less reliable, outdoor substation and would reduce the number of circuits that cross over other circuits or the substation.

Time to complete: 18-24 months from approval

9. Reinforcement of supplies to Penrose, the central business district and Wairau Road

These projects are not part of the 400kV proposal but are separate proposals that are currently published in the Request for Information (RFI) that was circulated in late May 2006. This project comprises two sequential stages:

- Reinforcement of Penrose from the south – currently the options being looked at are via Otahuhu; and
- Establishing a new 220kV cable link between Penrose and Albany via the CBD and Wairau Road.

Much of the preparatory work for the second stage of this project has been completed and ducts have been installed along most of the route, ready to take the cables.

Option 2: Both the reinforcement of Penrose from the south and the establishment of the new 220kV cable link between Penrose and Albany, could be accelerated. Selecting the Otahuhu-Penrose reinforcement option that is routed via Pakuranga would fit in with other proposals to establish an eastern corridor into Auckland via Penrose. This would involve:

- Establishing a 220kV gas insulated substation at Pakuranga (see next section);
- Converting the existing 220kV capable transmission line between Otahuhu and Pakuranga to operate at 220kV;
- Installing 220kV cables between Pakuranga and Penrose; and
- Establishing a high reliability 220kV substation at Penrose.

Once the substation is established at Penrose, the first section of 220kV cable could be installed to the CBD, allowing the development of a 220kV CBD substation. The next sections of the cable from the CBD to Wairau Road and Albany could then be implemented as required.

Time to complete: 24-36 months from approval

10. Provide diversity by means of an 'eastern' corridor into Auckland

At present all major transmission circuits supplying Auckland come into Otahuhu Best practice for critical loads such as Auckland would be to have multiple supply points with physical diversity. In the event of a major failure in one corridor, the alternative corridor would have the capacity to meet a substantial proportion of the total load, preferably with full backup capability.
Transpower originally considered developing an alternative corridor via Pakuranga to the east of Otahuhu. Otahuhu was ultimately selected as the preferred site because of:

- Costs associated with developing Pakuranga;
- Location of Pakuranga in a residential area.

Transpower is currently revising the Pakuranga option as it could, together with the 400kV project, provide a separate corridor into Auckland from Whakamaru.

Transpower feels that this option is desirable from a diversity standpoint and achievable at a reasonable cost, although costs will be higher than the original option of taking the 400kV into Otahuhu.

Option 3: If an eastern corridor is required, for reasons of security, Transpower could proceed to establish the 220kV switchyard at Pakuranga.

Time to complete: 2012, possibly earlier if designation and consenting processes are accelerated.

Preferred Options – Auckland Short Term Proposals

The reliability of supplies into Auckland could be improved significantly in 2-3 years from project approval by:

- Addressing the substation reliability issues at Otahuhu as soon as possible by creating a new 220 GIS substation at an adjacent site. This substation is part of Transpower's 400kV proposal. (Option 1);
- Advancing currently proposed projects, namely the reinforcement project from Otahuhu to Albany via Penrose (Option 2); and
- Modifying the proposed 400kV project to route it via Pakuranga, thus establishing an eastern corridor for supplies into Auckland (Option 3).

A diagram of these proposals is attached.

The above projects are examples of what can be done and will require further development and refinements. However, it is our view that these projects and options are reasonable and feasible. It is our plan to continue to develop these projects for presentation to the Electricity Commission for approval.

TRANSPOWER

Otahuhu Diversity Project
Delivery Phase

PROJECT MANAGEMENT PLAN

Version 2.0
October 2008

Document Control

Version History

Version	Description	Author	Date
1.0	For Delivery phase planning	Jitesh Raniga	August 2007
2.0	For Delivery phase execution - major revision with project participants and processes established	Graeme Oakden	October 2008

Recommendation

This document defines the:

- Project background, scope and general requirements
- Project governance, organisation, roles and responsibilities;
- Project management processes and systems to be applied during project execution.

Recommendation for approval:

Name	Title/Role	Reference	Date
Graeme Oakden	ETC/ Project Management Support	ODP-ETC084	15 November 2008

Approval:

Name	Title/Role	Signature	Date
Jitesh Raniga	Project Manager	ODP-PMR011	17 November 2008

Distribution

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Colin Kemp	Project Leader – Enabling Works Construction	Transfield
Anil Asija	Project Manager – DB1	AREVA

The PMP should be further distributed to project participants within Transpower, Maunsell, Transfield and AREVA and to the subcontractors as required to support their project roles.

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1. Introduction

1.1. Document Purpose

This Project Management Plan (PMP) is the prime management document to support the delivery phase of the Otahuhu Diversity Project (ODP). It references or contains all information required to manage the project.

The three main sections cover:

- **WHAT** is to be done including project background, scope, requirements and objectives.
- **WHO** is to do it including project governance, organisation, resources, roles, responsibilities and communication.
- **HOW** it is to be done encompassing project plans, processes and systems for planning, monitoring and management through to operational acceptance.

The PMP facilitates project participant and key stakeholder understanding of project management requirements in order to help achieve project objectives.

It will be updated as appropriate during the life of the project to reflect significant changes in scope, personnel, responsibilities or processes. However, it is anticipated that this Version 2 PMP will require no further updates.

1.2. Audience

This version of the PMP is written primarily for project participants from Transpower plus the three main vendors being Maunsell, Transfield and AREVA.

All project participants engaged by these four companies with any management responsibility for the project should read and comply with the PMP in order to support their project roles.

Other project participants should also read the PMP (or parts of it) and associated management documents in order to help them understand the project and execute their project tasks as required.

The ODP is a relatively large, complex and long duration project that will have many people working on it. The PMP is accordingly also a key document for project familiarisation for new project participants.

1.3. PMP Content and Associated Documents

This Version 2 status PMP has been prepared when all major project participants have been engaged and management plans, processes and systems have been implemented. Accordingly almost all project management detail is documented elsewhere and the focus of this version of the PMP is to identify; reference and provide an overview of, and context for, these documents.

Accordingly, where there is a primary source document such as a deliverable from the previous ODP phase of work (e.g. the Solutions Study Report) or a project procedure then the PMP contains relevant summary level information for clarity but references the relevant document rather than duplicating detailed information.

This Project Management Plan should be read in conjunction with the contracts, plans and procedure documents that define the detailed processes that underpin its implementation. In addition there are several other documents that are relevant as background information.

Project specific management documents are identified in Appendix A with latest revision date (where applicable), owner and an outline of their content/purpose. They are referenced from the PMP text using the 'Ref' number.

All project management documents listed in Appendix A are stored on the Transpower or Transfield project SharePoint sites.

2. Project Background, Scope & Requirements

2.1. Background

Transpower has recognised an issue with the reliability of transmission through the existing 220 kV Otahuhu substation. Most of the power supplied into the upper North Island, including Auckland and Northland, flows through Otahuhu substation, and its reliability is of critical importance to these areas. Furthermore, a major failure at Otahuhu could credibly result in voltage collapse that would affect most of the North Island from Whakamaru northwards, and possibly further south.

Transpower's Otahuhu substation is a legacy asset, having been developed incrementally over the past 50 years. Although there have been a number of security upgrades over the years, such as the addition of bus zone protection and bus coupler circuit breakers to help mitigate the impact of failures, it remains a basic single-breaker double-bus design, that is not considered under good electrical industry practice to be appropriate for the level of power being transferred through the substation.

Some of the historical developments have resulted in transmission lines crossing over both the 110 kV and 220 kV switchyards at the substation. These 'over crossings' are not unusual in an 'industry practice' context but are considered to be undesirable from the perspective of a critical substation because of the risk posed by falling conductors – a rare but high consequence event.

Recent events at Otahuhu have highlighted the vulnerability of the existing switchyard to low probability, high consequence events. Although by definition, these events are rare, they are also highly unpredictable and can have a major impact on supplies to consumers. In the probabilistic planning context, it is not always feasible to enumerate each and every event that could lead to a high impact event. The probability of a high impact event is thus always higher than an enumerated approach to reliability assessment.

Transpower's Otahuhu Diversity Project will address the vulnerability issues and improve the reliability of the 220 kV Otahuhu substation by building a new 220 kV switchgear facility on the same site, but physically and geographically separated from the existing switchyard. Existing and new circuit connections will be diversified between the two switchyards so that a major failure in one of the switchyards will not result in a total loss of supply via Otahuhu substations. The flexibility offered by two independent substations will also improve the flexibility and operational options available to restore supplies in the event of major loss of load event.

Other documents including the Solutions Study Report (Appendix A ref 1.1) and Application for Approval to the Electricity Commission (ref 1.2) provide more detail on project background.

2.2. Scope of Work

Deliverables from the previous '***development***' phase project included:

- An awarded GIS/AIS/EHV Cable Design/Build (DB1) Contract covering most of the new substation construction works
- Conceptual design for 'enabling works' including new GIS/AIS platform, transmission line deviation and associated infrastructure/services work
- Resource consents and property acquisition and agreements
- Electricity Commission and Transpower approvals to proceed with project delivery

An outline of the scope of this '***delivery'*** phase project is:

- Establish contracts for design and construction of the enabling works

- Execute the enabling works design and construction including provision of a new switchyard platform for the GIS/AIS construction and associated work plus existing bus and line protection upgrades etc
- Design and construction of new GIS and AIS facilities plus EHV cabling through the awarded DB1 contract.
- Commissioning and handover of the new facilities

It is noted that there was some overlap of the ***development*** and ***delivery*** phases above (particularly award of the DB1 contract) but they were managed separately.

The scope of work for ***delivery*** is described in detail in the Solution Studies report (ref 1.1) and fully specified in the contract documents (ref 3.1 to 3.5).

2.3. Business Case and Project Approvals

The business case for the Otahuhu Diversity Project delivery (ODP) in the form of a 'Grid Upgrade Proposal' (ref 1.1) was developed and submitted to the Electricity Commission in 2006.

The Electricity Commission approved the proposal in August 2007.

The Transpower Board approved the project in September 2007 (ref 1.3)

The CEO approved the Project Approval Document (PAD) in October 2007 (ref 1.4)

2.4. Project Work Breakdown Structure

The Project Work Breakdown Structure (WBS) subdivides the project scope into increasingly smaller and more detailed 'manageable chunks' of work following a hierarchical structure. This is the common basis for ongoing integrated planning and management of scope, schedule, cost and resources across the project.

The WBS is developed and presented to three levels only in the PMP being:

- Level 1 – Project: Total scope of the ODP Delivery phase as defined in this PMP
- Level 2 – Workstream: Five workstreams aligning with responsibility for project execution being:
    - Management/Support
    - Enabling Works Design
    - Procurement
    - Enabling Works Construction
    - GIS/AIS EHV Cable Design/Build
- Level 3 – Work Package: Breakdown to specific Work Packages within each Workstream being the cost/schedule integration level which is a summary task in the project schedule and the level at which where overall budgets are identified, forecasts are maintained and actual costs recorded (i.e. CA level project account in FMIS). WBS to work package level is shown in Appendix B.

Further WBS development through greater levels of detail is carried out as the project progresses as part of the ongoing planning and scheduling process.

2.5. Project Schedule

Approved commissioning date for the project following Electricity Commission project approval was set as March 2010. Detailed schedules have been developed accordingly and current internal project target commissioning date is 26 February 2010.

However, award of the DB1 contract slipped by 2 months to May 2008 and this has put significant pressure on the commissioning date. It is considered to be feasible but it includes no specific schedule contingency and given the complexity, concurrent parallel near critical paths, dependence on outage availability and risks associated with the project it is considered that the risk of slippage is high.

Integrated detailed project schedules including identification of inter-schedule dependencies across all workstreams were developed and baselined as at 1/8/08 (following award of the DB1 contract and its initial planning). These are updated on a monthly cycle as described in 4.2 below and specified in the Scheduling Procedure (ref 5.1).

See the summary Gantt chart and milestone schedules in current Monthly Progress Report or Steering Committee report (as identified in 4.1 below) for the baseline and latest actual/forecast dates.

2.6. Project Budget

Regulatory approval has been received by Transpower from the Electricity Commission for up to $99M being the P90 estimate in the 'Application for Approval' (ref 1.2).

The Transpower Board approved a budget of $83M in September 2007 (ref 1.3) being the P50 estimate in 2006 dollars in the 'Application for Approval'.

It is noted that the 'mean project cost estimate' in June 2009 dollars in the 'Application for Approval' is $94M.

The PAD budget as approved by the Transpower Chief Executive in October 2007 (ref 1.4) is $76.611M.

The project budget, as detailed in the PAD, has been mapped to the project work breakdown structure (see 2.4 above) at Work Package level and can be seen in the project cost status reports.

Commitments, forecasts and actuals are maintained and reported by work package along with budget and rolled up to workstream and total project level.

Refer to 4.3 below on how project costs are managed and reported as the project proceeds.

2.7. Contractual Approach

The major 'GIS/AIS and EHV Cable' package of work has been established as a design/build contract with engagement of AREVA through competitive tendering under the previous 'development' phase of the project.

However, the Enabling Works contractual approach was driven by project time constraints which required construction to commence in January 2008 in order to meet target commissioning date but project approval was not confirmed until October 2007. This did not allow time for a traditional detailed design then construction tendering process. A faster competitive RFP process based upon existing conceptual design only was selected.

A construction contract was awarded in December 2007 with detailed design and construction proceeding in parallel. This is described in the Enabling Works Construction PMP (ref 3.4) and the associated 'Scope Refinement' process and associated cost management is specified in the EW Cost Management Procedure (ref 5.2)

2.8. Dependencies

The project is largely independent of other Transpower projects except for the risk of unavailability of outages (or their cancellation) caused by other works or power system conditions. This has potential for significant schedule and some cost impact. It is managed by advance planning and early submission of outage requests plus close liaison with the System Operator.

There are, however, significant dependencies on other parties including:

- Local authorities for resource and building consents
- Contact Energy as owner of neighbouring power station (refer 2.1)
- Other utilities including Vector, Telecom, Watercare and Manukau Water for relocation of their services to accommodate the works.

These external dependencies are managed under the project scheduling process described in 4.2 below with associated communications with the parties managed as described in 4.11.

There are also many internal project dependencies between the 4 project major participants. Planning and management of these is a principal objective of the Project Scheduling Procedure (ref 5.1).

2.9. Key Delivery Objectives

The following are key objectives of all project participants in delivery of the project:

- Most importantly; undertake the work safely – measured by achievement of safety KPIs
- No unplanned Loss of Supply (LOS) as a consequence of project work
- Delivery of specified project scope within the approved timeframes and budget.
- Management processes developed and applied to support efficient and effective execution of the work
- Open and honest communications between the parties with no hidden agendas. This includes sharing of information unless there is a clear commercial imperative for confidentiality
- A collaborative team approach by all project participants with communication and relationships between all parties conducted in a non-adversarial manner.
- Transparent management and appropriate escalation of issues at all levels of the project as and when they arise.

3. Project Participants, Governance & Organisation

3.1. Project Participants

The four principal organisations responsible for project delivery and outline of their responsibilities are as follows.

- Transpower New Zealand Ltd (**Transpower**) – Transpower is the Principal/Employer responsible for overall management and delivery of the project.
- Maunsell AECOM Ltd (**Maunsell**) – Design consultant responsible for enabling works design and general technical support. See design contracts (ref 31, 3.2 and 3.3) for specifics.
- Transfield Services Ltd (**Transfield**) – Contractor responsible for enabling works construction. See EW construction contract (ref 3.4) for specifics.
- AREVA T&D Australia Ltd (**AREVA**) – Contractor responsible for GIS/AIS and EHV cable works. See Design/Build contract (ref 3.5) for specifics.

Several other subcontractors, vendors and consultants are also (or will be) employed on the project but are always engaged directly by one of the four companies above.

3.2. Project Organisation Structure

The high level project organisation structure identifying only those core project team members with management responsibilities (i.e. role and appointee as at October 2008) is shown in Appendix C. Other people working on the project will do so under the direction of one of those named on the organisation chart.

Specific roles and responsibilities of project team members are defined in the other referenced management documents and are not repeated here.

More detailed organisation structures for specific aspects of the project showing other project team members are included in:

- Transfield Enabling Works Project Management Plan (ref 4.5) shows the Transfield project organisation structure
- AREVA Project Quality Plan (ref 4.11) shows the AREVA project organisation structure
- Maunsell Project Plans (ref 4.2, 4.3 and 4.4) shows the Maunsell project organisation structure for each contract
- Communications and Record Management Procedure (ref 5.4) includes the Transpower technical management structure

3.3. Project Steering Committee

The Project Steering Committee (PSC) provides executive overview and direction of the project and is a forum for escalation of issues from the project team.

Membership comprises senior management from the four principal organisations with others attending (see Appendix C). It meets 2 monthly or as required and is chaired by the Transpower Director, Capital Works Programme Group.

The PSC Terms of Reference document (ref 4.1) specifies PSC structure, purpose and role.

3.4. Enabling Works Management Team

The Enabling Works Management Team (see Appendix C) provides management and coordination of the enabling works design and construction.

Core team members are:
- Engineer to Contract (Chair)
- Transpower Project Manager
- Engineer's Representative
- Transfield Project Leader
- Transfield Construction Managers
- Maunsell Project Manager

Other Transfield and Maunsell team members attend as required depending upon focus of work at the time.

Meetings are held fortnightly on site.

See the Enabling Works Construction PMP (ref 4.5) for more information.

3.5. DB1 Contract Management Team

The DB1 Management Team (see Appendix C) provides management and coordination of the GIS/AIS and EHV cable works design and construction.

Core team members are:
- Engineer to Contract (Chair)
- Transpower Project Manager
- Transpower Technical Manager
- Engineer's Representative
- AREVA Project Manager
- AREVA Project Engineer
- AREVA Site Manager

Other AREVA team members attend as required depending upon focus of work at the time.

Meetings are held monthly at Transpower's Auckland offices or on site.

3.6. Project Communication

Establishment workshops have been held for the Enabling Works and DB1 contracts immediately following their award to establish contract specific management objectives including responsibilities, processes, key drivers, KPIs and core values.

The Steering Committee, Enabling Works Management Team and DB1 Management Team as in 3.3, 3.4 and 3.5 above are the main ongoing forums for project communication and management for the remaining duration of the project. The overlap of membership between these teams is shown in Appendix C. The Transpower Project Manager and Engineer to Contract being the common link between all three forums.

Other forums are (or will be) established according to need including:

- **Project Coordination** – Meets monthly to identify and coordinate interdependencies between main project participants (Transpower, Maunsell, Transfield and AREVA). Attendees are combined Enabling Works and DB1 management teams as in 3.4 and 3.5 above and it is chaired by Engineer to Contract. Includes review of current integrated project schedule and input to next schedule update. Focus is on medium to longer term planning.

- **Site Coordination –** Meets weekly and complements Project Coordination meeting focusing on site 'real time' and short term issues. Chaired by Engineer's Representative.
- **Enabling Works Site Technical** – Meets weekly or as required to address real time site coordination and technical issues. Chaired by Engineer's Representative and includes Transfield and Maunsell.
- **Enabling Works Protection** - Meets weekly or as required for design and construction liaison on enabling works protection issues. Includes Engineer's Representative, Transfield and Maunsell.
- **Contact Energy Liaison** – Meets monthly or as required to manage issues with Contact Energy as neighbours. Chaired by Transpower Project Manager and includes Transfield and/or AREVA and others as applicable
- **DB1 Design** – Transpower Technical Manager meets with AREVA as required for design input, review and approval of GIS/AIS and EHV cable works design and construction.
- **Site Safety Coordination** – Meetings will be held weekly between Transfield, AREVA and Transpower when AREVA commences work on site. Focus is on safety management and particularly coordination between Transfield and AREVA.
- **Risk Workshops –** Convened monthly or as required for both DB1 and enabling works to review open risks and identify new ones. Refer 4.9 below.

Refer to 4.10 and 4.11 below and the communications procedures (ref 5.4 and 5.3) which cover specific implementation of project communications and associated records management.

3.7. Project Stakeholders

Stakeholders are those who are, or will be, affected in some way by the project. This does not include the project participants and project team members working to deliver the project.

The project is also dependent upon some stakeholders as owners of external dependencies as in 2.8 above.

While not directly involved in ongoing project execution from a governance perspective, stakeholders must be kept informed in their area of interest and many stakeholders will have significant input to the project as it progresses.

Primary stakeholders include the following groups:

Transpower Internal
- Board
- Executive
- Grid PMO
- Asset Owner
- System Operator
- Inventory and Procurement (i.e. neighbouring Otahuhu Warehouse significantly impacted)

External
- Electricity Commission – as regulator
- Contact Energy - as neighbour owning Otahuhu Power Station
- Vector Electricity Networks – supplied from substation and cable relocation works required
- Auckland Regional Council – RMA role
- Manukau City Council – RMA and building permit roles
- Watercare Services – modifications to their trunk sewer required

- Telecom – infrastructure relocation works required
- Major Energy Users Group (MEUG) – as project opponents

Stakeholder communication is an integral part of the project scope to ensure that stakeholders are informed about the project.

The Transpower Project Manager has primary responsibility for stakeholder communication. A formal stakeholder communications plan for the project has not been prepared at this stage but may be if it is considered that it would add value.

4. Project Management Processes

This section of PMP identifies and outlines the project management processes and procedures that prescribe how the project will be delivered by the project team. Detailed process/procedure information is not included in the PMP but they are listed in Appendix A5 and referenced from this section accordingly.

Transpower and Grid PMO standard processes, procedures and systems are used to support project management supplemented by project specific processes/systems as applicable.

Where project processes are not explicitly defined project management activities will be carried out following Project Management Institute best practice as defined in the standard ANSI/PMI 99-001-2004 'A Guide to the Project Management Body of Knowledge'.

4.1. Project Progress Reporting

Project progress reporting requirements are summarized in the table below.

Report	Author	Frequency	Audience	Contents
Enabling Works Construction Progress Status	Transfield Project Leader	Weekly Prior to Management Team Meeting	EW Management Team. Reviewed at EW Management Team Meeting	Ref 4.5
Enabling Works Construction Progress Summary Status	Transfield Project Manager	Monthly	Transpower Project Manager Input to Transpower monthly status report	Ref 4.5
Enabling Works Design Progress Summary Status	Maunsell Project Manager	Monthly	Transpower Project Manager Input to Transpower monthly status report	Bullet point summary of tasks achieved last period, planned next period and open issues.
DB1 Works Construction Progress Status	AREVA Site Manager	Weekly	Transpower PM, ETC and Engineer's Rep	Ref 4.11
DB1 Works Progress Status	AREVA Project Manager	Monthly	DB1 Management Team. Reviewed at DB1 Management Team Meeting and input to Transpower monthly status report	Ref 4.11
Cost Status	ETC	Monthly	Transpower PM Input to Transpower monthly status report	S curve and tabular output of monthly cost forecast (ref 5.10)
Summary Schedule	ETC	Monthly	Transpower PM	1 page summary Gantt

Report	Author	Frequency	Audience	Contents
			Input to Transpower monthly status report	chart (ref 5.1)
Transpower Project Progress Status Report	Transpower Project Manager	Monthly	Transpower management and posted on intranet	As per Grid PMO requirements
Steering Committee Report	Transpower PM with input from all project participants	2 Monthly	Project Steering Committee Reviewed at PSC meetings	As specified in PSC TOR (ref 4.1)
Key Performance Indices (KPIs)	ETC with input from Transfield and AREVA	2 Monthly	Project Steering Committee Reviewed at PSC and management meetings	KPIs including performance on safety, schedule, meeting attendance and action processing, query processing, drawing quality, risk management.

4.2. Scheduling

Project scheduling is carried out as specified in the Scheduling Procedure (ref 5.1).

This procedure defines the process for initial development and ongoing maintenance of Otahuhu Diversity Project schedules.

Its objective is to ensure that all project work is appropriately planned and scheduled in order to:
- align with and validate specified overall project timeframes
- provide the basis for assigning and executing the work
- support resource planning
- accommodate external dependencies
- identify and maintain inter schedule dependencies across the project
- identify and provide early warning of schedule related variances or issues
- report overall project progress at detailed and summary levels

Four ‘Level 2’ schedules based upon responsibility are developed and maintained covering full project scope and aligning with project WBS. These are as follows with owners and scope as outlined:

1. **Transpower** - owned by Transpower and covering Transpower work including procurement, technical review, RMA, property and general project management
2. **Enabling Works Design** - owned by Maunsell and covering the three enabling works design contracts
3. **Enabling Works Construction** - owned by Transfield and covering the enabling works construction contract
4. **GIS/AIS/EHV Cable** - owned by AREVA and covering all GIS, AIS and EHV cable works as in the DB1 contract.

They are maintained separately but integrated each reporting cycle into a single baselined, schedule for overall project monitoring and management reporting.

These ‘Level 2’ schedules are broken down to tasks of generally 10 days duration or less for the short term planning horizon. However, schedules may be progressively developed during project

execution with longer term work beyond about 2 months from the current date at a coarser level of detail (i.e. a 'rolling wave' approach).

Resources may be assigned to these 'Level 2' schedules or at a more detailed 'Level 3' that rolls up to 'Level 2'.

A key requirement in maintaining the integrated schedule for the project is to ensure alignment between individual schedules. This is achieved by defining inter schedule links using specifically identified milestones and monitoring alignment of those milestones as described in the Scheduling Procedure.

Integrated schedule progress updating and reporting is normally on a monthly cycle with individual schedules updated more frequently as required.

Update approach is based upon maintaining current actual and best estimate of forecast future dates by task monitored against an approved baseline.

4.3. Cost Management

Project cost management includes ongoing forecasting and recording of actuals and commitments by Work Package, monitoring against budget, reporting of variances and initiation of corrective action as applicable.

Its objective is to ensure that effective project cost control is implemented such that:

- the best estimate of Forecast End Cost (FEC) for the project is maintained for each Work Package and the total project on an ongoing basis
- potential cost variances are identified early so that corrective action may be taken
- expected variances of FEC from approved budget are identified, recorded and tracked
- only legitimate ODP costs are charged to the project
- project commitments are properly established and identified
- cost status is reported according to Transpower requirements, clearly, accurately and in appropriate detail to all levels of management
- cost information is readily available to support specific investigations or requests
- sufficient records are maintained in order to allow audit of all aspects of project cost history

Systems used are FMIS and MMS in accordance with Transpower business requirements (mainly for payment processing and recording actuals and commitments) supplemented by project specific systems for forecasting and reporting.

The project cost control cycle is monthly with updated commitments, forecast and actuals reported as at the end of each calendar month. Management summary reports include:

- **Summary Cost Status** – Tabular report with one line per Workstream including original PAD budget, current budget, forecast, commitments and actuals. This includes contingency amounts and derived variances
- **Financial Year Summary** – Tabular report showing actual and forecast expenditure by Workstream by financial year.
- **Work Package Cost Status** - Tabular report with one line per Work Package (approx 90) including original PAD budget, current budget, forecast, commitments and actuals plus variances.
- **S Curve Summary** – Graphical XY presentation showing cumulative costs by month plotting
    - Current Approved Budget
    - Commitments to Date
    - Actual Cost to Date and Forecast to Complete

Overall project cost management is carried out using the Project Cost Control workbook (ref 5.10) as described in the Process sheet of the workbook .

Cost management requirements of the major contracts are defined in the contract documents according to their specific nature and requirements and are implemented as follows:

- **Enabling Works Design** – A Design Cost Register workbook (ref 5.7) is maintained to manage change submissions and approvals and payment applications and approvals prior to processing in Transpower's MMS system.
- **Enabling Works Construction** – The 'Scope Refinement' process as specified in the EW Cost Management procedure (ref 5.2) is used to manage the concurrent design and build approach for this contract. An EW Cost Management workbook (ref 5.8) is maintained to record change submissions (i.e. Scope Refinements and Variations) and approvals and payment applications and approvals prior to processing in Transpower's MMS system.
- **AIS/GIS/EHV Cable Design/Build** - Variations and payments are managed in accordance with the standard FIDIC General Conditions used for this contract. A Cost Management workbook (ref 5.9) has been developed to record variations, payment applications and approvals.

Also see Section 4.6 Change Management below.

4.4. Quality Management

The three prime vendors (Maunsell, Transfield and AREVA) are all ISO9001 accredited and have quality management systems in place accordingly. They have project specific Project Quality Plan documents for the Otahuhu Diversity Project.

Quality management is accordingly the primary responsibility of the individual prime vendors for their deliverables. This is specified in their contracts.

Transpower under the direction of the Technical Manager also reviews, carries out spot checks, provides feedback on and approves deliverables. This does not, however, constitute any transfer of responsibility for quality of delivery from the vendor to Transpower.

Transpower may also require independent peer review of design work in critical areas – particularly protection design.

Transpower may arrange external audit of vendor's quality systems if required. This has been considered by the Project Steering Committee and the consensus view was that each vendor's regular internal audit processes should be adequate and Transpower initiated external audit would only be undertaken if a specific need was identified.

Transpower is not ISO9001 accredited but Transpower managed work will be undertaken in accordance with Transpower processes and be subject to audit.

4.5. Procurement Management

Procurement management covers Transpower management of all externally procured services, works, materials and equipment. This includes:

- **Enabling Works Design Services** – Maunsell have been engaged as one of Transpower's 'preferred consultants' under contract conditions TP/ServPC. The Transpower Project Manager is responsible for managing this work as specified in the contracts (ref 3.1, 3.2, 3.3).

- **Enabling Works Construction** – Transfield have been engaged through a competitive RFP process as one of Transpower's 'preferred contractors' under contract conditions TP/Wks4G. The Engineer to Contract and Transpower Project Manager are responsible for managing this work as specified in the contract (ref 3.4).
- **Enabling Works Equipment and Materials** – Transpower's Inventory & Procurement Group are responsible for procurement of primary equipment, secondary equipment, transmission line materials and other materials specified as required in the enabling works design.
- **AIS/GIS/EHV Cable Design/Build** - AREVA have been engaged through a competitive tendering process under FIDIC contract conditions for design services, equipment/material supply and construction works. The Engineer to Contract and Transpower Project Manager are responsible for managing this work as specified in the contract (ref 3.5).

The Transpower Project Manager and ETC supported by the Engineer's Representative have primary responsibility for procurement management in accordance with the contracts and Transpower processes.

Transpower Contract Support Group is available to provide procurement management support and as at October 2008 have nominated Chris Mayo to this role as single point of contact for advice on contractual issues or provision of support.

4.6. Change Management

Change management includes both 'overall project' and 'contract specific' scope change.

'Overall project' scope is well defined and few changes are expected on this project. The Project Manager is responsible for identifying any prospective changes or clarifications to approved project scope and submitting to Transpower management for approval.

Project scope changes are identified and tracked in the Project Cost Control work book (ref 5.10) and a separate scope change register is not maintained.

'Contract specific' scope changes, on the other hand, will be common. Change management processes for these are specified in the individual contracts and supporting systems for managing these changes have been developed as follows:

- **Enabling Works Design** – The Maunsell design contracts (ref 3.1, 3.2 and 3.3) are a mixture of 'Time and Materials' and 'Fixed Price'. Scope Changes are initiated and processed as specified in the contracts and approved in accordance with Transpower delegations. The Design Cost Register workbook (ref 5.7) is used to record, reference and track all enabling works design scope changes.
- **Enabling Works Construction** – The nature of the Transfield construction contract being awarded without a detailed design and the associated 'Scope Refinement' process means that there will be a large number of changes which must be efficiently and effectively managed. Transfield manage a Design/Contract Query process which helps clarify scope and identify changes. The change management process is specified in the Enabling Works Cost Management procedure (ref 5.2) and the Enabling Works Construction Register workbook (ref 5.8) is maintained to record, reference and track all enabling works change submissions and approvals.
- **AIS/GIS/EHV Cable Design/Build** – The AREVA contract is a conventional fixed price contract with changes (Contract Variations) managed in accordance with the standard FIDIC General Conditions used for this contract. The DB1 Cost Register (ref 5.9) is used to record, reference and track all DB1 contract design scope changes.

4.7. Deliverables Management

Project deliverables are managed in accordance with provisions of the relevant contracts and Transpower processes. This covers their initial specification, review, feedback, approval, signoff and handover.

Deliverables cover the following categories with Transpower approval as noted:

- Management documents including Project Quality Plans, Procedures, Management Plans etc are reviewed and approved by the Project Manager or ETC
- Technical documents including drawings, designs, technical specifications, test reports etc are reviewed and approved by the Technical Manager
- The physical works are reviewed and approved by the ETC supported by the Engineer's Representative and ultimately the Asset Owner at project handover.
- Operating documentation, training material and training delivery are approved by the ETC with input from the Asset Owner

Design deliverables are listed in the DB1 Document Tree (ref 5.11) maintained by AREVA and the Enabling Works Drawings Log (ref 5.12) maintained by Maunsell.

4.8. Safety Management

Safe execution of the works is the top priority project objective hence planning and management of safety is paramount.

This is specifically covered in the Enabling Works Safety Plan (ref 4.7), the DB1 Works Site Management Plan (ref 4.8) and the DB1 Works Health and Safety Emergency Plan (ref 4.9).

The nature of the works and site with two principal contractors and multiple subcontractors operating concurrently in the same general areas make safety management a significant challenge. This demarcation issue and clear definition of responsibility must be specifically addressed in the safety plans and ongoing safety management.

Safety is a standard agenda item for all three management forums.

Transpower will undertake regular site safety audits as part its safety audit programme and as directed by the Transpower Project Manager.

4.9. Risk & Issue Management

Project risk management is carried out in accordance with Australian and New Zealand Standard for Risk Management (AS/NZS 4360).

Its objective is to ensure that all project risk is appropriately identified, assessed and managed. The process includes:

- Systematically identifying each risk
- Assigning an owner to each risk who is responsible for monitoring and managing the risk
- Evaluating 'Likelihood' and 'Consequences' to derive a 'Level of Risk'
- Establishing 'Treatment' plans in response to each risk according to 'Level of Risk' to:
    - reduce likelihood or risk event and/or
    - mitigate its impact should it occur
- Monitoring the application of risk treatment plans to ensure risk is being managed appropriately
- Recording the above on a 'Risk Register' to support management and monitoring.

Two Risk Registers are maintained as follows:

- **Enabling Works** – The enabling works risk register (ref 5.5) is managed by Transfield as owner of most (but not all) enabling works risks. The risk management process is specified in the Enabling Works Project Management Plan (ref 4.5). Some enabling works risks are owned by Maunsell and Transpower team members who have access to update the register on the Transfield team site.
- **DB1 Contract Works** – The DB1 contract risk register (ref 5.6) is managed by AREVA as owner of most (but not all) DB1 contract risks. Some DB1 contract risks are owned by Transpower team members and the register is accordingly held on the Transpower project SharePoint site so that both AREVA and Transpower have direct access to update it.

Risk management for both enabling works and DB1 contract include:
- Risk registers in same format for consistency of presentation
- Each risk reviewed and updated at least monthly
- Risk management as a standard agenda item at management meetings
- Specific risk review meetings – generally monthly
- Reporting of all 'Extreme' and 'High' open risks to the Project Steering Committee who review them as a standard agenda item at their meetings

Issues are identified and managed through the management and/or technical meetings as applicable, recorded as actions and escalated if required to the Project Steering Committee. A specific process and 'Issues Register' has not been set up to support Issues Management but may be in future if considered beneficial.

4.10. Communications and Records Management

Project communications and records management is carried as specified in the Project Communications and Records Management procedure (ref 5.4).

This procedure defines how the four major project participants (i.e. Transpower, AREVA, Transfield and Maunsell) formally communicate and how the project records that are generated are managed.

Its objective is to provide the basis for effective communication and to ensure that appropriate records are prepared, stored and are readily accessible in order to support efficient execution of the project.

The procedure should be read in conjunction with project procedure ODP03 'Enabling Works Documentation Management and Communications' (ref 5.3) which covers the detail of enabling works communications.

Principles adopted for communications and records management include the following:

- Minimize administrative overhead consistent with meeting communications and records management objectives
- Formal communication between parties is to be by emailed 'transmittal'
- Subject line of all transmittal emails must start with a unique transmittal ID in order to support subsequent identification and retrieval
- 'Correspondence Logs' listing all transmittals will be maintained and made available to both parties of each transmittal
- Where practical have single sources of common project records maintained by one party with access by other project participants (i.e. minimize duplicate records held by different project participants)
- Processes should minimize the need to produce printed outputs of records
- Authorization/approval normally is by email – hand written signatures are not required
- Formal project records are stored in electronic form (no reliance on paper records)

- Standard forms should be used where beneficial but otherwise communications may be directly in the body of emails (not form for forms sake)

Tools and systems used to realize the principles above include:

- A Transfield hosted 'team site' is the principle repository for enabling works construction project records including Transfield maintained correspondence logs, drawings, meeting minutes, progress reports, risk register, schedules etc
- Transpower project development SharePoint site was for the planning and development phase of the project. It is now closed but contains a number of documents for reference including investigations, the Solution Study Report and those associated with establishing the execution contracts.
- A Transpower project delivery SharePoint site is for Transpower owned project records and those shared with or submitted by Maunsell and AREVA. This is structured to align with the overall project Work Breakdown Structure.
- Transpower email repository is for storage/retrieval of all transmittals plus emails in response to transmittals and any other emails that the sender considers should be held as a project record.
- Email and uploading/downloading records to/from the Transpower SharePoint site are the means for formal communication and the transfer of records. Where records are transferred via the SharePoint site then that transfer is communicated and referenced by email transmittal.

4.11. External Communications

The Transpower Project Manager has primary responsibility for management of communications with stakeholders external to the project team (i.e. both internal and external to Transpower)

This includes determining:

- Who to communicate with (i.e. stakeholder organisation and person)
- What information to provide
- How to communicate
- When to communicate
- Who should communicate (i.e. may be escalated or delegated from Project Manager)

Stakeholders to communicate with include the 14 identified in Section 3.7.

A specific external communications plan has not been developed for the project as communications requirements for each stakeholder are already established or sufficiently clear.

4.12. Operational Acceptance and Project Closeout

Operational acceptance of the new assets by the Asset Owner will be in accordance with standard Transpower processes.

A 'Project Closeout Report' will be prepared including index of project records, lessons learned and list of outstanding project related tasks with identification of responsibility and timing for their completion.

Project participants are responsible for keeping records as the project proceeds for input to the Closeout Report. An ongoing 'lessons learned' register has not been set up for the project at this stage but will be if considered necessary to properly capture this information.

Appendix A – Project Management References

Project specific management documents are identified below with latest revision date (where applicable), owner and an outline of their content/purpose. They are referenced from the PMP text using the 'Ref' number.

Ref	Document	Date	Owner	Outline
1	**Pre Delivery Phase Documents**			
1.1	Solutions Study Report	8/07	Transpower	Detailed report on engineering investigations to establish scope of works for project to provide diversity at Otahuhu substation. Prepared by Maunsell. Original issue was 10/06.
1.2	Otahuhu Substation Diversity Project, Proposal, Application for Approval	12/06	Transpower	This is Transpower's 'Grid Upgrade Proposal' to the Electricity Commission advocating approval of the Otahuhu Diversity Project
1.3	Submission to Transpower Board for Project Approval	8/07	Transpower	Board Paper recommending approval to delegate authority to the CEO to proceed with the works.
1.4	Project Approval Document (PAD)	9/07	Transpower	Submission to CEO to approve proceeding with 'Delivery' phase of the project.
2	**Environmental & Property etc**			
2.1	Contact Energy Agreement	12/07	Transpower	Agreement between Transpower and Contact to ensure Transpower can carry out the project works and Contact can continue operation of the adjacent power stations
2.2	Land Use Resource Consent	11/07	Transpower	Manukau City Council consent for the works
2.3	Stormwater and Industrial Trade Processes Consent	2/08	Transpower	Auckland Regional Council consent including stormwater discharge and sediment control
3	**Contract Documents**			
3.1	Enabling Works Detailed Design Contract (Civil)	9/07	Transpower/ Maunsell	Design contract with Maunsell for initial enabling works associated with AIS/GIS platform construction. Includes general civil infrastructure and transmission line deviations.
3.2	GIS/AIS Substation Tie-Line and Line Protection Detailed Design	2/08	Transpower/ Maunsell	Protection design contract with Maunsell for work new GIS /AIS works to be installed by the DB1 contractor
3.3	Enabling Works Protection, SCADA and Communications Detailed Design Contract	8/08	Transpower/ Maunsell	Design contract with Maunsell for balance of enabling works including protection, SCADA and communications.
3.4	Enabling Works Construction Contract	12/07	Transpower/ Transfield	Contract with Transfield for construction of enabling works
3.5	GIS/AIS/EHV Cable Design/Build Contract (i.e. 'DB1' Contract)	5/08	Transpower/ AREVA	Contract with AREVA for design, procurement and installation of the GIS/AIS/EHV cable and associated works.

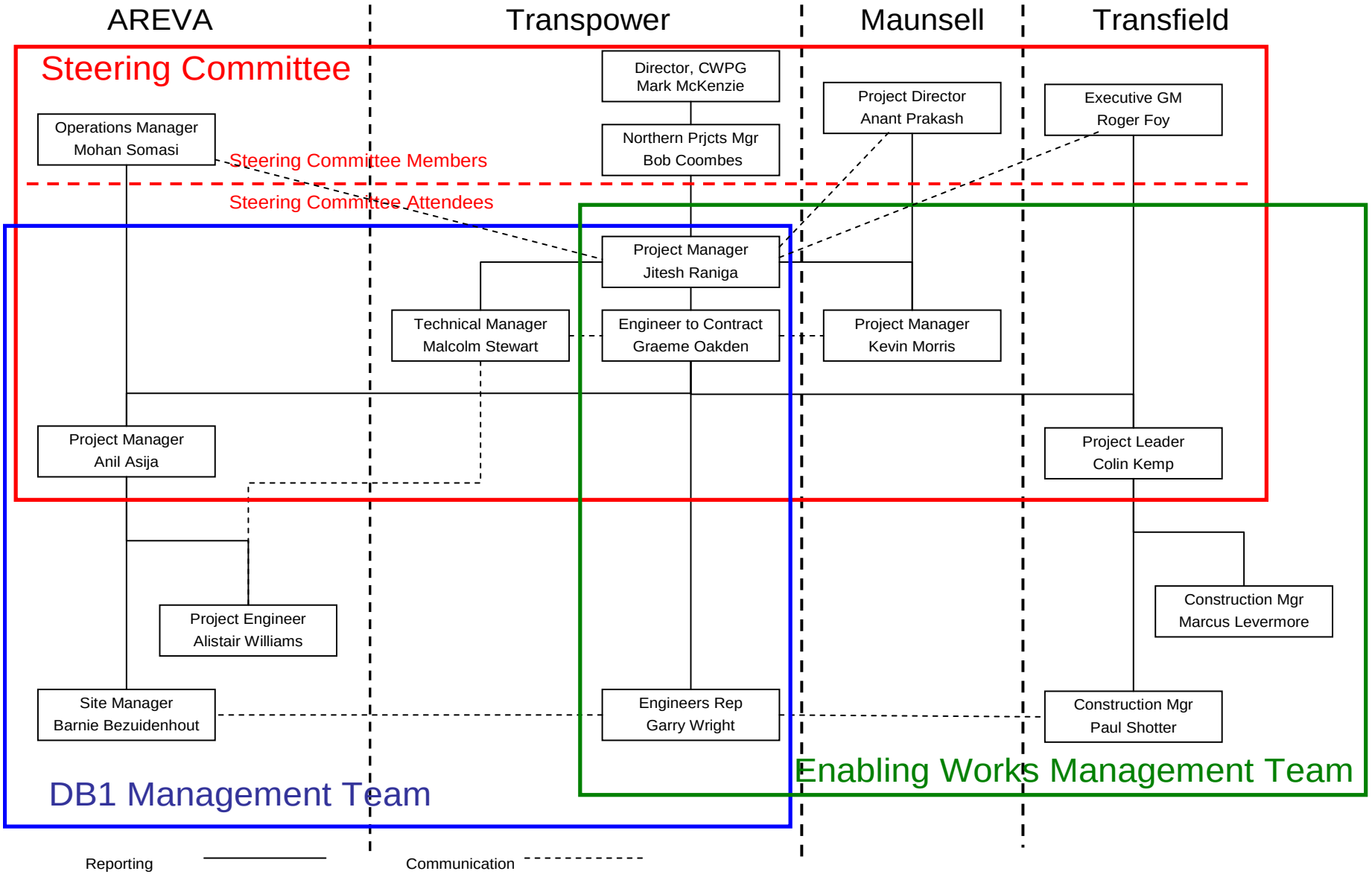
Ref	Document	Date	Owner	Outline
4	**Plans**			
4.1	Project Steering Committee Terms of Reference	5/08	Transpower/ Maunsell/ Transfield/ AREVA	Includes roles, responsibilities and membership of Project Steering Committee
4.2	Enabling Works Detailed Design (Civil) Project Plan	9/07	Maunsell	Project Plan as per Maunsells Quality System for the contract
4.3	GIS/AIS Substation Tie-Line and Line Protection Detailed Design Project Plan	2/08	Maunsell	Project Plan as per Maunsells Quality System for the contract
4.4	Enabling Works Protection, SCADA and Communications Detailed Design Project Plan	8/08	Maunsell	Project Plan as per Maunsells Quality System for the contract
4.5	Enabling Works Construction Project Management Plan	10/08	Transfield	Describes specific systems adopted by Transfield to comply with the requirements of the Enabling Works contract
4.6	Enabling Works Environmental Management Plan	8/08	Transfield	Covers enabling works requirements in order to comply with the resource consents??
4.7	Enabling Works Safety Plan	4/08	Transfield	Details the safety precautions and processes for Transfield and their subcontractors.
4.8	DB1 Works Site Management Plan	11/08	AREVA	Define project specific procedures, practices, resources and responsibilities to ensure control of site and occupational health and safety of all personnel.
4.9	DB1 Works Health and Safety Emergency Plan	9/08	AREVA	Methodology to respond to an emergency situation identified as per Environment Health and Safety emergency planning and preparedness procedure
4.10	DB1 Works Environmental Management Plan	9/08	AREVA	To identify environmental hazards associated with the site and define management practices to minimise hazards in accordance with the contract and legislation
4.11	DB1 Works Project Quality Plan	10/08	AREVA	Sets out specific quality practices for the DB1 works in accordance with AREVA quality system and AS/NZS 9001
5	**Procedures/Processes/Registers/Systems**			
5.1	ODP01 – Scheduling Procedure	9/08	Transpower	Specifies the process for initial development and ongoing maintenance of all Otahuhu Diversity Project schedules including their integration.
5.2	ODP02 – Enabling Works Construction Cost Management Procedure	3/08	Transpower/ Transfield	Defines the process by which Transpower and Transfield are to manage contract costs on the the Enabling Works contract. This includes ongoing management of change (through Scope Refinements and Variations), processing of

Ref	Document	Date	Owner	Outline
				payments and forecasting
5.3	ODP03 – Enabling Works Documentation Management and Communications Procedure	2/08	Transfield	Covers specific documentation and communication requirements between Transfield and Transpower. Supplements ODP04 below.
5.4	ODP04 – Communications and Records Management Procedure	10/08	Transpower	Defines how the four major project participants (i.e. Transpower, AREVA, Transfield and Maunsell) formally communicate and how the project records that are generated are managed
5.5	Enabling Works Risk Register	NA	Transfield	Risk register for enabling works in accordance with AS/NZS 4360. Updated monthly minimum.
5.6	DB1 Risk Register	NA	AREVA	Risk register for DB1 works in accordance with AS/NZS 4360. Updated monthly minimum.
5.7	Enabling Works Design Cost Register	NA	Transpower/ Maunsell	Workbook for recording, tracking, monitoring and approving design contract changes and payments. Includes process documentation. Updated on monthly cycle.
5.8	Enabling Works Construction Cost Register	NA	Transpower/ Transfield	Workbook for recording, tracking, monitoring and approving enabling works contract construction changes (scope refinements and variations) and payments. Updated on monthly cycle. Process is specified in procedure ODP02 above (ref 5.2).
5.9	DB1 Cost Register	NA	Transpower/ AREVA	Workbook for recording, tracking, monitoring and approving DB1 contract variations and payments as per the FIDIC contract conditions. Includes process flow chart. Updated on monthly cycle.
5.10	Project Cost Control Workbook	NA	Transpower	Workbook for ongoing cost forecasting at workpackage level, tracking changes, integration with actuals and commitments from FMIS and reporting. Updated monthly as at month end.
5.11	DB1 Document Tree	NA	AREVA	Register of DB1 document deliverables including design reports, technical specifications and drawings. Updated on ongoing basis including delivery status.
5.12	Enabling Works Drawings Log	NA	Maunsell	Register of enabling works drawing deliverables. Updated on ongoing basis including delivery status.

Appendix B – Work Breakdown (to Work Package Only)

ID	Workstream	ID	Work Package
10	**Management/Support**	10_10	Project Management
		10_20	Transpower Technical Support
		10_30	External Technical Support
		10_40	Environmental
		10_50	Property
		10_60	Switching & RTU/SCADA
		10_70	OTA Warehouse Changes
		10_90	Contingency
20	**Enabling Works Design**	20_01	110 kV Tie Line Deviation
		20_02	OTA - PEN C Deviation
		20_03	Warehouse Relocation/Alteration
		20_04	Manhole and Contact Sewer Relocation
		20_05	Site Platform Formation and Stormwater Relocation
		20_06	220 kV Switchyard Extensions
		20_07	220 kV Bus Zone Protection Modifications
		20_08	220 kV Protection System
		20_09	Cable Transition Stations
		20_10	Communications
		20_11	SCADA
		20_12	Local Service Power Supplies
		20_13	Security System
		20_14	Station Lighting
		20_15	Earthgrid Connections
		20_16	Sewerage Connection
		20_17	Water Supply
		20_18	Roading
		20_19	Vector Cable Relocation
		20_20	Miscellaneous Site Works
		20_21	Cable Route Security
		20_22	Low Impedance BZ Prot Existing 220 kV AIS
		20_23	Prot Settings Existing BZ
		20_24	Prot Settings Existing AIS
		20_25	Prot Settings GIS
		20_26	Prot Settings Low Impedance BZ Existing AIS
		20_30	Tie Line and Line Protection
		20_90	Contingency
30	**Procurement**	30_01	Miscellaneous
		30_02	Primary Equipment
		30_03	Protection
		30_04	SCADA
		30_05	Secondary Equipment
		30_06	Communications
		30_07	Line Materials
		30_90	Contingency
40	**Enabling Works Construction**	40_01	110 kV Tie Line Deviation
		40_02	OTA - PEN C Deviation
		40_03	220 kV Bay Tie Line 4
		40_04	Tie Line 5 Cable Termination
		40_05	Southdown Cable Termination
		40_06	OTA 'C' Bus Tie Cable Termination
		40_07	220 kV Bus Sections 478 & 488
		40_08	Henderson Circuit Transition Station
		40_09	Southdown Circuit Transition Station
		40_10	Huntly Circuit 2 Transition Station
		40_11	Ohinewai (WKM3) Circuit Transition Station
		40_12	OTA 'C' Bus Tie Transition Station
		40_13	Earthing Connections
		40_14	General Civil Works
		40_15	Communications/Protection Signalling
		40_16	Protection Systems
		40_17	SCADA Systems
		40_18	AC Supply
		40_19	Water Supply
		40_20	Huntly Circuit 1 Relocation to Bay 502
		40_29	Project Management
		40_30	Vector Cable Relocation
		40_90	Contingency
50	**GIS/AIS EHV Cable Design Build**	50_01	MS1 Contract Agreement
		50_02	MS2 Plant & Bldg Design & Spec
		50_03	MS3 Factory Test Reports
		50_04	MS4 Civil Works
		50_05	MS5 AIS Substation Plant
		50_06	MS6 GIS Substation Plant
		50_07	MS7 220 kV Cables & Accessories
		50_08	MS8 Substation Installation
		50_09	MS9 220 kV Cables Installation
		50_10	MS10 O&M Manuals & Training
		50_11	MS11 Taking Over Certificate
		50_12	MS12 Contract Closeout
		50_13	MS13 Tests After Commissioning
		50_14	Cable Test Set
		50_15	Variations
		50_90	Contingency

Appendix C – Core Management Structure



PROCEDURE:

ENABLING WORKS CONSTRUCTION COST MANAGEMENT

Procedure Ref No:	**ODP02**
Version:	**1.1**
Date Approved:	**26/03/08**
Owner	**Graeme Oakden**
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EFFECTIVE FROM:	**March 2008**

DOCUMENT HISTORY

Version	Description	Author	Date
1.0	Revised as per 19/2/08 cost management meeting	Graeme Oakden	21/02/08
1.1	Add appendix on Scope Refinement and Variation mgmt plus minor changes	Graeme Oakden	26/03/08

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Appendix A – Scope Refinement and Variation Management

1. Purpose

This procedure defines the process by which Transpower (TP) and Transfield (TSL) are to manage contract costs on the Otahuhu Diversity Project Enabling Works contract. This includes ongoing management of change (through Scope Refinements and Variations), processing of payments and forecasting.

Its objectives are to:

- Support efficient and effective contract cost management
- Streamline administrative and approval processes including minimizing of paper records through email based submission and approvals
- Generate records to provide a full audit trail of both change and payment approvals
- Provide clear and easily identified links back to prime documents as a record of reasons for changes
- Meet Transpower's requirements for cost management using the MMS and FMIS systems
- Maintain a current record of actual expenditure, current approval and forecast by price schedule item that reconciles with summary figures in MMS/FMIS
- Clearly report contract cost status versus original contract price at detailed and summary levels

2. Overview

A key driver in establishing the cost management process for this contract is the need to accommodate the parallel development of design during the contract period and the associated ongoing 'Scope Refinement' during the construction period. A consequence is that there will be a relatively large number of changes to be managed under this procedure.

In the overall project work breakdown structure the Enabling Works Contract is one of six 'Workstreams'. Next level down is 'Work Package' being the 21 summary items in the pricing schedule followed by each of the approx 400 items in the contract price schedule at the next level. In order to minimize administrative effort the Transpower MMS and FMIS systems are setup to capture costs and commitments at Work Package level only with supporting detail at price schedule item level maintained in the TSL cost system.

This procedure covers the entire TP/TSL process on 'what' is required but not the detail on 'how' to do it. The

'how' is covered in Appendix A and other material as referenced.

Timings stated in the procedure are based upon meeting MMS requirements for payment processing.

The procedure steps are based around the level of transfer of responsibility between TSL and TP only. Within each step TSL and TP may have a number of secondary steps (eg TP approval involves ETC (GO) recommendation to TP then TP (JR or higher) approval then ETC (GO) transmittal to TSL of that approval)

3. Responsibilities

Roles and responsibilities in the context of this procedure are as follows.

Transpower – Responsible for initial setup of the contract in MMS, initiation of changes, review and approval of changes, review and approval of payments and processing of changes and payments in MMS.

Transfield – Responsible for developing and maintaining the system to support the process at price schedule item detail, submission of changes and submission of payments including MMS processing.

4. Inputs

- Enabling Works Contract
- MMS Requirements

5. References

- Enabling Works Project Management Plan
- TSL Contract Cost System (ie spreadsheet plus instructions for users)
- MMS User Requirements
- FMIS User Requirements

6. Outputs

- Scope Refinements
- Variations
- Payments
- Cost records and status reports

7. Procedure

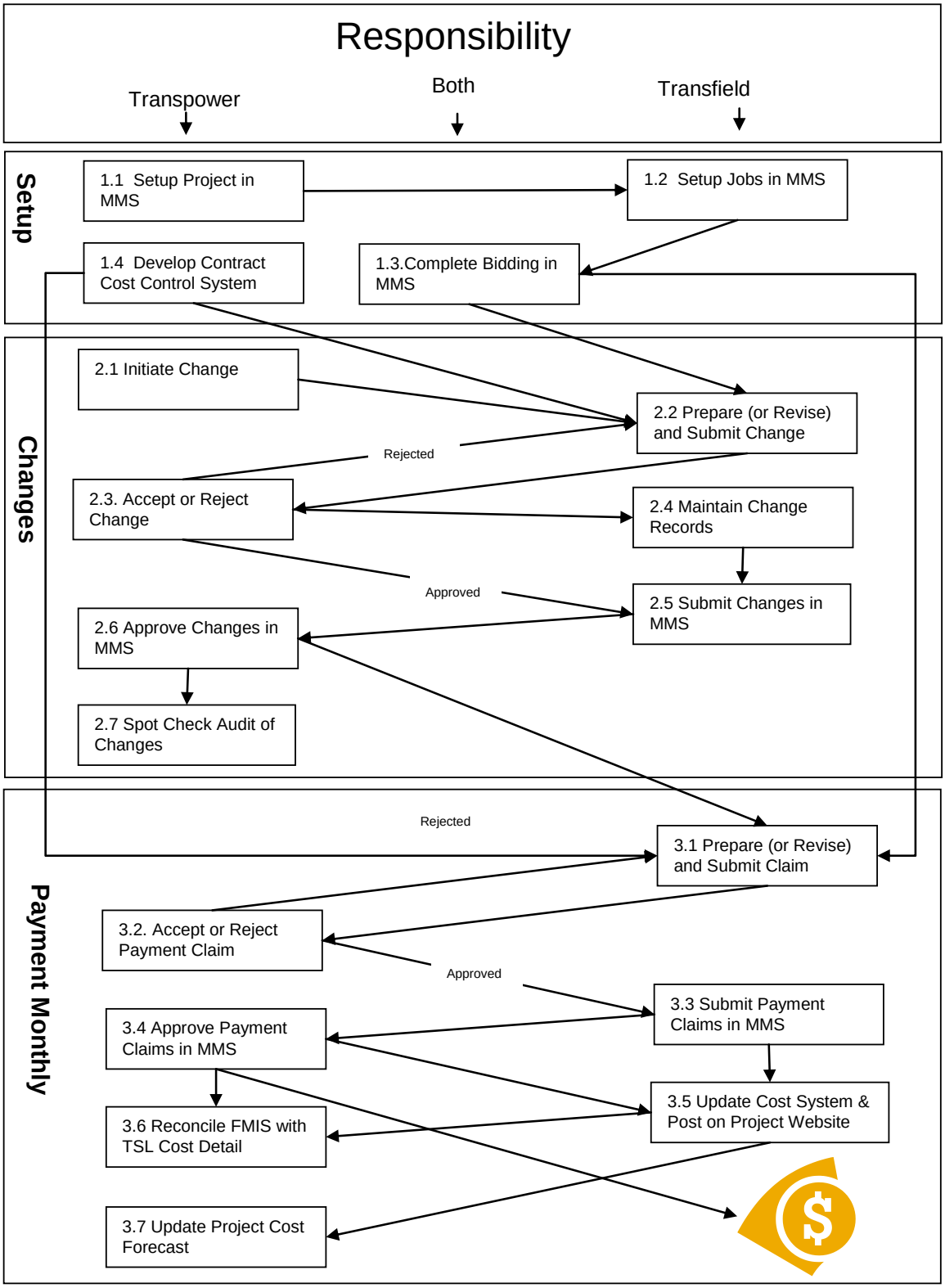
Step	Action	Who
1	**Initial Setup**	
1.1 Setup Project in MMS	Enter the 21 'Work Packages' (i.e. level 2 breakdown in price schedule) in MMS in accordance with MMS requirements.	TP
1.2 Setup Jobs in MMS	Enter 'Job Requests' in MMS with each Job linked to a single 'Work Package' being level 2 breakdown in the price schedule. It is noted that at initial set up 2 of the 'Work Packages' have 2 jobs each rather than 1 due to MMS constraints on approving values >$1.5M.	TSL
1.3 Complete Bidding in MMS	Complete standard MMS setup process being TP verification of Jobs, followed by TSL bidding prices as per the price schedule then TP approval.	TP/TSL/TP
1.4 Develop Cost Control System	Develop spreadsheet based system to support recording, tracking, submitting and reporting costs (including changes) in accordance with this procedure.	TSL
2	**Changes**	
2.1. Initiate Change	Initiate a change via a 'transmittal' issued in accordance with the project communications procedure. This may be to issue a package of drawings (usually processed as a Scope Refinement) or other instruction (usually processed as a Variation) often in response to a Contract Query or Design Query.	TP

Step	Action	Who
2.2. Prepare (or revise) and Submit Change	Determine price impact of change against current contract price by item as a 'Scope Refinement' or 'Variation' as appropriate and record in 'Changes' sheet of cost control system (refer Appendix A for details). Include an aggregate summary of changes by MMS Job for each change submission (i.e. to become the 'Work Orders' submitted in MMS under step 2.5 below) and submit to TP by transmittal. Note it is expected that TSL and TP will communicate informally on changes prior to submission to resolve issues and minimize the number of changes that are rejected in Step 2.3 and require revision under this step. Keep record of justification of change value versus underlying 'Estimator V6' contract price detail for review and audit purposes (see 2.7 below).	TSL
2.3 Accept or Reject Change	Review, negotiate as necessary, recommend (GO to JR) and accept change (JR). This may necessitate a further cycle of Step 2.2 by TSL. Advise acceptance or rejection by transmittal. (GO).	TP
2.4 Maintain Change Records	Update TSL cost system for accepted changes including status, amount and approval transmittal number.	TSL
2.5 Submit Changes as Work Orders in MMS Monthly	Submit new accepted changes as Work Orders in MMS from the accepted 'Changes' sheet (i.e. at Work Package/MMS Job level) monthly no later than 10 working days before calendar month end.	TSL
2.6 Approve Changes/ Work Orders in MMS	Approve submitted changes/Work Orders in MMS checking that they align with those in the accepted 'Changes' sheet (JR) no later than 8 working days before month end in time for invoicing against those variations in that month.	TP

Step	Action	Who
2.7 Spot Check Audit of Changes	Review and validate with TSL underlying detail of a sample of 3 to 5 changes per month. Initiate corrective action as required. Ratio of number requiring corrective action over total is a KPI reported to the Steering Committee.	TP
3	**Invoicing/Payment**	
3.1 Prepare (or Revise) and Submit Claim for Payment	No later than 7 working days before calendar month end prepare a progress payment claim for the month by updating the 'Payments' sheet in the TSL cost system (refer Appendix A for information to be provide) for current claim amounts by item. Include proposed claim summary by MMS Job/Work Order that balances with total claim by item and submit to TP by transmittal Note it is expected that TSL and TP will communicate informally on progress status prior to submission to resolve any issues and minimize the number of claims rejected in Step 3.2 and require revision under this step.	TSL
3.2 Accept or Reject Payment Claim	Review, negotiate as necessary, recommend (GO to JR) and accept claim (JR). This may necessitate a further cycle of Step 3.1 by TSL. Advise acceptance or rejection to TSL by transmittal (GO) no later than 4 working days before month end.	TP
3.3 Submit Payment Claims in MMS	Submit payment claims in MMS monthly as in the accepted 'Payments' sheet no later than 3 working days before month end as in the approved payment forms.	TSL
3.4 Approve Payment in MMS	Approve submitted payment in MMS checking that they align with the accepted 'Payments' sheet (JR) by the last working day of the month.	TP

Step	Action	Who
3.5 Update Cost System & Post	Update TSL cost control system with current approved changes, payments and forecast by item as at month end and post on the project website by the 2nd working day of the month for access by TSL and TP.	TSL
3.6 Reconcile FMIS Payment Records with TSL System	Reconcile FMIS commitments and actuals by Work Package (i.e. CA Project) at each month end against Work Package totals from TSL cost system. Follow up and arrange to fix any inconsistencies.	TP
3.7 Project Cost Forecasting	Incorporate TSL cost forecasts by work package into overall project cost forecast for month end reporting	TP

8. Flow Chart


Responsibility
Transpower
Both
Transfield
Setup
1.1 Setup Project in MMS
1.2 Setup Jobs in MMS
1.4 Develop Contract Cost Control System
1.3.Complete Bidding in MMS
Changes
2.1 Initiate Change
2.2 Prepare (or Revise) and Submit Change
Rejected
2.3. Accept or Reject Change
2.4 Maintain Change Records
Approved
2.5 Submit Changes in MMS
2.6 Approve Changes in MMS
2.7 Spot Check Audit of Changes
Payment Monthly
Rejected
3.1 Prepare (or Revise) and Submit Claim
3.2. Accept or Reject Payment Claim
Approved
3.3 Submit Payment Claims in MMS
3.4 Approve Payment Claims in MMS
3.5 Update Cost System & Post on Project Website
3.6 Reconcile FMIS with TSL Cost Detail
3.7 Update Project Cost Forecast

APPENDIX A – SCOPE REFINEMENT & VARIATION MANAGEMENT

1. Objective

This Appendix specifies the process for ongoing identification and processing of Scope Refinements and Variations as defined in the Contract to support the Cost Management Procedure.

The Principal, Contractor and Engineer to Contract have jointly developed a cost management process which includes:

1. Defining the initial **Total Contract Sum** for the contract and its breakdown into the various price schedule items and all related assumptions, rates, quantities and prices
2. A **Scope Refinement process** for managing the incorporation of the final (and approved) scope changes into the works and their effect (increase or decrease) on the Total Contract Sum
3. **Variation management** for managing the incorporation of changes into the works identified during the construction of the works and their effect (increase or decrease) on the Total Contract Sum
4. **Measure and value activities** where the Contractor carries out activities and is paid for the measured quantity at the agreed rate (items in the Price Schedule MV).
5. Pricing against **provisional and cost reimbursable items**
6. **An ongoing updating process** for the real time (as the contract progresses) cost management including regular updates of final contract forecast end cost to the Engineer and Principal
7. **Closeout of contract** and finalisation of all cost related matters

1.1 Collaboration

The parties agree that cost management for this contract will be undertaken in an open and transparent manner in accordance with the following guidelines:

1. The Contractor and Principal will endeavour to work together to solve any contract cost related matter.
2. The Contractor and Principal will notify the other party as soon as either becomes aware of any matter which could increase the Total Contract Sum.
3. The Principal, Contractor or Engineer may require the others to attend a meeting to discuss any early warning matter related to the contract cost
4. The Contractor will respond to any request for information made by the Principal or Engineer as soon as reasonably practicable. In any event the Contractor's reply will be not later than 5 working days after the request

5. The Engineer will respond to any request made by the Principal or Contractor for a response or decision as soon as is reasonably practicable. In any event the Engineer will provide a reply not later than 5 working days after the request

1.2 Role of the Engineer

The Engineer will facilitate the resolution of any matter between the Principal and Contractor. The Engineer will make a decision where the parties fail to reach agreement.

1. The role of the Engineer is as defined in clause 2 of TP/Wks 4
2. The Engineer will act impartially and fairly in all matters related to the contract and in particular cost (TP/Wks 4 GC 2.4)
3. Any decisions made by the Engineer will be in writing and provided to the Contractor and Principal (TP/Wks 4 GC 2.5)
4. The Contractor or Principal may dispute any decision or instruction made by the Engineer (TP/Wks 4 GC 2.6)
5. The Engineer may delegate any powers to the Engineer's Representative (TP/Wks4 GC 2.2). Any delegations must be in writing and must be provided to the Contractor and Principal
6. The Contractor accepts that at times the Engineer will have two roles, one as Principal's representative and the other as Engineer to Contract (ETC). If there is a conflict between these two roles the Engineer will retain the ETC role and request the Transpower Project Manager fulfil the Principal's role.

2. References

1. Conditions of Contract TP/Wks 4 G/3
2. RFP Document Appendix 4 Specials Conditions of Contract Additional Requirements for OTA-DIV-EW1

3. Definitions

Proposal Estimate
The estimate based on detailed design documentation and information made available to the Contractor up to the time of Proposal submission. For each work element the level of accuracy/completeness of the scope is given by categories (ie ND, PD, SD and CD as defined in 4.1-2 below). The Proposal estimate forms the basis of the initial Total Contract Sum.

Total Contract Sum
The Proposal estimate prepared at award of contract as updated regularly throughout the contract period to include approved Scope Refinements and Variations.

Contract Forecast
Best estimate of final Total Contract Sum built up from current Total Contract Sum plus estimated variances including submitted unapproved and forecast Scope Refinements and Variations

4. Scope Refinement and Variation Management Process

Both parties agree the need to provide price surety to the Principal whilst not disadvantaging the Contractor. Outlined below is a cost change management process to achieve this outcome in an open and transparent manner.

4.1 Defining the Proposal Estimate

1. Transpower had prepared (as part of the RFP process) a Schedule of Prices which splits the (scope of) Works into:
    a. Milestone items 1 and 2 (Project Management and Installation works respectively)
    b. Work Package items (comprising the Project Management milestone as one Work Package and the Installation works subdivided into 20 Work Packages as identified in the contract price schedule)
    c. Price schedule Items (break down of Work Packages to line items in the price schedule). For example item 2.6.5 or 2.7.5
    d. Price Schedule Items are split by cost classification (Labour, Plant, Materials) and listed as either LS, MV, CR or PC:
        - LS = Lump sum related for the work related to that defined / clarified within the notes
        - MV = Measure and Value against a unit rate with clarification within the notes
        - CR = Cost reimbursable with clarification within the notes
        - PC = Provisional cost allowance with clarification within the notes

2. Transfield have completed the Schedule of Prices and have:
    a. For the purposes of understanding the accuracy of the scope (and ultimately the accuracy of the pricing) the following categories are assigned to items in the Schedule of Prices:

ND = Not Defined
1. No similar or Transpower standard design information available
2. Estimate is based on high level information
3. Accuracy/Completeness of scope or design information <25%

PD = Partially Defined

1. No similar or Transpower standard design information available
2. Estimate is based on high level information including estimate from subcontractors or other source of information
3. Accuracy/Completeness of scope or design information 25%<PD<60%

SD = Substantially Defined

1. Similar or Transpower standard design information available
2. Estimate is based on information including estimate from subcontractors or other source of information
3. Accuracy/Completeness of scope or design information 60%<SD<90%

CD = Clearly Defined

1. Scope and design information to a detailed level
2. Similar or Transpower standard design information available
3. Accuracy/Completeness of design information 90%<CD<100%

b. Prepared the prices using information provided with the RFP documents and/ or their own assessment based on similar work activities undertaken for Transpower and/or Transpower standard designs, drawings and layouts. The reference/standard information has been indicated in the notes field of the "OTA-Enabling-wks-P-Schedule-Submission Rev_G.xls or in supporting correspondence

c. Prepared detailed Schedule of Quantities and related rates (Refer Transfield 'Estimator V6' Take off)

3. Transfield and Transpower agree that the totals for Milestones 1 and 2 plus agreed price changes will become the Total Contract Sum for the scope of the Enabling Works (the Works).

4 An electronic copy and (hardcopy signed by the Principal and Contractor) of the agreed Total Contract Sum and breakdown (to Transfield 'Estimator V6' level) will be made available to the Engineer and Principal in the event of dispute. This hardcopy will be initialled by both parties and be held in secure storage by the Contractor.

4.2 Scope Refinement

General comments

Scope refinement is the process whereby designs are issued and the price is refined based upon design drawings and specifications. This is the process of collaboratively working together to convert the ND, PD, SD and CD items into fixed and firm prices.

Scope Refinement Process

1. As the design is finalised/approved by Transpower the information will be issued by the Engineer to the Contractor. Transpower will issue complete and comprehensive design documentation for work areas to allow meaningful assessment by the Contractor as described below
2. The design information will be provided to the Contractor (at least 5 working days or as detailed in Contract Programme/Schedule) before associated construction commences. Any change to the work element, will be assessed by the Contractor under the relevant categories:
    a. **No change** to cost and / or time.

        The approved design is as assumed / designed in the initial work element pricing. No change in cost or time results.

    b. **Change in scope**

        The approved design is different from the designed/assumed scope for the initial work element. The Contractor will prepare and submit proposed scope refinements including revised price with all necessary supporting cost information. The change may be an increase or decrease in price. The following basis of pricing will be utilised:

        i. All rates, prices and quantities will be extracted from the initial Proposal Estimate including underlying detail.

        ii. Where no directly applicable rates exist or the application of existing rates would be inequitable or unfair then new rates will be agreed

    c. **Significant change**

        The approved design is, in the Contractor's opinion, a significant change or clarification from the design assumed / provided for the initial work element scope.

        The Contractor will prepare and submit all necessary supporting time and cost/pricing information as in b) above and reasons why the change is "material". Note: significant change can also relate to changes in quantum or nature of the particular works or change in design philosophy

3. The Engineer will review the submission, consulting with the Contractor and Principal before making any necessary changes and issue notification to the Contractor
4. Upon commencement of construction or procurement activities by the Contractor the method of cost change management will be as outlined in the Variation Management section described below.

4.3 Variation Management. (Post construction start)

General comments

The implementation of the variation management process is generally utilised when changes to the scope of works occur during site construction activities or after related procurement activities have commenced.

Examples of when the Variation Management process applies may include:

- A difference between the design drawings (upon which the scope refinement is based) and subsequent revised construction issue drawings
- Site construction activities / conditions / circumstances necessitate a departure from the construction issue design
- An instruction is issued by the Engineer to vary the works

1. The Contractor will assess the variation to the works under the relevant categories below:
    a. **No change** to cost and / or time – The approved design as presented in the construction issue drawings is as assumed in the initial work element. No change in cost or time.
    b. **Variation Request** –The Contractor is to prepare and submit proposed variations giving all necessary supporting time and cost information. Note the change may be an increase or decrease in price:
        i. All price increases will use rates from the Agreed Labour Plant and Equipment rates and agreed Overheads and Profit (ie Dayworks rates).
        ii. All price decreases will use rates prices and quantities extracted from the initial Contract Sum breakdown.
        iii. Quantities will be extracted from the initial Contract Sum. (Transfield Estimator V6 takeoff)
        iv. Where no directly applicable rates exist or the application of existing rates would be inequitable or unfair then new rates will be agreed.

2. Field work will proceed pending finalisation of any Variation Request and or price for the work element upon a notice to proceed being issued by the Engineer. The Contractor will gain the Engineer's approval to bring onto site any additional resources, plant or equipment to complete any variation activity (such approval will not be unreasonably withheld)

3. The Engineer will review the submission, consulting with the Contractor and Principal before making any necessary changes and issue notification to Contractor

4.4 Measure and Value Activities

Measurement of earthworks will be based on 3 topographical surveys to be conducted as follows:

1. Prior to commencement of Topsoil stripping
2. Prior to commencement of Bulk earthworks
3. On completion of earthworks

The difference between surfaces for surveys 2 and 3 will determine the volumes of cut and fill. This will also determine the cut to waste or imported fill requirement.

All other measure and value items will be measured during execution of the work and/or upon completion as appropriate.

4.4.1 Explanation of 25% Quantity Variance

The Transfield proposal includes the statement "*Please note that some rates may be affected by changes in quantity and >25% and Transfield reserve the right to review these rates for which a situation occurs"*.

The clause above is based on reasoning given for clauses 9.3.5 and 9.3.6 in the guidelines for NZS 3910:2003 In summary this is to protect against an item reduced in quantity sufficient enough to lower the productivity therefore effectively increasing the overhead for that item.

The nomination of 25% is a blanket figure to flag significant changes to measure and value items. In actuality, they would be looked at on a case by case basis as reduction (or increase) in quantity may have varying degrees of effect (or none at all) depending on both the schedule item and degree of reduction

4.5 Cost Reimbursable and Provisional Costs

Where the Classification for the Work Element is Cost Reimbursable (CR) or is Provisional as noted in the price schedule the applicable rates will be based on the rates included in the Proposal Estimate. (ie not Dayworks).

Where no directly applicable rates exist or the application of existing rates would be inequitable or unfair then new rates will be agreed

4.6 Records and Reporting

Transfield will maintain cost records and manage the updating and reporting process. The overall Construction Estimate will be recorded and maintained in an extended version of the Proposal Estimate (price) schedule spreadsheet. This will be developed to include:

1. 'Changes' sheet identifying each Scope Refinement/Variation and including:
    a. Initiating transmittal ID
    b. Price schedule item number
    c. Reason for Scope Refinement/Variation
    d. Drawing number, revision, title and issue date (where applicable)
    e. Variation/Price Refinement value including breakdown by labour, subcontract and materials
    f. Date of submission
    g. Approval status, date and approval transmittal ID
    h. MMS Works Order number
    i. Change category
    j. Change summary by MMS Works Order package
2. 'Payments' sheet identifying each price schedule item and including:
    a. Item ID
    b. Description
    c. Category (i.e. ND, PD, SD or CD)
    d. Classification (i.e. LS, MV, CR or PC)
    e. Unit, Quantity, Rate, Hours and prices as per Proposal price schedule
    f. Notes as per Proposal price schedule
    g. Approved value of Scope Refinements/Variations
    h. Total approved price
    i. Claimed last period
    j. Claimed to last period
    k. Claimed this period
    l. Total claimed to date
    m. Percent claimed to date
    n. Total forecast cost
    o. Subtotals by MMS Job/Work Package
    p. MMS claim summary by Job and Works Order

This spreadsheet will form part of the "open set" of project documentation that will be accessible to the Engineer and the Principal.

Transfield will maintain records of the underlying detail linked to quantities and rates in the 'Estimator V6' Proposal Estimate to support quantification of Scope Refinements and Variations for auditing by the Engineer under step 2.7 of the procedure.

Transfield's direct cost recording and documentation will be carried out in Transfield JDE/SAP accounting system

At the completion of each of the Project phases 1, 2 and 3 (or other stages as agreed) the Contractor will closeout that portion of the Works and provide the Principal with a final end cost for the phase (ie section) of the Works.

4.7 Contract Closeout

The Contract closeout of the Contract from cost perspectives will be completed as quickly as reasonably practical after issue of the Take over Certificate for each phase/stage.

TRANSPOWER

Transpower New Zealand Limited

Otahuhu Diversity Project

Independent Quality Assurance Review

Health Check Review

Date: January 2009

Version: 0.6 draft

Executive Summary

Introduction

IQANZ was requested by the Senior Risk Manager to provide an independent quality assurance Health Check Review of the Otahuhu Diversity Project as part of the 2008/09 Internal Audit Plan. KEMA Consulting has been engaged to address specific technical components. KEMA and IQANZ have not undertaken any previous reviews with respect to this project.

Project Background

The purpose of the Otahuhu Substation Diversity Project (the project) is to diversify and improve the reliability of supply into Auckland and Northland through the Otahuhu substation.

Currently most of the power for the upper North Island including Auckland and Northland is supplied through the 220kV Otahuhu substation, and its reliability is of critical importance to these areas. Furthermore, a major failure at Otahuhu could result in voltage collapse that would affect most of the North Island from Whakamaru northwards, and possibly further south.

Recent events at Otahuhu have highlighted the vulnerability of the existing switchyard to low probability, high consequence events. Historical developments have resulted in transmission lines crossing over both the 110kv and 220kv switchyards which, while not unusual within industry practice, pose the risk of falling conductors. While a rare occurrence, they are a high consequence event with an example of such being the power outage which occurred in 2006 caused by the failure of an overhead earth wire crossing over the existing AIS switchyard.

The solution proposed by Transpower is to build a new 220kV switchgear facility on the same site, but physically and geographically separated from the existing switchyard, with new and existing circuit connections diversified between the two. This would mean a failure in one of the switchyards would not result in a total loss of supply via Otahuhu substations, and also improve flexibility and operational options to restore supplies in the event of the major loss of load.

The key delivery objectives of the project are specified within the Project Management Plan Version 2.0 (the PMP) as:

- Most importantly: undertake the work safely – measured by achievement of safety KPIs
- No unplanned Loss of Supply (LOS) as a consequence of project work
- Delivery of specified project scope within the approved timeframes and budget
- Management processes developed and applied to support efficient and effective execution of the work
- Open and honest communications between the parties with no hidden agendas. This includes sharing of information unless there is a clear commercial imperative for confidentiality.
- A collaborative team approach by all project participants with communication and relationships between all parties conducted in a non-adversarial manner.
- Transparent management and appropriate escalation of issues at all levels of the project as and when they arise.

The project is a committed investment project with a budget of $99M approved by the Electricity Commission, and with a planned commissioning date of 2010. The project is currently in the delivery phase.

Review Objectives

The key objectives of this Health Check Review were:

- Determine whether the overall project management environment (governance, project management approach, processes, standards and controls) in place for project are appropriate, robust and in accordance with the Transpower's approved policies and procedures, and prudent practice.
- Provide assurance to the Sponsor, Sponsor Delegate and the Transpower Board that the project is being managed in accordance with internal guidelines and that it is well positioned to deliver expected outcomes within time and budget, and to the expected level of quality.
- Determine whether technical aspects of the project have been adequately considered for a project of this nature (undertaken by KEMA).
- Identify project strengths and weaknesses, and provide appropriate and pragmatic options and recommendations for any opportunities for improvement with regard to the project management approach, processes and controls in order that the project meets Transpower's project management requirements and prudent practice.

Conclusion

In summary, this is a large and complex project that is being well run by an experienced and capable project team. Being a multi-vendor project on a live switchyard, the close monitoring of inter-dependent tasks and safety management is of paramount concern. Safety is a prime requirement from Transpower and has been dutifully followed by the project team with adequate safety and site management plans, an emphasis on safety on site, evidence that contractors are 'walking the talk', and regular coordination and site management meetings to ensure transparency of all tasks on site.

Whilst a safety incident did occur earlier this year which was not immediately reported to senior management, it is not clear whether this would have been reported outside the standard 24-hour notice period expected from Transpower's contractors. However it is clear that safety is being provided the due attention it requires, and the vendors demonstrate a clear understanding that it is a number one Transpower priority.

A robust governance and management process has been put in place, utilising a Steering Committee of senior representatives from across the vendor organisations, to perform risk and issues management, as well as continue fostering the high level of cooperation that is evident across the project. While this is an effective means to ensure good communications across the vendors, it does mean some functions normally carried out by a Steering Committee cannot be done, such as monitoring delegated authority within the project, ensuring compliance with internal project management standards / quality, and guidance on vendor commercial issues and decisions, and ensuring adequate representation from the affected areas of the Transpower business. Instead this appears to be done between the line management functions of the Transpower Project Manager, Sponsor Delegate and Sponsor. We understand Transpower are establishing programme managers and a governance framework within the Grid Projects area, and are also considering forming a Governance Board. These roles could complement the project functions currently being considered by line management; in the interim, in the lack of any significant commercial vendor issues, the Steering Committee appears to be working well, although we would strongly suggest the addition to the Steering Committee of a representative from the Grid Performance division.

The need for civil works to commence before the scope and detailed drawings were fully defined, has led to the need for the development of an innovative scope refinement process to control costs and scope creep. A detailed pricing schedule was agreed within the Transfield and Maunsell contracts, with provisional estimates provided within the RFP responses for those work components that were only at conceptual design phase. As detailed drawings are completed by Maunsell, final costs can be ascertained under the scope refinement process. We understand the process is working well, with the final Maunsell costs tracking close to that originally forecasted, and Transpower satisfaction to date with the Transfield refined costs submitted. The success of this process is testament to the amount of planning to develop the procedure, and to the amount of trust established between Transpower and its preferred suppliers, Transfield and Maunsell, for the Enabling Works.

Bearing in mind that a number of innovative processes and procedures have been developed, we would suggest Transpower find some means for capturing and sharing these learning's across the wider Transpower team. This is perhaps something the new Grid Programme Management Office could consider.

The vendors have all expressed a clear understanding of the contractual procedures in place, the scope management, escalation process, safety requirements and objectives of the project. We note that Areva is a relatively new supplier for performing works with Transpower in this area, and accordingly are being managed with a more 'hands-on' approach. Part of this has been a series of design workshops based in Sydney to bring them up to speed on Transpower's design standards, expectations and requirements, and a clearly defined scope, detailed within their contract. We note that due to a two-month delay in completing contract negotiations with Areva and Areva securing subcontracting resource, the Areva schedule submitted to the project has no provision for contingency. Accordingly there is a high risk of slippage, although this is being monitored closely by the Engineer to Contract.

Minor improvements are possible for the project schedules, such as some task durations and linkages, but this is not unusual for a project of this size and complexity. Indeed, it is commendable that the right level of attention and detail to scheduling and dependency management is occurring, and the project should be encouraged to keep up the good work in this area.

A number of critical tasks have the potential to delay the project, such as the delay in manufacture and delivery of the 220kv cables, and relocation of the Contact sewer / stormwater pipe and other services. This is being monitored closely by the Engineer to Contract.

Risks are adequately captured in two risk registers maintained by Transfield for the Enabling Works (civil construction works, demolition and preparation of the switchyard platform), and by Areva for the DB1 works (the building of the enclosed GIS switchyard and cable troughs). The risk procedure has been developed on Australian / New Zealand risk standards. All risks expected for a project of this nature have been adequately captured, with only minor suggested improvements. We note that the management of risks is considered a prime function of the Steering Committee, and is appropriately dealt with at regular management level meetings.

It does appear that there is room for improvement for the level of engagement with the eventual Asset Owner of this project, being the Grid Performance division. While operational acceptance has been outlined within the Project Management Plan, we would expect further detail on how the operational impacts of the new asset are proposed to be managed, such as the handover of as-built standards, training, operational documentation, testing and commissioning, etc. This will become increasingly important as the project draws nearer to the commissioning date.

Review participants are satisfied that project deliverables delivered to date have been of high quality and the vendors are all ISO9000 accredited, with appropriate quality plans in place. However the discussion of quality within the project management plan is quite light. Bearing in mind this is an essential item for the project to minimise the risk of outages, and while we are satisfied there is a robust quality process in place for all project work, we feel it would be beneficial to have this outlined within one document (such as a quality management plan), or alternatively detailed in greater depth within the PMP. A programme of external / independent audits should also be a consideration for key milestone points.

Summary of Key Findings

The review findings (strengths and opportunities for improvement) from this review are summarised in the following table. In order for readers to quickly identify the relative strengths and weaknesses of the project we have assigned an overall effectiveness rating to each review element. The following key describes these ratings:

Key	Description
★	Effective controls / activities in place. No issues were identified.
●	Effective controls / activities, minor issues identified or some compensating controls exist.
▲	Partially effective controls / activities in place. Moderate or low risk issues identified.
✖	No effective controls / activities in place Or high risk issues were identified

Key Review Components	Rating	Key Findings
Summary	●	**In summary, this is a large and complex project that is being run well. A robust governance, safety and management process has been established, along with a Steering Committee (a first for the Grid Projects division) comprising senior representatives from across the vendors, to perform risk and issues management and focus on safety, as well as continue fostering the high level of cooperation that is evident across the project, although it would be beneficial to include a representative from the Grid Performance division.** **A robust scope refinement process has been established to control potential scope creep and cost control from the need for civil works to commence before the scope was fully defined. We understand the process is working well and is testament to the amount of trust established between Transpower and its preferred suppliers, Transfield and Maunsell, for the Enabling Works.** **Minor areas for improvement exist within scheduling, the descriptions and mitigation treatments currently recorded for some risks, and the potential development of a quality management plan and external communications plan, and further involvement of the Grid Performance division with the project.** **Additionally a number of critical tasks have the potential to delay the project, such as the delay in manufacture and delivery of the 220kv cables, and relocation of the Contact sewer / stormwater pipe. This is being monitored closely by the Engineer to Contract.**
Governance & Management	●	• Project Team members have the appropriate level of experience and authority, with a clear demarcation of roles and responsibilities, and there is a high level of confidence and trust amongst them. • The project utilises a Steering Committee (a first for the Grid Projects division) consisting of senior representatives from across the vendors for safety, risk and issues management, and as means of communication to continually foster cooperation across the project. • The Sponsor and Sponsor Delegate is actively engaged and senior management have high visibility of the project.

Key Review Components	Rating	Key Findings
		• A good range of key performance indicators have been developed and are utilised appropriately by the project management team. • Robust vendor and records management procedures are in place, with intranet sites and correspondence logs supporting strong version control for design drawings and other key project deliverables. • Minor improvement opportunities exist within the project management plan and the Steering Committee terms of reference.
Scope	★	• For the Enabling Works, an innovative scope refinement process has been established to control potential scope creep and costs resulting from the need to commence civil works before the detailed drawings were complete. For the DB1 (i.e. construction of the enclosed GIS switchyard), the scope is comprehensively detailed within the Areva contract. • For changes which are not scope refinements, there is an appropriate scope change management process and contract variation process which is managed by the Engineer to Contract, and includes the escalation of all scope changes impacting time, cost and quality to the Steering Committee for review and approval. • Review participants clearly articulated an understanding of the approved project scope and objectives, and noted the project is maintaining a tight control in this area
Time / Schedule	●	• Currently tracking to plan in respect to meeting the commissioning date, although two months behind in awarding the DB1 / Areva contract and there is a high risk of slippage due to the lack of any contingency within the Areva schedule. • A number of critical tasks have the potential to delay the project, such as the delay in manufacture and delivery of the 220kv cables, and relocation of the Contact sewer / stormwater pipe and other services. This is being monitored closely by the Engineer to Contract. • Full critical path analysis is not currently possible due to some missing linkages within the Areva schedule, however the Engineer to Contract is working with Areva to resolve this. Additionally, consideration might be warranted on conducting sensitivity analysis on key tasks, to help manage stakeholder expectations and project scheduling. • The project has established a robust scheduling process with fortnightly coordination meetings and 'rolling wave' approach to more detailed 'level 3' scheduling, which is entirely appropriate for a project of this complexity and should be commended. • The project makes good use of milestone table and rolled up GANTT charts for progress reporting.
Cost / Budget	●	• The project has regulatory approval to spend up to $99M and has recently approved P90 board approval for delegation to the CEO of this amount. The project is currently forecasting spend of $97M. • Detailed budgeting has been carried out to the work package level, and there are robust cost management and reporting procedures in place.

Key Review Components	Rating	Key Findings
		• Review participants noted the administrative complexity of having to use the Transpower Maintenance Management System (MMS) which is not really fit for purpose for use for projects of this size and complexity. For future projects, Transpower should consider alternatives for the financial management of project costs. • Robust cost control procedures for scope refinements and contract variations are in place.
Resources		• Feedback from review participants confirms that resource levels are tracking to plan, with the requisite capability and capacity to deliver expected outcomes, within time and to the required level of quality. • For the larger contracts of work, vendors have been engaged using the Transpower-modified FIDIC Yellow Book standards. • Establishment workshops were held for the Enabling Works and DB1 contracts immediately following their award to establish contract specific management objectives including responsibilities, processes, key drivers, KPIs and core values, including safety. • Key performance indicators are being used to monitor project team performance, safety and interactions between the two. (Such as design query response times). • A strong degree of trust and cooperation has been established across all parties.
Safety		• The project has developed 'safety' KPI's for the project, which are included within the monthly vendor status reports and monitored by the Project Manager, who has prime responsibility in this area. • Safety procedures appear robust, with key documents have also been developed by both Areva and Transfield for safety and emergency plans, and environmental management planning. • There is evidence that the contractors 'walk the talk' when it comes to safety. • Minor improvements exist in terms of the management of SF6 gas, which while being a low risk hazard should be included in the appropriate safety / site management plans. • There was a perceived failure to immediately report a safety incident earlier this year, however there was no evidence that this would not have been reported within the standard 24-hour reporting period during the normal course of events.
Risk & Issues Management		• Project risk management is carried out in accordance with the Australian and New Zealand Standard for Risk Management (AS/NZ 4360). • Two risk registers are maintained – one orientated towards Enabling Works and which is maintained by Transfield on their project intranet site. • Some minor improvements could be made within the risk registers in terms of the risk description and proposed mitigation strategy, and consistency within the risk ratings, and some missing risks detailed further within this report. • Appropriate risk management and reporting is carried out by the project, with adequate discussion at Steering Committee level.

Integration		• There are a high level of interdependencies within the project which are managed through an interlink schedule, monthly coordination meetings, on site representation and management plans, and representation by senior representatives across all the vendors on the Steering Committee. • More formal dependency tracking and management could be achieved through the development of a Dependencies Register. • The project is reliant upon securing planned outages in order to proceed, which is highly subject to outside influences, for example, dry winter events. • It is unclear as to what level of ongoing consultation is in place with the eventual Asset Owner, the Grid Performance division, and what steps are in place to minimise organisational impact upon this area. (E.g. Planned support arrangements, etc).
Communication		• The project uses a range of meetings across the parties, and review participants commented on a high level of transparency. • Communication is a prime responsibility for the Transpower Project Manager, and status reports provided to management teams and the Steering Committee are clear and of high quality. • Good use of sharepoint sites for version control and formal communication by way of email 'transmittals' which are registered within a correspondence log. • Communications is being handled appropriately, but given the concerns over reputational risk and opposition by MEUG by the project, we would suggest the development of an external communications plan to formalise and plan these communications and maintain key messages.
Quality Management		• The vendors are all ISO9000 accredited and review participants report a high level of standards within the project deliverables. • Evidence suggests an appropriate socialisation / consultation process with respect to key deliverables; with final approval points noted for all key deliverables and document within the project schedule and document controls. However we note the project may benefit from a separate quality management plan to provide guidance on quality management planning and to standardise quality management activities and clarify the standards expected.

Key Recommendations

The following recommendations should be addressed as a high priority:

- **Steering Committee Membership** (high priority) (*Recommendation 1.1)*

  Consider representation from the Grid Performance area (the eventual business owners) on the Steering Committee.

The following recommendations should be addressed as a medium priority:

- **Peer Review the schedule** (medium priority) (*Recommendation 1.6)*

  Conduct a peer review of the project schedules focusing on design hold-points, tasks of long duration, logical linkages and any missing tasks, and a sensitivity analysis of the critical path.

- **Organisational Impact Strategy Development** (medium priority) (*Recommendation 1.14*)

  Ensure adequate consultation, planning and documentation for impact on the Asset Owner, such as training and support procedures, transfer / acceptance of known issues, develop of ongoing maintenance contracts and procedures, etc.

- **Develop A Quality Management Plan** (medium priority) (Recommendation 1.18)

  Consider developing a quality management plan to detail and incorporate all quality measures, such as the design drawings peer review approval process and the levels to which external independent peer review is expected (e.g. in-depth review against Transpower Standards).

- **Consider the use of FMIS only and not MMS for Future Projects** (medium priority) (Recommendation 1.8)

  Consider the appropriateness or otherwise of FMIS only for use as a project cost and invoice control system rather than MMS.

Next Steps

The project report will be finalised and presented to the Project Sponsor. IQANZ is happy to discuss the detail of this report and provide further explanation and advice with respect to the intention behind the recommendations contained in this report.

Management Comment Summary

Specific Actions on Key Recommendations:

Recommendation	Priority	Management Response (including action to be taken)	Date Action will be Completed
Steering Committee Membership (Recommendation 1.1) Consider representation from the Grid Performance area (the eventual business owners) on the Steering Committee.	High	Agreed. Invite Ian Burgwin (or delegate) to join Steering Committee from next meeting in March 2009.	Feb 2009
Peer Review the schedule (Recommendation 1.6) Conduct a peer review of the project schedules focusing on design hold-points, tasks of long duration, logical linkages and any missing tasks, and a sensitivity analysis of the critical path.	Medium	Agreed. This will be incorporated in the planned review of the detailed integrated schedule to be carried out in March/April 2009 as agreed at 10/12/08 Steering Committee Meeting (refer minutes item 7.4 and action 4.2). Prior to this ETC will brief the 4 schedule owners on audit recommendations as input to the February 2009 schedule updates that will be used as the basis for this review.	Apr 2009
Organisational Impact Strategy Development (Recommendation 1.14) Ensure adequate consultation, planning and documentation for impact on the Asset Owner, such as training and support procedures, transfer / acceptance of known issues, develop of ongoing maintenance contracts and procedures, etc.	Medium	Accepted. Detailed planning has not yet been carried out for this; however, it is covered at a high level in PMP 4.12 and general Transpower requirements/processes are well established. It is considered that the optimum time for detailed planning, preparation and implementation of 'handover' to the Asset Owner is from late 2009 to commissioning in March 2010.	Dec 2009 to Mar 2010
Develop A Quality Management Plan (Recommendation 1.18) Consider developing a quality management plan to detail and incorporate all quality measures, such as the design drawings peer review approval process and the levels to which external independent peer review is expected (e.g. in-depth review against Transpower Standards).	Medium	Under consideration. AREVA, Transfield and Maunsell are all ISO9001 compliant and maintain the own quality plans accordingly. Transpower has established technical review processes with responsibilities as defined in the PMP for this project. It is not clear that a specific additional Quality Management Plan for the project will add value. The Project Manager will prepare a submission on the subject for consideration at the next Steering Committee meeting.	Mar 2009

Consider the use of FMIS only Instead of MMS for Future Projects (Recommendation 1.8) Consider the appropriateness or otherwise of MMS for use as a project cost and invoice control system.	Medium	Agreed. The requirement to use MMS for Enabling Works project payments adds significant administrative constraints, complexity and effort for little benefit to the project. The ETC and/or PM will brief the PMO for the benefit of future projects.	Mar 09

Document Signoff

W Edwards.

25.02.09

Wendy Edwards
Senior Risk Manager
Corporate Governance, Corporate Services
Transpower New Zealand Limited

[Date]

M Carter

2/3/09

Mike Carter
Project Sponsor and GM, Grid Projects
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[Date]

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Wendy Edwards	Senior Risk Manager	29 January 2009	v0.6 draft

Associated Documents

Document Name	Date of Issue	Version
IQA Terms of Reference	4 Nov 2008	v1.0 final

Background

Review Objectives

The key objectives of this Independent Quality Assurance Health Check Review were to:

- Determine whether the overall project management environment (governance, project management approach, processes, standards and controls) in place for project are appropriate, robust and in accordance with the Transpower's approved policies and procedures, and prudent practice.
- Provide assurance to the Sponsor and the Transpower Board that the project is being managed in accordance with internal guidelines and that it is well positioned to deliver expected outcomes within time and budget, and to the expected level of quality.
- Determine whether technical aspects of the project have been adequately considered for a project of this nature (undertaken by KEMA).
- Identify project strengths and weaknesses, and provide appropriate and pragmatic options and recommendations for any opportunities for improvement with regard to the project management approach, processes and controls in order that the project meets Transpower's project management requirements and prudent practice.

Review Scope

The scope of the work for this review focused on the following areas:

In Scope Components
• Review of the current status of the project to gain an understanding of progress and context for reporting purposes. • Review the project management environment including standards, processes and controls. • Provide comment on the quality of the following: – The processes to ensure appropriate governance and management of the project. – The project's monitoring and reporting processes and environment. – The existing and proposed project management controls. – The project's objectives, success criteria and their definitions against the agreed project charter. – The processes used to develop a clear definition of the total project scope, inclusions and exclusions. – The project schedule and estimation processes. – The project's resourcing approach and its ability to manage those resources. – The project's approach to financial management; including budgets, approvals and reporting. – The project's approach to decision making and the major decisions made to date. – The project's approach to change management (business and technical) and the major changes managed to date.

In Scope Components
– The project risks, mitigation strategies and management controls. – The project's approach to the management of its dependencies. – The project's communication management approach with internal and external stakeholders. – The project's quality assurance, audit and testing strategies and approaches. • Provide comment on the following technical areas: – Review of the technical aspects of the project to date. – Review the technical risk (all levels) and advise on the appropriateness of the risk level, remedy and any other technical risks which may have been overlooked for a project of this scope. – Review the potential effect on partially completed designs while construction is underway and comment on contingency aspects, communications, protection and the control building. – Review the preparedness of Transpower for the significant testing and commissioning schedule. – Review primary and secondary isolation techniques as applicable in a transmission substation, including a review of each contractor's Site Safety Plan. • Identification of findings (strengths and improvement opportunities) together with pragmatic recommendations in relation to any improvement opportunities. • Preparation of a draft report for factual accuracy review by the Project Manager. • Delivery of a final report for presentation to the Project Sponsor and Steering Committee.

The scope of this review excluded the following:

Scope Exclusions
• A review of the project feasibility study, business case and cost/benefit analysis. • A review of the procurement process, ROI, RFP and resulting contracts. • A technical review of the design and solution chosen. • Any ICT or business operational processes.

Approach

Our approach for this review was to:

- Review the project management documentation outlined in Appendix A – Project Documentation Checklist.
- Meet with the Engagement Sponsor to determine the key stakeholders to be interviewed as part of the review process. IQANZ conducted interviews with key stakeholders, who included:
  1. Project Sponsor Delegate – Mark McKenzie
  2. NI Projects Manager – Bob Coombes
  3. Project Manager – Jitesh Raniga
  4. Engineer to Contract – Graeme Oakden (Contractor)
  5. Engineers Representative – Garry Wright (Beca)

6. Technical Manager – Malcolm Stewart
7. Transfield PSC Member – Roger Foy
8. Transfield Project Manager – Colin Kemp
9. Maunsell PSC Member – Anant Prakash
10. Maunsell Design Manager – Kevin Morris
11. Areva Project Manager – Anil Asija

- For the technical aspects of the review, KEMA conducted additional interviews with:
    1. Engineer to Contract – Graeme Oakden
    2. Technical Manager – Malcolm Stewart
    3. Transfield Project Manager – Colin Kemp
    4. Areva Project Manager – Anil Asija

- Meet with Mike Carter, GM and Patrick Strange, CEO, to discuss initial findings prior to drafting the report.

The following table outlines the roles and responsibilities and schedule of activities undertaken during this review.

Action	Objective	Resource
Preparation		
Agree Quality Assurance requirements	Identify the specific quality assurance review requirements. Familiarise IQANZ with Transpower's ICT Governance Framework and Enterprise Project Management Methodology. Familiarise IQANZ with the project background and context.	Engagement Sponsor IQANZ Practice Manager
Draft Terms of Reference	Document review objectives, scope, approach, dates, interviewees and documentation to be reviewed.	IQANZ Practice Manager
Approve Terms of Reference	Review, approve and signoff the Terms of Reference. Authorise commencement of the IQA process.	Engagement Sponsor Project Sponsor
Execution		
Documentation Review	Request project documentation. Detailed review of project documentation. Prepare file notes of key findings and recommendations.	Engagement Lead Senior Consultant
Conduct Interviews	Conduct interviews with agreed stakeholders, covering project management control areas and specific questions arising from documentation review.	Key Stakeholders Engagement Lead Senior Consultant

Action	Objective	Resource
Initial Review Findings	IQA review team workshop to review initial findings, highlight significant issues, ensure scope and objectives of review have been covered. Draft initial findings and recommendations.	Engagement Lead Senior Consultant
Draft Report	Draft detailed findings and recommendations in regard to review.	Engagement Lead Senior Consultant
Internal QA Review	Ensure quality of report adheres to internal IQANZ standards, Terms of Reference and agreed quality measures.	IQANZ Practice Manager
Draft Report	Presentation of the draft report to the Management Chair.	Engagement Lead Senior Consultant Management Chair
Completion		
Finding Validation Review (Factual Accuracy)	Review draft report to ensure findings identified are factually accurate.	Management Chair
Final Report	Present final report (hard and soft copy) to Project Sponsor.	Engagement Lead Project Sponsor

Review Team

IQANZ assigned an experienced team of personnel to conduct this work. David Benfell led this engagement.

Team Member	Role
David Benfell	Engagement Lead
Justin Parker	Senior Consultant
Phillip Grieshaber	KEMA Principal Consultant

Detailed Findings and Recommendations

Governance and Management

Rating	●	**Effective controls / activities, minor issues identified or some compensating controls exist**

Findings

Project Management Structure and Controls

The project is a relatively large, complex and long duration project, engaging multiple vendors on a live 220kV switchyard. The project is managed in two parts:

- Enabling Works: covers the provision of a new switchyard platform for the GIS / AIS construction and associated work, plus existing bus and line protection upgrades. Maunsell have been retained to perform the design works for the Enabling Works, with Transfield the prime for its implementation.
- DB1: covers the new GIS and AIS facilities plus EHV cabling, which includes the cable troughs and building of the substation. Areva are performing both the design and construction works for DB1.

The team structure is outlined in Appendix B – Project Team Management Structure, which has been taken from the Project Management Plan (PMP). The project follows the standard Transpower approach for Grid upgrade projects whereby an Engineer to Contract (ETC) works to a Project Manager from the Grid Projects division. The project manager in turn reports to his line manager, the Northern Projects Manager. Under this arrangement in addition to acting as the conduit for technical / engineering issues the ETC does a substantial amount of project management work, such as responsibility for project controls, setting up the project framework, managing the interfaces and the scope refinement process. Whereas the Project Manager appears to act at more of a project director level, split across a number of major projects, and with prime responsibility for finances, external communications and safety.

We note this approach appears to work well for this project, with review participants clear on roles and responsibilities.

We understand Transpower are currently reviewing this project approach in general, with a view to removing the ETC, introducing programme managers, and re-balancing the tasks into the current Project Manager role with support from the newly established programme management office (PMO). Transpower are also considering whether to establish a governance group to sit across all Grid projects. However, the Otahuhu Project will remain in its present form until completion.

The vendors have been engaged for the larger contracts using the Federation Internationale des Ingenieurs-Conseils (FIDIC) Yellow Book[1] standards which have been further refined for Transpower's needs. All other contracts follow Transpower's suite of contract conditions depending on contract value. For example, the Enabling Works construction contract with Transfield complies with Transpower standard "TP Works 4G3" conditions, which also sets out the deliverables.

Project management is through the PMP version 2.0 dated October 2008 (the PMP) and integrated project schedules, along with the measurement of a number of project KPI's, including an emphasis on safety, and supporting project management plans from the vendors. Currently projects are expected to follow the 'Capital Works Process' which is effectively a project management framework, and the substantial range of design templates and Transpower construction policies, standards and requirements. In terms of PMP's and other project deliverable templates, the project has used the best available at the time. However with the establishment of the

[1] FIDIC Conditions of contract for Electrical and Mechanical Work.

PMO, it is expected that these templates and styles will be further refined and standardised across all Grid projects.

A review of the PMP for this project finds that it is a robust document with references to other documents to avoid duplication. While this is appropriate, we feel certain areas should be duplicated again within the document, such as the terms of reference for the Steering Group, and the roles and responsibilities of the core project team members.

The project is unique within the Grid projects area in that it has a Steering Committee, primarily established due to the need for the project to commence civil works before designs had been completed and to sit across subsequent risks, remove roadblocks and ensure open communication amongst all the parties. The Steering Committee consists of executive members of the prime vendors and Transpower, including the Sponsor Delegate.

The project is currently in the delivery phase.

Sponsor Delegate

The Sponsor Delegate, in his capacity as the Capital Works Programme Director, has the appropriate level of organisational oversight and authority to successfully sponsor the Project and has taken a detailed interest due to the reputational risks associated with the Otahuhu substation. He has substantial project management experience and is the driver behind the existing project changes within the Grid Projects area, including the establishment of the PMO. Examples of his detailed involvement have been a complete detailed review of the first scope refinement submitted by Transfield, and of the costings behind the first scope variation, aided by his background in cost engineering. He also chairs the Steering Committee. He has a particular interest in ensuring safety for the project.

The Sponsor Delegate has been involved with the project for circa 18 months.

Core Project Management Team

The project manager has been with Transpower for over six years, with experience in the Transpower projects pre-approval management unit before moving to the Northern Projects Team. Accordingly he has an excellent understanding of Transpower processes and is receiving a good level of mentoring / support from his line manager, the Northern Projects Manager. The project manager is currently working on three other projects and is primarily responsible for external communications and safety. He is based in Auckland and meets regularly with the Project Team, and co-locates to the site office 2-3 days each fortnight.

The Northern Projects Manager has a team of five project managers and is responsible for all grid upgrade projects north of Taupo. He effectively acts as part practice manager and part portfolio manager of the projects under his care. He meets weekly with his team to monitor progress and provide mentoring and support.

The ETC is an independent contractor, PMI certified and with extensive experience in Transpower projects. He is currently fully engaged on Transpower projects, working on this project and managing the business process reengineering stream within the Transpower Market Systems Project (MSP). The ETC runs a series of meetings with the DB1 and Enabling Works Management Teams, including progress meetings, risk workshops, and schedule coordination meetings. The ETC also manages the commercial aspects of the vendor arrangements, including the scope refinement and contract variation process, and has extensive experience in this area. Feedback to date is that the ETC has established a high level of engagement with the Steering Committee members, the project team and key stakeholders. He is based in Wellington and co-locates to the Otahuhu Site office 2-3 days each fortnight.

The ETC has an Engineers Rep based in Auckland for managing the onsite construction of the project, including resolving minor technical issues as they arise. The Engineers Rep is an employee from Edison, with extensive experience in Transpower projects. He is assigned 2-4 days per week on the project, ramping up or down dependent on the level of project activity. He is currently also engaged in overseeing another project at Otahuhu which is replacing some of the aged infrastructure on the existing switchyard.

Feedback from review participants indicates a high level of confidence in the experience and capability of the project management team, with particularly good feedback about the ETC's experience, relationship skills and overall capabilities.

Management Teams

The construction work is split into two streams, DB1 and the Enabling Works. We note that both the DB1 and Enabling Works proposed management team structure and key personnel were thoroughly vetted for competencies and experience by the Transpower project team during the RFP process. Both Management Teams have the Transpower ETC, Engineers Rep and Project Manager on them, and are highly experienced and capable.

Transfield has established a construction office onsite, where the Transfield project management team is based. There is also ample room for the Core Project Management team, including specific desks for the ETC, Engineers Rep and Transpower Project Manager. Transfield also has a project facilitator assigned to the project whose duties include managing the Transfield's Intranet site for the project. The Transfield Project Leader is the GM for Projects and Generation Group, and has over 30 years project experience. The Transfield project management and team structure is specified in the Transfield Enabling Works Project Management Plan.

The Areva Project Manager has extensive experience in electrical construction, and was originally a protection and control engineer. We note that while Areva have not had extensive experience on Transpower projects, this is mitigated by a more thoroughly detailed contract, their involvement on the Steering Committee, a more hands-on management approach from Transpower, and Transpower has given Areva access to their internal intranet site for Transpower design policies and standards. The Areva project management and team structure is specified in the Areva Project Quality Plan.

All vendors expressed a clear understanding of the contractual procedures in place, the scope management, escalation process, safety requirements and objectives of the project. Review participants commented there has been a commitment within Senior management across all vendors

Technical Management

A Technical Manager has been assigned to manage technical issues as they arise and for quality assurance of the design work. The Technical Manager has been with Transpower for over 18 years and is a Senior Development Engineer, with the ability to draw on technical expertise from the different groups across Transpower, as well as contracted resources / specialists as and when required for peer review and conducting the design work itself.

Checks and balances are achieved through a spot check of design changes by the ETC, although this is of limited value as the ETC does not have the same level of expertise. However, review participants noted that the Technical manager is highly competent and pragmatic in his design work.

Steering Committee

The Steering Committee consists of representatives from across Transpower and the three prime vendors at senior management level, with attendance by the four project managers, ETC, and the Technical Manager. This is an excellent way of ensuring a good flow of information between the vendors, issue escalation, buy-in from all parties, and brings a wealth of expertise to the group. However, we note that as Transfield and Areva are competitors there are restraints on what issues can be raised and dealt with at Steering Committee level, such as commercial issues (if any) with the vendors and concerns about vendor performance; and functions such as monitoring / ensuring delegated authorities within Transpower are being adhered to. We also note the absence of any representation from the Grid Performance division, which will be the eventual owner of the asset.

Steering Committee members interviewed articulate a consistent understanding of project scope and objectives; and involvement to-date shows clear accountability for undertaking their project governance responsibilities. Key duties of the Steering Committee include risk management, scheduling for planned outages, ensuring the project achieves critical success factors and to act as a forum for communication across the parties – although the Chair is careful to ensure this does not become an arena for aggrieved commercial claims.

A terms of reference for the Steering Committee has been established and agreed between members, although some minor areas have not been covered within it, (detailed within the recommendations below). Additionally, it is not apparent whether the Steering Committee has any delegated authority to act.

Steering Committee meetings are held on a regular basis and are provided adequate time for meetings (up to four hours), which are chaired by the Sponsor Delegate, with the ETC performing the secretariat function for these. Meetings are face-to-face. Feedback from review participants was that the Steering Committee is working well.

We were advised from participants that this is the first time a steering committee has been utilised for Grid Projects, which is a reflection of the size of the project, complexity and number of contractual interfaces involved. We understand Transpower are considering introducing Steering Committees for other projects of a similar size and scale.

Monitoring and Reporting

The Steering Committee receives a steering committee reporting pack three days in advance of Steering Committee meetings. The packs provide a comprehensive level of information along with key performance indicators (KPIs) and construction photos, the latter of which review participants have agreed have contributed to a good understanding of progress.

We understand that while the project has been formally approved by the Electricity Commission, there is no ongoing requirement to report on progress. Governance is provided through existing practice where project managers produce regular (currently monthly) project status and commentary reports to the line manager, who reports upwards in turn. These are picked up within the Divisional Reports to the CEO who reports to the Board on the project as required. These reports are also made available to the Grid PMO and others.

The Grid PMO also collates and analyses project status reports and provides summary status information to Transpower management for governance and higher-level reporting purposes on a monthly basis.

In summary, we find the project has established robust governance and management procedures, with senior management actively engaging in emphasising the need for cooperation amongst all parties. It was noted that while there is a good level of interest by senior management in the project, during major events on site such as planned outages, a senior management presence onsite to provide visibility of Transpower's commitment would encourage further project team motivation. Additionally, regular positive feedback (where warranted) would also be beneficial, especially for team members where was work conducted during adverse conditions such as weather storms. A primary concern is the possible lack of involvement from the eventual Asset Owner in the project, and we would suggest as a minimum their representation on the Steering Committee.

#	Recommendations	Priority	Owner	Due Date
1.1	**Steering Committee Membership – Asset Owner** Consider representation from the Grid Performance area (the eventual asset owners) on the Steering Committee.	**High**	Sponsor Delegate	Feb 2009
1.2	**Steering Committee Reporting Packs** Consider extending issuing the reporting pack at least one week in advance of meetings, from the present three day period. Add to the agenda the approval of minutes from the previous Steering Committee meeting.	**Low**	Project Manager (see comments re trade off for report quality if one week lead time is agreed)	Completed
1.3	**Project Management Plan** Consider adding: - A summary of the Terms of Reference for the Steering Committee, - Descriptions of the roles and responsibilities of the members of the project management team - Commissioning and testing strategy, or reference to how this will be developed. - Handover to BAU procedure, and development of supporting operational documents.	**Low**	Project Manager	Mar 2009

1.4	**Steering Committee Terms of Reference** Consider adding sections on: - The process where a Steering Committee member cannot attend (e.g. proxy vote? Post-briefing? How to advise non-attendance?) - Decision making (e.g. Chair to have power to bring discussion to an end and determine a position) - Recording of decisions. e.g. written resolution to be signed by all parties? - Circulation of minutes. i.e. to be within 3-5 working days of a steering committee meeting - A signature panel for each Steering Committee member's signoff	**Low**	Sponsor Delegate	Mar 2009
1.5	**Senior Management Visibility** Consider the onsite presence of senior management during major events such as during planned outages, so as to emphasise cooperation and motivate the project team.	**Low**	Sponsor	Feb 2009

Scope

Rating	★	**Effective controls / activities in place, no issues were identified**

Findings

Scope Definition

The scope of the project is to build a new physically separate, enclosed, high reliability 220 kV switchyard on the Otahuhu site for diversification. The scope was documented within the Otahuhu Substation Diversity Project Grip Upgrade Plan Application for Approval (dated 4 December 2006) as:

- Construct a new 220 kV Gas Insulated Switchgear (GIS) facility adjacent to but physically separate from the existing 220 kV switchyard. This switchyard will be for the connection of incoming and outgoing circuits.
- Construct a new 220 kV air insulated switchgear facility adjacent to the new GIS building in single breaker double bus configuration. This switchyard will be for the connection of reactive plant and transformers.
- Connecting the existing switchyard to the new GIS switchyard by two cable tie lines.
- Re-arrange the existing 220 kV Henderson and Penrose outgoing lines and the 220 kV Huntly and Whakamaru incoming lines so that one circuit from each line will be connected to the new 220 kV GIS facility. Rearrangement of these key incoming and outgoing circuits will result in a split of circuits between the existing switchyard and new switchgear so that the loss of either facility will not result in a total loss of transmission capacity into Auckland and Northland.
- Construct a new control room for the two new switchyards. This will be geographically and electrically independent from the existing control room.
- Remove and cable existing 220 kV crossovers of the 110 kV bus.
- Install two bus section circuit breakers in the existing switchyard in order to improve its reliability.

A detailed Solutions Study Report developed by Maunsell in conjunction with Transpower (numbering some 177 pages) was completed in August 2007 which detailed the proposed design and scope of works. This was further built upon within an RFP and the resulting contracts that were developed with the vendors.

Deliverables from the previous development phase of the project included the RFP and awarding of the DB1 contract, the conceptual design for the enabling works, resource consents, property acquisition and agreements, and the requisite Electricity Commission and Transpower approvals to proceed with project delivery.

The scope of the delivery phase of the project is to establish contracts for the design and construction of the enabling works (now complete) and implement these works; develop the design and execute construction of the new GIS and AIS facilities through the DB1 contract, and the commissioning and handover of the new facilities.

Due to the construction window for the enabling works and to allow construction to commence in January 2008, it was decided to commence the civil works before the detailed design work was complete. Accordingly a construction contract was awarded in December 2007 with detailed design and construction proceeding in parallel, with the scope based on the work completed in the detailed solutions study. The size of the required platform and components were not given, instead vendors were asked to make assumptions (e.g. volume of concrete / steelwork required) and priced on this basis for the RFP (the provisional sum / estimate).

The design work for the Enabling Works has been scoped into three separate work packages, all of which has been awarded to Maunsell via a competitive RFP tendering process with clear milestone dates per design deliverable. The project also ensures a continuous flow of information between Transfield and Maunsell to ensure

design resources are directed to the requisite design components should re-prioritisation of delivery dates be required, such as to will allow time for adequate planning and resourcing by Transfield.

Monitoring and control is achieved through a detailed, integrated schedule with the vendors which is discussed every two weeks at project coordination meetings with the vendors run by the ETC. Design version control is managed by Transfield via a sharepoint system managed on their intranet. Risk is mitigated by the fact that both Maunsell and Transfield have done this type of work before, and as a preferred supplier are expected to understand Transpower's required standards. We note this needs to be rigidly monitored and controlled to ensure focus is maintained on design inputs and delivery of the design drawings between the parties as required.

For the DB1 workstream, the contract is both a Design and Build contract. As Areva are somewhat new to being used by Transpower in this area, the scope has been comprehensively detailed within the contract, although review participants note Transpower are open to design refinements and suggestions. Further, current design workshops are underway with Areva to ensure understanding of Transpower's existing design policies and standards that will help further clarify scope, coupled with a peer review function of the completed designs by the Technical Manager.

Review participants articulated a clear understanding of scope and of the project delivery objectives.

Scope Change Management

For the Enabling Works, the risk of scope creep and thereby costs was high in that the enabling works had to commence before the scope was fully defined. To reduce this risk, an innovative approach has been taken to pricing whereby for work that could not be clearly defined within the RFP, Transfield and Maunsell were required to develop a pricing schedule within their RFP response, with provisional estimates provided based on what was understood from the conceptual designs and the solution study. As the project progresses the scope and costs are further refined against the design drawings (as they are completed) from Maunsell as part of a 'Scope Refinement' process, against the rates in the pricing schedule. A detailed 'Scope Refinement Process' is prescribed within the Transfield Enabling Works Construction Contract, and an Enabling Works cost Management Procedure which was developed and agreed with Transfield.

Review participants note this process is working well. The ETC also notes that while they could have employed an independent quantity surveyor to double-check pricing, due to the transparency and maturity in Transfields pricing, only spot checks have been required by the ETC. The Sponsor Delegate was also involved in a detailed, line-by-line cost breakdown for the first scope refinement and scope variation that was submitted, and only minor changes were required as a result of this review. The Sponsor Delegate also has a background in cost engineering.

Scope variations and where major design changes are required fall within the contract variation / scope change management process. We understand there is a substantial dependency on the Transpower Technical Manager for the direction and finalisation of the design work. However, review participants noted the Technical Manager is pragmatic and has been involved with the project since its conception, as well has having had in excess of 16 years experience within Transpower. We understand there is a healthy tension between the ETC for cost and time control, versus the Technical Manager's responsibility for quality, where discussion is welcomed.

We note there have been recent scope increases include the need for a rain-water filtration system to meet Manukau city Council resource consent requirements (due to a concern over heavy metal levels in measured rain-water runoff from the site), and ongoing problems with the relocation of the Contact Energy sewer main.

In summary, we find the project has in place a thorough scope definition and scope change management process which should ensure scope is appropriately managed within time, cost and quality constraints.

We have no recommendations for this section.

Time / Schedule

Rating		**Effective controls / activities, minor issues identified or some compensating controls exist.**

Findings

Status

The project is currently in the delivery phase and on track for the March 2010 commissioning date, although slippage due to the late awarding of the DB1 contract and Areva's delay in securing a subcontractor means review participants note the timeframes are now tight, but still achievable. We also understand the DB1 schedule contains no schedule contingency and has complex, concurrent parallel near critical paths, with dependence on outage availability and other associated risks detailed below. Accordingly the risk of slippage is high, and this is appropriately recorded within the PMP and the risk register.

A number of critical tasks have the potential to delay the project. AREVA advised they believed that the relocation of existing services (cables, communications, water and waste water services) were program critical.

From a technical point of view the delay in manufacture and delivery of the HV Cable test set was agreed by all interviewees as potentially able to significantly delay the testing of the 220kV cables and impact the project end date.

Transpower understand that the GIS and Control Building is also likely to become critical. The impact to the overall project program has been caused by the late award of the building construction contract. The completion of the substation building is critical as it houses the GIS switchgear and control and protection systems.

There were varying opinions received from interviewees regarding other critical program tasks, although we note the ETC appears well aware of these tasks and their critical nature.

The project is currently facing a problem with the relocation of the Contact sewer / stormwater pipe and other services. This is registered as an issue and all parties are working to resolve this.

Schedule

The scheduling procedure is outlined within the document entitled 'ODP01 Scheduling procedure', and specifies that projects schedules must be built up by the vendors based on a logically structured work break down structures.

The master project schedule was based on timeframes developed in the Solutions Study report, and further refined based on schedules developed with the vendors. Vendor schedules are further refined in detail by way of an iterative, 'rolling wave' approach as the project progresses (e.g. Maunsell releases new design works and further planned outages are secured, etc), although high level detail and critical milestones remain the same within the master project schedule, which was based lined on 1 August 2008 soon after the award of the DB1 contract and finalising the schedules with Areva.

We have reviewed a series of project schedules for each of the associated contracts, the Transpower overall contract program and an integrated schedule. In general, the project schedules are comprehensive and effort has been applied in identifying all pre-requisite tasks. Given the situation that the substation design work is being carried out in parallel with construction, it would be appropriate to further break up the design tasks and identify key approval hold points.

This has been addressed comprehensively in the AREVA program with up 82 separate approvals with Transpower identified to date within the AREVA schedule. The ETC notes this is part of an ongoing stream of several hundred technical approvals managed by the Technical Manager and his Technical Support team. Accordingly while this large number of separate approval activities and their associated durations provides a challenge for Transpower, the ETC states it is an integral part of the Transpower approach to the technical management of the project and notes that the technical team have provided an excellent turnaround of approvals and information to date.

A review of all project program tasks was undertaken and a number of long duration tasks were identified. It is considered that if the duration is long then it is possible that the work breakdown for these tasks could be longer or shorter than the duration identified. Examples of long duration tasks from the AREVA program include:

1. AIS Equipment testing – 10 weeks
2. Secondary Systems Testing – 6 weeks

It is possible to breakdown the secondary system testing into task of durations from 1-4 days as a minimum. A similar breakdown is possible for segments of the AIS testing.

All interviewees advised that the duration of these tasks were reasonable but it is possible for these activities to overrun. It was pointed out that further more detailed testing programs and plans would be developed well in advance of this testing.

It was apparent that there were many program tasks dedicated to installation of the earth grid for the substation but no specific task identifying the final testing of the earth grid and linking this as a pre-requisite task to further 220kV cable, AIS and GIS livening and testing activities.

As discussed in the interviews, the substation is utilising GIS and as part of any typical substation, there is a detection system installed to detect the presence of SF_6 leakage. A program item to identify the installation and subsequent testing of this detection system was not found on the program. It would also be a pre-requisite for installation of the GIS equipment in the GIS and control building.

Monitoring of the schedules and their interdependencies is performed through 'Coordination' meetings run by the ETC, and within the vendor status reports. A rolled up GANTT chart is also reported to the bi-monthly Steering Committee meetings.

Scheduling is backwards looking based on planned network outages the project is able to secure for commissioning purposes. A key risk is whether the project can secure enough network outages of the required duration to successfully complete all commissioning activities on time, which could be materially impacted if there is a dry winter.

In summary, the project has established robust scheduling procedures and detailed schedules are in place, with the need to adhere to these standards understood by all parties. We have identified only minor improvement opportunities.

#	Recommendations	Priority	Owner	Due Date
1.6	**Review the schedule** Conduct a peer review of the project schedules focusing: - specifically on design hold-points. - long duration tasks. e.g. the Areva testing timetable and reduce or breakdown any long duration testing tasks. e.g. secondary systems testing - for any missing tasks, such as the SF6 gas activities.	**Medium**	Engineer to Contract	Apr 2009
1.7	**Sensitivity Analysis on Durations** Rather than focusing specifically on the critical path, consider applying some sensitivity analysis to the durations of the next most critical items including GIS and control building construction and relocation of services, to allow stakeholder expectation management.	**Low**	Engineer to Contract	Apr 2009

Cost / Budget

Rating	★	**Effective controls / activities in place, no issues were identified**

Findings

The project has regulatory approval from the Electricity Commission for up to a $99M spend limit. The Transpower Board approved a budget of $83M in September 2007 based on the P50 estimate in 2006 dollars. The budget has recently been approved to increase to $99M, (which is still within the MAC) based on a recent board paper that reported costs increase due to an increase in the cost of earth works and the final negotiated DB1 contract, with current estimated total spend at $97M.

The project budget has been appropriately mapped back to the project work breakdown structure.

As per Transpower procedures, the project was set up via the Transpower Maintenance Management System (MMS). The ETC raised a concern about MMS being administratively cumbersome to operate, primarily as it is a maintenance based system and does not easily allow for project related expenses and/or variations. For example, it has idiosyncracies in that a variation in cost has to be entered as a separate work order – which needs to be negative in value if the final cost for the original item is less than allowed for – and therefore also generates unnecessary approval requests.

To make the system work, the ETC held workshops with Transfield to develop commercial management procedures to match and notes these procedures could be rolled out to other projects of similar size and scale where construction contracts are awarded prior to finalisation of designs. Although the ETC noted it would be preferable and easier to use a Financial Management Information System first for project costs, and then pro rata to MMS upon capitalisation of the project.

The project also has project specific systems for forecasting and reporting (the project cost control workbook), with vendors understanding what inputs are required from them (especially in terms of invoicing).

A number of management summary cost reports are produced by the project, including summary costs, financial year summaries, work package cost status (which compares against PAD budget, current budget, forecast, commitments and actual plus variance) and also an S curve summary.

Cost control procedures for scope refinements and scope variations is a key component for controlling costs within the project, particularly given the situation where enabling works commenced before the scope was fully defined. These procedures are discussed within the Scope section above.

Procurement cost management is through engaging the Transpower procurement team in the purchase of items outside of scope of the main vendor contracts.

We find cost control and reporting to be robustly governed and managed by the project.

#	Recommendations	Priority	Owner	Due Date
1.8	**Consider the use of FMIS for future projects** For future complex Transpower construction projects, consider the use of FMIS for project costs and then pro rata across to MMS at appropriate project capitalisation points.	**Medium**	Sponsor	N/A

Resources

Rating	★	Effective controls / activities in place, no issues were identified

Findings

The PMP defines the core management team project structure, (see Appendix B – Project Team Management Structure) and required skills and resources.

Resourcing is mainly through the use of contracted resources via the main vendors, and from the Transpower internal design team and supporting resources, with the requisite skills and resources specified within the vendors project management / quality plans.

For the larger contracts of work, vendors have been engaged using the Transpower-modified FIDIC Yellow Book standards, with all other contracts following Transpower's suite of contract conditions depending on contract value.

We understand Establishment workshops were held for the Enabling Works and DB1 contracts immediately following their award to establish contract specific management objectives including responsibilities, processes, key drivers, KPIs and core values, including safety. It is noted that there will be a lot of interaction required between Areva and Transfield on protection and civil works. Both Transfield and Areva have established site offices, with the former providing desk space for Maunsell and the Transpower project management team to use as and when required.

The ETC plays a prime contract management function and is in charge of reviewing scope refinements, contract variations, and any commercial issues that may arise. He also chairs the project coordination meetings. Daily site activities are managed onsite by the ETC Representative, who meets with both Areva and Transfield onsite representatives on a daily basis as required.

The Technical Manager acts as the gate between releasing approved designs for construction between Maunsell and Transfield, and as the point of approval for the Areva designs under the DB1 contract, as outlined within the PMP. We understand that there is a healthy level of interaction between the Transpower Design Team, onsite power technicians and Transfield Resources, who proactively feed through pragmatic solutions and design feedback to the Maunsell Design. Additionally, Maunsell designs are first reviewed by Transfield for their practicality / constructability as part of the peer review process.

Areva have also reported a high level of support from all parties, with recent design workshops held at Areva's office in Sydney. Although they are new to Transpower for this type of work, risk is mitigated through a comprehensively detailed and scoped contract and regular meetings.

Skilled resources are encouraged through existing long-term relationships with Transfield and Maunsell, both of which who are preferred suppliers. Additionally, the Project Director for Maunsell is the account manager on the Transpower account and therefore has an overview of all Transpower design work, which allows him to prioritise resources and work, as and when required. He additionally can request design resources from Australia when required.

Maunsell did question whether the competitive tendering process for design packages outside of scope was necessary. We understand the three RFP packages went through a 6-8 week tender and evaluation process, where this time could have been used for resource-levelling within Maunsell. While there is an understanding Transpower has internal requirements for tendering work above a certain value, there was a question as to whether this process could be streamlined. We understand that the Maunsell Project Director has previously been seconded to work for the Transpower Northern Projects Manager, and so Maunsell have an excellent understanding of the Transpower environment.

Transfield also advises that with the current building slow-down, they have more than an adequate supply of skilled resources for this project.

Areva are well resourced with access to resources worldwide; additionally the Project Manager used to be a protection and control engineer. Areva report there is a high level of cooperation with the project team, and provided the example of Transpower's assistance in helping gain resource consent for the GIS building construction.

All review participants have indicated that the ETC has been careful to use the performance KPI's as a way to keep parties motivated and focussed on key deliverables and timeframes, and that they are being used effectively in this manner. We understand KPI's are used as a trending tool and are discussed at the Steering Committee. As noted earlier, the KPI reporting process should be recorded within the PMP.

In summary the project appears adequately resourced with good team morale, and review participants across all the parties have expressed a shared common view and commit to the objectives of the project, along with the requisite level of cooperation.

We have no recommendations for this section.

Safety Management

Rating	●	**Effective controls / activities, minor issues identified or some compensating controls exist.**

Findings

Transpower has a strong emphasis on safety, and it serves as a core principle for this project. This focus is also one of the core functions for Transpower Project Manager, who has delivered Transpower's "Keys to Life[2]" safety training to the vendors and staff on the project in group training sessions. The project has also developed 'safety' KPI's for the project, which are included within the monthly vendor status reports and monitored by the Project Manager.

Key documents have also been developed by both Areva and Transfield for safety and emergency plans, and environmental management planning. The site managers also conduct daily site meetings prior to commencing civil works, and a hazards notification board is managed onsite, and Transpower have safety assessors who perform site safety assessments as required, dependent on the level of activity on site. It was noted by some review participants that some of the Transpower safety assessors take a constructive feedback approach, whereas others could be coached more in this method so as to engage more effectively with onsite project team members.

Additionally, there are outage planning review meetings that are conducted prior to each commissioning / planned outage, where safety is also discussed.

As a number of safety incidents have occurred in September 2008, we reviewed the site safety plans from AREVA and Transfield Site Management Plans. The documents were comprehensive and addressed the majority of substation and transmission line construction specific issues.

As this substation involves a 220kV cable and associated cable trough, some additional safety issues related to this type of installation should be highlighted. A revision to the AREVA Site Management Plan, required by Transpower, related to the required competency and capability of resources working in up to 3 areas of the construction site which include the GIS, AIS and cable trough areas. AREVA's approach to this was to ensure that all resources were fully competent for all areas.

Transpower has dedicated some effort to review specific site management plans and propose amendments to the contractors. A preferred approach is to conduct an "endorsement process" where the Transpower safety assessment group separately endorse each contractor identifying shortcomings and resolving inconsistencies in safe working practices and plans, followed by routine field validation audits. This two stage process is an accepted practice for large transmission operators in Australia. The endorsement process may be valid for several years.

During the interviews, the issue of management of SF_6 gas was discussed and as part of the site safety issues KEMA was advised that the placement of SF_6 detection systems on site is part of the construction project. It was unusual that the issue of detection, collection and containment of SF_6 is not mentioned in either of the site Management Plans. It is a low risk hazard but as detection systems are in place it should be highlighted in the plan.

We also understand there was a possible failure to immediately report a safety incident that occurred earlier this year, in part prompting the commissioning of this review. We understand the incident was brought to senior management's attention (on the same day) by way of an ad hoc update at a project function. Senior Management immediately brought this to the Transpower CEO's attention; fortunately the consequences of this incident were minor. We note that the standard timeframe for safety incident reporting is within a 24-hour period, and it is unclear from review participants whether this was breached.

[2] See also Transpowers "Keys to Life" safety brochure.

We understand, however, that the ETC and Project Manager are more than aware that safety incidents need to be immediately reported to the Sponsor Delegate and Sponsor (who will in turn report this to the CEO), and this has also been reinforced to the vendors.

We also understand that soon after the safety incident occurred, the Project Manager presented the 'keys to life' Transpower safety training to some 70x Transfield staff and contractors, and an article was also published in the Gridlines journal the month after.

In summary, we find Transpower's strong emphasis on site safety is appropriately understood and echoed by its vendors, with a site visit where it was evident site safety is treated with paramount importance. Safety procedures appear robust, with only minor areas for improvement.

#	Recommendations	Priority	Owner	Due Date
1.9	**Coaching of Transpower Safety Assessors** Consider coaching safety assessors to ensure that all are engaging in a constructive feedback approach, rather than 'penalty-based' approach.	**Low**	Construction Manager	Mar 2009
1.10	**Consider a 'Safety Endorsement Process'** For future projects, consider conducting an "endorsement process" whereby the Transpower audit group separately endorse each contractor identifying shortcomings and resolving inconsistencies in safe working practices and plans, followed by routine field validation audits.	**Low**	Construction Manager	Mar 2009

Risk & Issue Management

Rating	●	**Effective controls / activities, minor issues identified or some compensating controls exist.**

Findings

Risk Management

Project risk management is carried out in accordance with the Australian and New Zealand Standard for Risk Management (AS/NZ 4360).

Two risk registers are maintained – one orientated towards Enabling Works and which is maintained by Transfield on their project intranet site. The second is orientated towards the DB1 contract and is maintained on the Transpower project intranet site. All project team members have read access to the Sharepoint sites, which also records assumptions expressed as risks.

The two risk registers provided (design and build and Enabling works) are comprehensive and identify typical risks associated with a large transmission substation construction.

Some of the risk descriptions are not actual risks to the substation or the project. For example R-112 "New Product familarisation" is not a risk in itself. A complete risk description for this case would be "A lack of training on a new product leads to inadvertent protection trip or mal-operation".

Some of the risk mitigation strategies require some attention. With reference to R-113 "Test equipment failure", the risk mitigation states an action "ensure all test equipment has current calibration". This is a quality issue and there would be an assumption that any test equipment with an "out of date" calibration certificate would simply not be used and unavailable for use under all circumstances. A suggested risk mitigation description would be to "make available/procure alternative test units".

R-120 states "Primary injection causing loss of supply" has a mitigation of "Test procedure for high risk primary injection test. Check list ensure all isolation switches action correctly. Peer review of test plan." Unfortunately, this risk mitigation description in this case is merely re-stating a process which is already part of the quality and safety systems that are in place. In general, a 'risk mitigation' should be some form of additional check or measure, in this case it would be to overlap an existing process in the event that that existing process is not appropriately applied or overlooks an issue.

A suitable overarching risk mitigation may be to arrange with the control room that it is possible to carry out some emergency switching which would quickly restore supply and minimise the overall impact of any interruption.

We reviewed the risk ratings of all the risks in the "design and build" and "enabling works" risk register and advise that it was unusual that up to 6 currently "open" risks are assigned an EXTREME rating. In our opinion, R-076 MAD 4m correctly incurs a "Catastrophic" consequence while the other EXTREME-rated risks are almost all of "Moderate" consequence, thus a risk assessment of HIGH is more appropriate.

It is also unusual that two EXTREME-rated risk have a likelihood of "almost certain". Risk R-008 "concurrent design and build" could have a likelihood of LIKELY given there is significant effort applied to co-ordinating design and building activities. With respect to R-189 "non-constructability of the sewer line" a comment provided on the register indicated that a solution "will be found". Under this basis, in our opinion, it should have a "Possible" likelihood, thus a risk assessment of HIGH is more appropriate.

It was noted in reviewing the risk ratings that some identical risks were assigned different ratings on the different registers. Interviewees from AREVA and Transpower were challenged on this issue but were of the opinion that from each organisations point of view the consequence and likelihood could be different.

Transpower has developed a series of standard designs for specific sub-systems in the substation. These designs specifically developed on other substations have been forwarded to the design contractor to provide the basis for Otahuhu substation designs (e.g. bus section design). Selection of the GIS switchgear has been done after visiting the manufacturer and confirming their suitability for Transpower.

Taking into consideration this conservative approach, it is clear that the project program includes sufficient duration but there are no specific tasks or contingency identified for additional training or familarisation of new products. It is noted that the risk register did include a familarisation risk R-112.

Interviewees were asked whether Otahuhu substation presented any additional challenges over typical substation constructions completed by Transpower:

1. Otahuhu is a switching substation so there are no large transformers (apart from station services) and no capacitor or reactor banks to separately commission. The absence of these items in a transmission substation reduces the complexity of the design and reduces overall testing time.
2. The main difference identified was the utilisation of a 220kV cable provided in an enclosed ground level cable trough. Testing and commissioning this type of cable required specialised HV test set which is due to be supplied under this contract.

There are some technical risks associated with SCADA, security system, condition monitoring systems, communication system service risks that could be included. We have listed these within the recommendations section below.

Review participants noted that some of the key risks were seen as:

- Site Safety
- Interruption to supply – especially during the commissioning of the programmed / automated system / protection circuits
- Incorrect Panel / Protection Circuit design
- Whether the project can secure enough network outages of the required duration to successfully complete all commissioning activities on time, especially if there is a dry winter.
- Reliance on third parties to move buried services for the cable trenches (e.g. Telecom, Gas etc).
- Delivery of hardware, such as the high voltage cables.

Issues Management

Issues management is through raising issues at formal project meetings, which are then tracked within an actions point register. Each specific project meeting type, (such as the Management and Engineering Coordination Meeting Actions report) maintain an action point register. Major issues from across all action point registers are then summarised and reported up to the Steering Committee. Within the PMP it notes that while this is currently working adequately, it will be monitored in case an issues register should be developed.

Current major issues include difficulties with relocating the Contact sewer pipe, relocation of buried services for cable trench work, and the late engagement of Areva and late engagement of Areva's subcontractor. Review participants noted that issues are transparent and dealt with appropriately by the ETC and Transpower Project Manager.

In summary, the project has established a robust safety, risk and issues process with minor areas for improvement.

#	Recommendations	Priority	Owner	Due Date
1.11	**Review the Risk Registers** Review the risk registers for the following: - Re-write the risk identification descriptions where the description is not linked to an event at the substation or a subsequent substation event. - The risk mitigation description should not include any existing quality or safety controls. In similar risk register these are covered in "Existing controls" and the mitigation becomes an overarching action.	**Low**	Engineer to Contract	Mar 2009
1.12	**Add additional risks** Add the following risks to the risk register: - Not all alarms are identified and captured in SCADA database leading to no warning of imminent plant equipment failure - Incorrect limits set in SCADA due to incomplete protection design leading to plant overload condition - Incomplete substation design requires a re-visit of the SCADA database completeness delaying commissioning - SCADA and protection systems not well integrated leading to lengthened testing - Substation auxiliary systems not fully captured in SCADA reducing substation availability - Key person dependency risk for the Engineer to Contract and the Technical Manager - New Product Familiarisation – That a lack of training on a new product leads to inadvertent protection trip or mal-operation.	**Low**	Engineer to Contract	Mar 2009

Integration

Rating	●	**Effective controls / activities, minor issues identified or some compensating controls exist.**

Findings

Dependency Management

The PMP lists key external dependencies as:

- Local authorities, for resource and building consents
- Contact Energy, as owner of the neighbouring power station
- Other utilities, including Vector, Telecom, Watercare and Manukau Water for relocation of their services to accommodate the works.

The project relies on managing these external dependencies through the project scheduling process, with associated communications.

Design dependencies between Areva and Transfield / Maunsell designs are coordinated through the Transpower Technical Manager signing off the technical decisions, reviewing designs, and being a part of the coordination meetings. Construction inter-dependencies between the vendors are managed by the ETC along with the vendor project managers in fortnightly Coordination meetings, through an integrated project schedule and the Otahuhu Diversity Project interlinks schedule, and through respective site management plans, with clear demarcations within the designs as to what party is responsible for what.

Overall inter-dependencies are communicated through the two-monthly steering committee meetings.

We note there is no dependency register for the project, instead dependencies are managed via scheduling and the PMP.

The review participants noted there is a high level of complex task interdependencies, but that these are being managed well by the ETC and Project Manager through the processes put in place. However despite this, we note that for a project of this size and to minimise a key person dependency risk on the ETC, we would expect to see a dependency register as this would formalise the close communication with relevant stakeholders, and enable the project to identify and agree with stakeholders timeframes within which projects affected by conflicting priorities will be delivered.

Organisational Impact Assessment

The project is largely independent of other Transpower projects, and is mainly impacted by the availability of planned outages for commissioning works. This is managed by advance planning and the early submission of outage request plans, plus close liaison with the System Operator. At the time of the field work for the review, we understand the Project Team were undergoing a period of planning to incorporate the latest information available on planned outages.

As the nature of the project is the diversification of an existing switchyard, the organisational impact upon Transpower will mostly be upon the System Operator and the operational and financial aspects of the new asset within the Grid Performance area. While there is a section within the PMP that discusses the Asset Owner, it only looks at the “Operational Acceptance in accordance with standard Transpower Procedures”, and should include (or refer to standards or a strategy that will cover) the following::

- Ongoing consultation with the Asset Owner and System Operator
- Processes for handover into BAU (including the development of BAU operational procedures and training)
- The transfer of issues from an issues log (if any), into BAU.

- Development with the Asset Owner of BAU operational acceptance criteria (including testing and commissioning strategies)
- Arrangements for ongoing maintenance upon project completion (such as As-built documents, proposed maintenance contracts, etc).

While these are more likely to be well defined and understood processes within Transpower, it is important to summarise and refer to these within the PMP to ensure adequate consultation is undertaken and approvals are secured.

Additionally, it was noted the project is unique in a number of ways from standard Grid Asset projects in terms of having a steering committee, utilising a vendor new to this part of Transpower's business (Areva), and implementing building works prior to the scope being fully defined. As such, it would be beneficial to establish a lessons learned register to capture the new learnings and assist in knowledge transfer within the wider Transpower project management team.

In summary, the project is tracking dependencies through senior representation on the Steering Committee, the inter links schedule report, and attendance by the ETC and Transpower Project Manager at a variety of meetings. However more formal tracking could be achieved through the development of a Dependencies Register. Interaction and impact upon the Asset Owner by the project needs to be more clearly recorded, and it would be beneficial to establish a lessons learned register.

#	Recommendations	Priority	Owner	Due Date
1.13	**Dependencies Register and Communications** Consider developing a Dependency Register, to bring a level of formality to the communications between the project and key stakeholders for the interdependencies, so that requirements can be formally aligned, and promote communications to be clear, transparent and regular.	**Low**	Project Manager	Mar 2009
1.14	**Organisational Impact – Asset Owner** Ensure planning and proposed tasks for transfer into BAU are recorded within the PMP and supporting documentation, such as consultation with the Asset Owner, development of training and support procedures, transfer / acceptance of known issues, develop of ongoing maintenance contracts and procedures, etc. Involve the Asset Owner further within the project.	**Medium**	Project Manager	Dec 2009 To Mar 2010
1.15	**Establish a Lessons Learnt Register** Consider establishing a lessons learnt register to capture the learnings from dealing with the unique new situations within the project, such as Areva operating in this space, utilising a steering committee, and the new MMS procedures, to name a few.	**Low**	Project Manager	Mar 2009

Communication

Rating	●	**Effective controls / activities, minor issues identified or some compensating controls exist.**

Findings

Internal

The Transpower Project Manager has formal responsibility for communications, with the ETC performing a supporting role. The project does not have a communications plan, instead these aspects are adequately covered within the PMP and specifically developed communication procedures. It is noted that the need for a communications plan will be reviewed as the project progresses, and we strongly endorse the need to monitor this.

The Steering Committee, Enabling Works Management Team, and DB1 management team (see Appendix B) are the main ongoing forums for project communication. Other forums established by the project and denoted within the PMP include:

- Project Coordination – Meets monthly to identify and coordinate interdependencies between the projects, with a focus on medium to longer term planning;
- Site Coordination – Meets weekly, complements the Project Coordination meeting with a focus on 'real time' and short term issues;
- Enabling Works Technical – Weekly or as required to address real time and technical issues.;
- Enabling Works Protection – Meets weekly or as required to address design and construction liaison on enabling works protection issues;
- DB1 Design – Meets as required between Transpower Technical Manager and Areva for design input and review approval of DB1 design work;
- Site Safety Coordination – Held weekly between Transpower, Areva and Transfield, with a focus on safety management and coordination of site activity between the parties;
- Risk Workshops – convened monthly or as required for both DB1 and the Enabling Works.

The Transpower Project Manager also has weekly meetings with the Northern Projects Manager, who in turn keeps the Sponsor Delegate updated. However, these are informal meetings as part of the line management functions of these positions and as such are not recorded within the PMP.

In addition, PSRs are provided to the Transpower Grid PMO and the Steering Committee, and each work stream project manager (i.e. DB1, Enabling Works Construction, Enabling Works Design) also produces regular reports to the ETC and Transpower Project Manager. The Sponsor Delegate in turn provide updates to the Sponsor who includes this within his standard monthly report to the CEO, who then consolidates these views and reports on the project (along with other projects) to the Board.

We have reviewed the communications procedures developed by the project and visually inspected the sharepoint sites. We find they are appropriate for a project of this size and complexity, and in particular with dealing with a multitude of external parties.

We note the sharepoint sites contain the risk register and key project deliverables, such as the Solution Study Report, progress reports, design drawings (and version control) etc. It is used effectively by review participants as a means of version control and is an excellent means for the efficient reference and storage of documents.

The project also utilises a formal email 'transmittal' system, where formal emails and transfer of records are provided a transmittal identifier number, registered and tracked in a correspondence log, with the sending party responsible for updating the log and placing a copy on the Transpower email repository.

Standard forms have also been developed by the project to support communication, and are described within OPD04. They include: Contract query, design query, RFI, Document Transmittal, Notice to Contractor and Variation Orders.

In summary, we understand from review participants that the level of informal internal communications is very good and a key requirement for a project with this level of interdependencies, safety requirements and where two competing vendors have been engaged onsite. It has been noted that the ETC has done an exemplary job, along with the Project Manager, in establishing these forums and procedures.

External

We note there is no external communications plan; instead the PMP notes that the communication requirements for each stakeholder is already established or are sufficiently clear.

The project is appropriately described on the www.gridprojects.co.nz website, with the general public able to subscribe to receive updates. A good level of information is provided and updated recently, notably with photos from October 2008 civil works.

The Project Manager is assigned responsibility for prime external communications on Transpower's behalf, with a key stakeholder being Contact Energy, (who has a generation station next to the project site). We understand Transpower has entered into a commercial arrangement with Contact that this project will not impede Contact's abilities to generate electricity or distribute this through the Otahuhu substation; we understand this is monitored closely by the Transpower Project Manager, however there is no mention of this within the PMP or project management documentation provided to us.

Along with informal weekly phone calls to Contact as required, the only formal meetings within the PMP are denoted as the Contact Energy Liaison, which meets monthly or as required to manage issues with Contact Energy as neighbours and is chaired by Transpower Project Manager (with Areva and/or Transfield attending as required).

Further, Transfield have reported they have been able to make good use of their existing relationships at engineer level within Contact Energy to assist in relationship management.

Given the concerns over reputational risk should an incident occur, the opposition by MEUG to the project, and the nature and size of the project, we consider that an external communications plan should be developed. This plan should identify and assess stakeholder needs, assign liaison responsibility, develop the key messages for the project and be developed in conjunction with the Transpower Communications department. This would help ensure there are consistent, planned and regular communications across all stakeholders that meet their needs, and will help ensure manage expectations and potential opposition of stakeholders. This will become increasingly important as the potential for outages and safety incidents increase as the site moves into the commissioning phase.

#	Recommendations	Priority	Owner	Due Date
1.16	**Monitor the Effectiveness of Internal Comms** Continue the monitor the effectiveness of internal communications and periodically re-assess whether an internal communications plan is required.	**Low**	Project Manager	Ongoing
1.17	**Create an External Communications Plan** Develop an external communications plan to identify and assess stakeholder needs, potential impacts, assign liaison responsibility, and develop the key messages for the project. This should be developed in conjunction with the Transpower Communications department and should include the external website, Contact, the media and MEUG.	**Low**	Project Manager	Mar 2009

Quality Management

Rating	●	**Effective controls / activities, minor issues identified or some compensating controls exist.**

Findings

The project has no separate quality plan. Instead a requirement for quality control is specified as a requirement within the RFPs, and within the vendor contracts. Additionally the vendors are ISO9000 accredited and are required to adhere to Transpower standards and policies for this type of work.

The PMP describes a number of procedures to ensure quality management across all aspects of the project, including KPIs that include quality measurements, and a deliverables register is maintained with the Areva document tree for the DB1 work, and the Maunsell Drawings list for the Enabling Works.

Bearing in mind that quality is an essential item for the project to minimise the risk of outages, and while we are satisfied there is a robust quality process in place for all project work, we feel it would be beneficial to have this outlined within one document (such as a quality management plan), or alternatively detailed in greater depth within the PMP.

Design Work

We understand all designs (both Areva and Maunsell) must be approved by the Transpower Technical Manager, prior to implementation, who compares this against the overall Solution Study Report and the project's Technical Objectives (i.e. safety, ongoing ease of maintenance, conformance with Transpower's standard designs and overall design philosophy).

Each design work package contains a brief, any applicable Transpower design standards and detailed drawings from similar components that have been implemented before (i.e. standard designs).

All Maunsell designs undergo a drawing and design check, after which a high level peer review is applied. Where the designs are not based on standard Transpower designs, they are passed to an external reviewer (agreed with Transpower), who performs an in-depth review.

Additionally, these Maunsell designs are then reviewed by Transfield for their practicality / constructability. The Maunsell design work is also conducted by the Transmission and Distribution Department, with 90% of its work sourced from Transpower. Maunsell reports daily contact with the ETC for decisions and guidance on design work, along with the Technical Manager and appropriate departments within Transpower as required. The majority of the work is based on existing Transpower approved designs, with modifications based on the specifications of the hardware purchased by Transpower. It is noted that the designs are undergoing a stricter review process than for other Transpower work, due to the complexities and criticality of the designs.

Maunsell reports the quality of the design inputs has been sufficient; whilst there has been some delay on occasion, generally it has been good. Where further detail is required, Maunsell also employs subcontractors for site inspections to determine further design input details. Maunsell reports that the designs produced in Auckland are peer reviewed by its Wellington office, and vice versa. Maunsell also has a quality management plan that they are adhering to, and are ISO 9000 accredited.

Construction Works

Actual construction of minor civil works is accepted onsite by the ETC, supported by the Engineers Representative, as to the Design Drawing specifications and against appropriate acceptance criteria specified within the contracts.

In Summary, while review participants agree a high emphasis has been placed on quality and approval of deliverables, this is specified across a number of documents and it may be beneficial to summarise this into a quality management plan.

#	Recommendations	Priority	Owner	Due Date
1.18	**Develop A Quality Management Plan** Consider developing a quality management plan which pulls into one place: - The standards against which project deliverables will be measured, (such as acceptance criteria, applicable Transpower design standards). - References to the acceptance criteria as described within the various contracts; - Roles and responsibilities for quality acceptance within the project team (i.e. peer review signoffs; who's responsible for quality overall); - What will trigger the requirement for independent peer reviews of critical work designs, etc.	**Medium**	Project Manager	Mar 2009

Appendix A – Project Documentation

PM Attribute	Documentation
1. Governance & Management	Last 4 Steering Committee Status Reports
	Last 4 Steering Committee Meeting Agenda & Minutes
	Last 4 Governance Committee Status Reports
	Last 4 Board Papers
	Agenda & Minutes for any Internal or External Advisory Groups
2. Scope	Business Case
	Project Management Plan
	Scope Change Register
3. Time/Schedule	Work Breakdown Structure
	Project Schedule (MS Project)
	Last 4 Project Team Status Reports and Meeting Minutes
4. Cost/Budget	Budget
	Cost/Benefit Model
	Budget/Cost Tracking Spreadsheet
	Last 4 Cost/Variance/Forecast Financial Reports
5. Resources	Project Structure Chart
	Resource Management Plan
6. Risks & Issues	Risk Register
	Issues Register
	Escalation Report(s)
7. Communication	Communications Strategy and/or Plan
	Stakeholder Analysis & Engagement Plan
	Stakeholder Communications Activity Log
8. Integration	Dependency Chart or Dependency Register
	Organisation Impact Assessment/Management Plan
	Training & Service Support Plan
9. Quality Management	Quality Management Plan
	Deliverables Register
	Lessons Learned Register
	Historic Independent Quality Assurance Reports

Appendix B – Project Team Management Structure