Specialist Consultants
to the Electricity Industry

ElectraNet Project Cost Estimates

Comparison Report

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For	**ElectraNet**
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Revision Table

Revision	Issue Date	Description
0	25/5/12	First Draft
1	29/5/12	Client comments incorporated
2	30/5/12	Additional explanation of cost difference in section 5.5 added

Reviewers

Name	Interest	Signature	Date
Andrew Robbie	Principal Engineer		30/5/12

Approval

Name	Position	Signature	Date
Les Brand	CEO		30/5/12

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1. Introduction

PSC Australia was engaged by ElectraNet to undertake independent cost estimates for a representative selection of network projects proposed in their capital project forecast for the next regulatory period (2013-14 to 2017-18).

The purpose of the engagement was to demonstrate whether the cost estimates developed by ElectraNet are prudent and efficient, and within the range of accuracy expected.

This report is provided to summarise the methodology, source of costs/prices, key costing assumptions and results of the independent cost estimates.

Following completion of the independent cost estimates, PSC undertook a comparison with those developed by ElectraNet, and analysed the key differences. This analysis is also provided in this report.

Information on PSC and the CV's for the PSC Australia team for this project can be found in Appendix 1.

1.1 Scope of Services

PSC's scope of services for this engagement is repeated below for each of the selected projects detailed in Table 1:

- Review the functional scope documents provided by ElectraNet;
- Break the scope down into building blocks;
- Prepare a cost estimate to a +/-30% accuracy; and
- Identify the accuracy of the estimate with low, likely and high range of costs.

Table 1 provides the list of eight selected projects.

Table 1 - Final List of Selected Projects

ElectraNet Project Number	Project Name
10618	Baroota Substation Replacement and Transformer Upgrade
11826	Dalrymple North Replacement and Transformer Upgrade
10517	South East CB
11509	Bungama Second Transformer
11316 to 11319	Morgan Whyalla Pumping Stations Rebuild
11103	Blanche Capacitor Bank
10619	Kincraig Substation Replacement & Transformer Upgrade
11553	South-Heywood Telco Bearer Project

The final stage of PSC's engagement was to compare the cost estimates developed independently by PSC against those developed by ElectraNet and to provide an analysis of key sources of variation and possible reasons for the differences.

1.2 Accuracy and Limitations

The cost estimates developed by PSC Australia are high level estimates only and are the result of a desktop study. No site visits or detailed engineering has been undertaken, nor was it in PSC Australia's scope to develop an independent functional scope for any of the selected projects.

Whilst it is difficult to be precise, it is expected that the cost estimates are accurate to at least ±30%.

Specifically excluded from the PSC Australia cost estimates are:

- Development application, cultural heritage, environmental, and permitting costs.
- Costs associated with the alteration of easements, or acquisition of easements.
- Purchase of land.
- Allowances for annual movement in foreign exchange.
- ElectraNet internal costs which are also excluded from the comparison tables.

PSC notes that reasonable costs associated with these activities would be incurred in the efficient delivery of network projects.

2. Methodology

2.1 Overall Process

The overall process followed by PSC Australia to undertake the review is as follows:

Step 1 - *Initial Cost Estimate* - PSC were provided with the functional scope of work for each project (un-costed) and broke the scope into building blocks and from this developed an independent cost estimate based on this functional scope and ElectraNet's design standards.

Step 2 - *Scope Clarification* - PSC met with ElectraNet to review the detail of the scope and compare against the building blocks developed by PSC during Step 1.

Step 3 - *Final Cost Estimate* - PSC refined the independent cost estimate to account for any differences in scope as identified in Step 2.

Step 4 - *Cost Comparison* – PSC received ElectraNet's high level cost estimates and provided a high level cost comparison to assess and analyse ant differences between the two costs.

2.2 Step 1 - Initial Cost Estimate

PSC was provided with ElectraNet's design standards. These standards were used to develop a more detailed scope of work, building on the functional scope provided, for each of the proposed projects. PSC staff reviewed the supplied standards and other relevant technical information made available by ElectraNet.

The methodology applied to each of the selected projects depended on a number of factors specific to the selected project, the amount and quality of technical information available and the type of project. The methodology followed by PSC for each of the selected projects is as follows:

1. Review the functional scope document for the project provided by ElectraNet.
2. Develop the cost estimate for the project using any or all of the following:
    a. Cost estimates, unit pricing, allowances and/or assumptions based on PSC's current "building block" cost estimation archive.
    b. Contact suppliers for budgetary pricing and lead times for major items of plant and equipment.
    c. Contact contractors and suppliers of construction plant and labour for unit pricing and construction duration estimates.
3. The cost estimates, and any costing assumptions and allowances made, were peer reviewed and approved in accordance with PSC's Quality System.

No site visits were undertaken by PSC staff. The cost estimate was based on the high level functional scopes provided and with reference to the ElectraNet design standards.

No pricing information on the selected projects developed or held by ElectraNet was provided to PSC during this step.

On completion of this step, PSC issued its detailed cost estimate to ElectraNet for review.

2.3 Step 2 - Scope Clarification

PSC met with ElectraNet to clarify the detailed scopes which formed the basis of the estimates.

During this step a selection of projects were reviewed in terms of project scope. The more detailed scope of works developed by ElectraNet were compared to those developed by PSC (building blocks) and any differences in scope and/or approach were discussed.

Key issues identified and discussion during this step included:

- Ensuring that PSC had access to the latest versions of the functional scope documents. Several cases were found where PSC did not have the latest revision of the functional project scope – this mainly affected the communications works associated with the network projects.
- Ensuring that certain quantities have been consistently applied; for example quantities used for the estimation of civil works for substation projects.
- Ensuring consistency in key detailed scope assumptions. One example was that PSC's scope assumption for cable trenches was based on pre-cast cable trenches, whereas ElectraNet's was based on being cast in situ.
- Identifying any areas of doubling up, either in PSC or ElectraNet's detailed scope.

- Identifying any areas of double counting of the applied contingencies and/or allowances as detailed in Table 3. Some double counting was identified which contributed to overestimation in PSC's initial cost estimate.
- Identifying any ElectraNet assumptions in estimates that were not documented or explicitly identified in the scope – an example of this was the site benching requirements.

In addition there were some differences in site infrastructure quantities not stated in the project scope document that were instead based on assessments made from site layouts, such as roadway lengths, cable trench routing or piping length which differed from those assumed by ElectraNet – these were not changed as PSC did not have the benefit of site inspection.

For the purpose of discussion, details of ElectraNet's own cost estimates were provided at this stage for a number of the sample projects:

These were provided for discussion purposes only and were not used to influence PSC's unit prices, with adjustments only being made to correct any scope differences.

2.4 Step 3 - Final Cost Estimate

For each project, the cost estimate developed by PSC in Step 1 was revisited in light of any scope differences identified in Step 2. Any significant scope differences were addressed and estimates finalised for these items using the same methodology as was used for Step 1.

On completion of this step, PSC issued final cost estimates to ElectraNet for review.

A comparison of PSC and ElectraNet cost estimates is provided in Table 4.

2.5 Step 4 - Cost Comparison

ElectraNet's final cost estimates for the selected projects, with a high level breakdown and comparison with PSC's costs were then provided to PSC.

Any areas of significant differences were reviewed at a high level. Based on this analysis, PSC has provided an assessment of reasons for and possible causes of cost difference. The results of this analysis are provided in Section 5.

3. Source of Costs and Prices

The sources of the cost assumptions adopted by PSC for major items of primary plant are summarised in Table 2. The original equipment manufacturer (OEM) pricing information typically has a degree of confidentiality associated with it. The names of OEMs and suppliers used can be provided on request.

Table 2 - Sources of Primary Plant Equipment Unit Prices

Cost Item	Source Description
CVT 132kV	Derived from prior experience
CVT 275kV	Budget prices from OEM, 2011
Capacitor bank 100MVAr 275kV	Budget prices from OEM, 2012

Capacitor bank 8MVAr 132 kV	Budget prices from OEM, 2012
Circuit breaker 132 kV	Budget prices from OEM, 2012
Circuit breaker 275 kV	Budget prices from OEM, 2012
Current transformer 132 kV	Derived from prior experience
Current transformer 275 kV	Budget prices from OEM, 2011
Disconnector 132 kV	Scaled from a 33kV disconnector price
Disconnector 275 kV	Budget prices from OEM, 2011
Earth Switch 132 kV	Derived from prior experience
Surge arrester 132 kV	Derived from prior experience
Surge arrester 275 kV	Derived from prior experience
Transformer 10 MVA 132/33 kV, with OLTC	Budget prices from OEM, 2012
Transformer, 25 MVA, 132/33 k, with OLTC	Budget prices from OEM, 2012
Transformer, 200 MVA, 275/132 k, with OLTC	Budget prices from OEM, 2012

Sources for other major cost items are summarised in Table 3.

Table 3 - Sources of Other Cost Items

Cost Item	Source Description
Primary Construction/Installation	Estimates from an electrical contractor obtained in 2011
Secondary design/construction /installation	Costs are based on a combination of 1. Engineering experience; 2. Electrical contractor time/cost estimates from 2011; 3. Relay equipment prices sourced from supplier budget prices; and/or 4. Publically published prices.
Site infrastructure and civil works, and foundations	Based on a combination of: 1. Engineering experience; and 2. Unit rates in Rawlinson's Australian Construction Handbook 2011.
Transmission Lines and structures	Tower basic parameters (e.g. steel tonnage) established from engineering experience. Steel supply/assembly/installation costs built up from units rates in Rawlinson's Australian Construction Handbook 2011, and engineering experience. Line stringing costs based on unit rates from engineering experience. Conductor cost based on budget prices from a supplier.
Communications	Based on a combination of: 1. Engineering experience; and 2. Budget prices obtained from suppliers.
Design	Based on the following allowances developed from experience: 1. Transmission line design – 5% of transmission line cost 2. Primary/civil design – 8% of total primary/civil cost
Project Management	"Rule of Thumb" allowance of 8% of total project cost used in similar costing projects.
Site specific allowance	5% or 10% depending on scope of project. • 5% was used with projects with a well defined scope with minimal scope assumptions or a low likelihood of potential issues. • 10% was used with projects with a significant number of assumptions/unknowns or unquantifiable requirements.
Remote location allowance	A percentage premium for construction in remote locations was obtained directly from Rawlinson's Australian Construction Handbook 2011 for the nearest reference location to site or the average if the site is located between two reference locations.

4. Key Costing Assumptions

Key costing assumptions used by PSC in the development of the cost estimates are listed below:

- A design allowance of 8% and 5% of the estimated project costs has been used for primary/site works and for transmission lines respectively. Secondary systems and communications already have design costs built into PSC's building block estimates.
- A project management allowance of 8% has been applied to all works except communications which has project management already built into PSC's building block estimates.
- A site specific factor of 5% or 10% has been applied to each project. This is cover unforeseen site conditions (e.g. geotechnical, earthing, weather), possible 24 hour shifts during critical outages, the staging and structuring of work or items that may be identified during a site visit/inspection. Where some or most of these conditions are not expected to occur then the lower value was used. PSC has not visited any of the project sites.
- Equipment unit prices which are more than one year old have been escalated by 2.5% per annum.
- No contractor margin (profit) has been added to any of the major procurement items. These have been assumed to be free issued by ElectraNet.
- Prices for major items of equipment have been based on budget/unit prices, either obtained from OEM(s) or from PSC's existing cost estimation database. These estimates are based on one-off purchases and do not take advantage of any discounts or lower than market prices that may be negotiated by ElectraNet due to large quantity ordering.
- Certain assumptions have been made on base metal prices. These are detailed specifically in the list of costing assumptions applied to each individual project, as well as the validity of the price. These assumptions apply to the cost of copper, aluminium and steel. February 2012 rates have been used, obtained from http://www.olex.com.au/, and for steel the rate as at 1 May 2012 from the London Metal Exchange website.
- Certain assumptions have been made on exchange rates where pricing information is provided in a currency other than AUD. These are detailed specifically in the list of costing assumptions applied to each individual project. January 2012 average rates have been used, obtained from http://www.x-rates.com.
- All other project specific assumptions have been detailed in the individual cost estimates.

5. Comparison with ElectraNet Prices

An overall summary of the cost estimates is provided in Table 4.

Table 4 - Summary of PSC Cost Estimates Compared to ElectraNet's Cost Estimates

ElectraNet Project Number	Project Name	PSC Cost Estimate	ElectraNet Cost Estimate
10618	Baroota Substation Replacement and Transformer Upgrade	$12,481,128	$13,071,203
11826	Dalrymple North Replacement and Transformer Upgrade	$18,194,309	$18,979,598
10517	South East CB	$8,321,177	$6,832,633
11509	Bungama Second Transformer	$9,535,184	$6,936,324
11316 to 11319	Morgan Whyalla Pumping Stations Rebuild	$45,704,894	$47,193,556
11103	Blanche Capacitor Bank *	$4,171,250	$3,718,430
10619	Kincraig Substation Replacement & Transformer Upgrade	$25,105,279	$30,792,823
11553	South-Heywood Telco Bearer Project *	$6,593,383	$5,531,473

* Due to time constraints, these projects did not have the benefit of scope clarification

5.1 Baroota Substation Replacement and Transformer Upgrade

The cost comparison between the PSC estimate and the ElectraNet estimate is shown in Appendix 2.

Comparing the two cost estimates:

- PSC's total estimate is approximately 5% lower than ElectraNet's estimate. This is well within the accuracy range of PSC's desktop estimates.
- Differences include estimates of Contractor's overheads and design costs. PSC's estimates are based on rule of thumb allowances as described in Table 3 and in Section 4.

5.2 Dalrymple North Replacement and Transformer Upgrade

The cost comparison between the PSC estimate and the ElectraNet estimate is shown in Appendix 2.

Comparing the two cost estimates:

- PSC's total estimate is approximately 5% lower than ElectraNet's estimate. This is well within the accuracy range of PSC's desktop estimates.
- Differences include estimates of Contractor's overheads and design costs. PSC's estimates are based on rule of thumb allowances as described in Table 3 and in Section 4.

5.3 South East CB

The cost comparison between the PSC estimate and the ElectraNet estimate is shown in Appendix 2.

Comparing the two cost estimates:

- PSC's total estimate is approximately 22% higher than ElectraNet's estimate.
- The major cost difference occurs in PSC's estimate of primary plant (higher by $736k), the majority of which is bay infrastructure and switchgear. One reason could be due to the difference budget rates quoted from the OEMs when PSC developed the estimate, which are based on one-off purchases.

5.4 Bungama Second Transformer

The cost comparison between the PSC estimate and the ElectraNet estimate is shown in Appendix 2.

Comparing the two cost estimates:

- PSC's total estimate is approximately 37% higher than ElectraNet's estimate.
- The major difference is in the procurement cost of the 200 MVA transformer, with PSC's budget price being approximately $1 million higher than ElectraNet. It would be expected that a detailed specification and competitive tender, and the potential bulk buying capability of ElectraNet, could result in lower prices.
- Another difference includes the estimate of the locality allowance. PSC's estimate is based on rule of thumb allowances as described in Table 3 and in Section 4.

5.5 Morgan Whyalla Pumping Stations Rebuild

The cost comparison between the PSC estimate and the ElectraNet estimate is shown in Appendix 2.

Comparing the two cost estimates:

- PSC's total estimate is approximately 3% lower than ElectraNet's estimate. This is well within the accuracy range of PSC's desktop estimates.
- Differences include estimates of Contractor's overheads, design costs and locality allowances. PSC's estimates are based on rule of thumb allowances as described in Table 3 and in Section 4.
- PSC have allowed for a locality allowance of $4.4M whereas ElectraNet have not. ElectraNet advised that they did not include an allowance in this instance to account for assumed efficiency savings due to their proposed strategy to consolidate the pump stations under one project. PSC have not allowed for any efficiency gains due to consolidating all four pump stations under the one project.

- There is also a significant cost difference in the transmission lines component. PSC has not used any multipliers to account for short line length inefficiencies in this project.

5.6 Blanche Capacitor Bank

The cost comparison between the PSC estimate and the ElectraNet estimate is shown in Appendix 2.

Comparing the two cost estimates:

- PSC's total estimate is approximately 12% higher than ElectraNet's estimate. This is well within the accuracy range of PSC's desktop estimates.
- The main difference is in the estimate of the locality allowance. PSC's estimate is based on rule of thumb allowances as described in Table 3 and in Section 4.
- Substation infrastructure, primary plant and secondary system costs are also estimated slightly higher in PSC's cost estimate.

5.7 Kincraig Substation Replacement & Transformer Upgrade

The cost comparison between the PSC estimate and the ElectraNet estimate is shown in Appendix 2.

Comparing the two cost estimates:

- PSC's total estimate is approximately 18.5% lower than ElectraNet's estimate. This is well within the accuracy range of PSC's desktop estimates.
- Differences include estimates of Contractor's overheads and design costs. PSC's estimates are based on rule of thumb allowances as described in Table 3 and in Section 4.
- Substation infrastructure costs are lower in PSC's estimate. PSC's estimate for site civil works and benching was $1.3 million less than ElectraNet's. ElectraNet advised that Kincraig had a higher allowance than normal due to the site being in a high flood risk area and the additional allowance was to raise the substation bench height. PSC has made no allowance for flood mitigation, not having had the benefit of site inspection.
- PSC allowances for a number of items were lower than that of ElectraNet: specific items including earthing, existing transformer refurbishment, roadways, control building, amenities building, and landing gantry. For the amenities building PSC had assumed a size less than that of ElectraNet.
- Several items were not specifically allowed for in PSC's estimate such as storm water drainage and the busbar connecting the additional diameters.
- PSC estimate for the transformer installation was also $0.8 million less than ElectraNet.

5.8 South-Heywood Telco Bearer Project

The cost comparison between the PSC estimate and the ElectraNet estimate is shown in Appendix 2.

Comparing the two cost estimates:

- PSC's total estimate is approximately 20% higher than ElectraNet's estimate. This is within the accuracy range of PSC's desktop estimates.
- PSC included a locality allowance which ElectraNet did not, which accounts for almost $183k difference. ElectraNet advised that a locality allowance is already built into their telecommunication construction rates.

6. Conclusion

On the basis of the review undertaken, and within the limitations stated in Section 1.2, PSC finds that the network project cost estimates developed by ElectraNet for the sample projects studied are within the range of accuracy expected for high level cost estimates of this nature.

The majority of the material variations observed in the cost estimates based on confirmed project scopes can be attributed to site specific factors (for which PSC did not have the benefit of site inspection), primary plant procurement costs, and specific locality allowance assumptions.

On the information available, PSC concludes that the cost estimates produced by ElectraNet appear to be reasonable and provide a realistic indication of the costs required to undertake network projects of the types identified.

APPENDIX 1 – PSC Information and CV's

Power Systems Consultants was established in 1995 in New Zealand by two passionate electricity professionals. Now known as PSC, the company has rapidly grown into a multi-national organisation. PSC is now a team working across the globe from our bases in Australia, New Zealand, USA, Europe and Asia.

PSC is a niche provider of engineering services to clients within the electricity industry globally. Our clients include Market System Operators, Transmission Network Providers, Generation Companies and Distribution Network Providers. Our consultants work for clients in Australia, New Zealand, Singapore, the USA and Canada and have a good understanding of the business and our customer's needs.

PSC Australia has permanent offices established in Adelaide, Melbourne, Brisbane and Perth.

The professionals employed by PSC have real experience in one or more of our core business groups and in many cases have operated in significant roles within transmission utilities or significant transmission projects both in Australia and overseas.

The key team members for PSC Australia were:

- Andrew Robbie – Principal Engineer and Technical Lead
- Hoang Tong – Senior Power Systems Engineer
- Johan Hendricks – Principal Engineer
- John Grace – Senior Telecommunications Engineer
- Les Brand – PSC Australia CEO and Electrical Engineering Manager

Individual "pen portraits" of the team members are provided below.

Andrew Robbie – Principal Engineer – PSC Australia

Andrew Robbie has 19 years of experience in the electrical power industry. After graduating with an ME from the University of Canterbury, Andrew joined Transpower New Zealand where he carried out system studies for generation connections, new capacitor banks, and the static var compensator at Islington substation. He then joined ESBI Engineering in the United Kingdom where he was responsible for the electrical design of 132 kV substations. Andrew returned to New Zealand and joined Meritec Ltd (now AECOM), primarily providing services to Transpower. He has been with PSC for eight years providing system study and electrical cost estimation services both within Australia and New Zealand.

Andrew has completed a number of studies for several clients including Western Power, Transend Networks and the Australian Energy Market Operator (AEMO) in Australia, and Transpower in New Zealand.

Relevant experience includes:

- Powerlink – Independent scoping and cost estimation of 275 kV and 132 kV transmission lines and 275 kV substation projects. A detailed scope for each project was developed to obtain a cost estimate to within +/-30% accuracy, as an independent check for the client's own internal cost estimates.

- Western Power – A lead role in developing the justification and preparing the Project Planning Report for a new two zone substation (132/22kV) in Balcatta, including cost estimates and development of scope. Evaluation of reinforcement options in Rockingham City, including evaluation of substation reinforcement options.
- AEMO - Case study for transmission connection of large scale remote renewable generation up to 5000 MW to the National Electricity Market.
- Transend - Analysis and submission of projects through the New Small Network Transmission Assets arm for the Regulatory Process for the Tasmanian transmission network.

Hoang Tong – Senior Power Systems Engineer

Hoang Tong has 19 years experience in the electrical power industry specialising in power management systems, analysis, optimisation, operation and planning for large-scale generation, transmission, and distribution networks. Hoang has been involved in real-time power system management and electricity market software development and implementation.

He has acted as the World Bank's representative in multidisciplinary technical assistance projects for the various governments and power utilities. In these projects Hoang has had technical responsibilities for the design, costing, and evaluating of options and alternatives for power system development. He has gained broad experience ranging from "green field" rural electrification schemes in Vietnam to highly developed power system optimisation in Portugal and the USA.

Relevant experience includes:

- Cost benefit evaluation of distributed generation in large rural distribution networks (Turnkey Micro Hydro-Diesel Hybrid and Battery Charging Station, Vietnam).
- Feasibility studies and development strategies for rural electrification schemes (Vietnam Rural Electrification and Thang Binh district distribution network survey and loss study, MFAT New Zealand Government and Development Strategy for the Central Region of Vietnam, Asian Development Bank, Vietnam).
- Optimisation of distribution and transmission networks taking into account international comparison of best practice, network architecture design, testing of options, security of supply standards, construction techniques and recommendation of a future structure for the network (Rural Network Planning Orion NZ Ltd, New Zealand and Optimal Dimensioning of Portuguese Transmission Network, Portugal).
- Preparation of long-term distribution and transmission network development plans for small networks (ElectroPower, Levin, New Zealand and Central Power, Palmerston North, New Zealand) to medium sized networks (WEL Energy, Hamilton, New Zealand and United Networks, Auckland, New Zealand) to large networks (Portuguese power system and Maharashtra State network, India).

Johan Hendricks – Principal Engineer

Johan Hendriks has 21 years' experience in the electricity industry and 3 years in manufacturing and production related roles. This has encompassed a broad range of roles ranging from electrical engineering design and project management, asset management through to the installation and commissioning of high voltage AC systems up to 220 kV. After graduating, Johan started a career in electrical distribution. During this phase of his career he worked on all aspects of distribution, including system planning, asset management, designs, construction and commissioning of electrical distribution systems up to 33 kV.

More recently, Johan worked with Meridian Energy as a Strategic Electrical Engineer. In addition to strategic asset management, Johan also provided Meridian with mentoring of graduate engineers, organizing engineering symposiums and ensuring Meridian remained a professional development partner with IPENZ.

During his time working in generation, he developed a passion for all aspects of power transformers. Several design reviews, FAT, quality audits and SAT were completed by Johan, for transformers ranging from 65 MVA to 225 MVA 220 kV.

Relevant experience includes:

- Meridian Energy (NZ) - Preparation of successful business cases for replacement/refurbishment of a power station Local Services transformers, four 65 MVA generator step up transformers (220/11 kV) and the replacement of six generator circuit breakers and three new 225 MVA 220/16 kV transformers.
- Meridian Energy (NZ) - Let contracts for electrical equipment as part of a refurbishment and reconfiguration of Benmore Power station (225 MVA 220/16kV transformers, design consultant services contract, 5000 A, 80 kA generator circuit breakers).
- Meridian Energy (NZ) - Tender documentation preparation and tender evaluation for contracts to purchase and install generation step up transformers.

John Grace – Senior Telecommunications Engineer

John Grace has 30 years' experience in the electrical supply and telecommunications industries specialising in telecommunications strategic, capital and business case planning, as well as design, specification, commissioning and installation.

With his experience he brings the ability to organise people and projects in engineering and manufacturing environments. This ability is complemented by professional design and investigation skills focused on the telecommunications industry, with niche experience in the electrical supply industry aspects of telecommunications. He has particular depth of experience in power system telecommunications, including planning and managing the technical/commercial interface in the tendering of complex equipment.

His qualifications include a Bachelor of Engineering from Canterbury University and an MBA (Technology Management) awarded by APESMA / Deakin University. He is currently the PSC representative on the Australian Panel of CIGRE Committee D2: "Information Systems and Telecommunications".

Relevant experience includes:

- Management of telecommunications deployment projects as client project manager, maintaining focus on time, scope and cost for projects for a New Zealand utility's new network rollout.
- Provided the conceptual design for projects that required power line carrier and SDH/PDH Radio design for ElectraNet in different regions of South Australia.
- Completed site investigation and provision of preliminary scope and cost for the work to prepare Transpower Substation sites for new network equipment.
- Responsible for the design of telecommunications and project management of the changes required to enable replacement of ageing power line carriers terminating in the Huntly Power Station, including and the remote ends at Otahuhu, Glenbrook, Takanini, Hamilton, Stratford and Whakamaru substations.
- Project management and detailed design for a non-metallic fibre optic cable, installed on a section of the Transpower Wilton-Central Park 110kV transmission line Project management and design input for the network design and infrastructure upgrading for the Transpower East Coast Microwave project.
- Preparation of the strategic plan for the Upper and Lower Waitaki Power System telecommunications network as part of the Area Remote Control upgrade project in the South Island of New Zealand.
- Analysis and provision of radio frequency planning for capacity upgrades to Genesis Energy radio links in the Tongariro National Park area.

Les Brand – CEO and Electrical Engineering Manager – PSC Australia

Les has over 17 years experience in the high voltage electricity industry and during that time has undertaken roles ranging from the electrical engineering design, project management, installation and commissioning of high voltage AC and DC transmission systems, through to senior management within the power systems industry throughout Australia, Asia and the United States. Les has experience in all aspects of power systems engineering and has a high technical knowledge of transmission systems. Les has worked for both utilities and regulators in Australia.

Relevant experience includes:

- South Australia substation conceptual design, scope of works and cost estimate, including development of scope (covering primary, secondary and transmission lines and structures), coordination of cost estimates, high level project schedule and outage planning for the following projects:
    - Brinkworth substation – 275kV and 132kV augmentation works, including new 200MVA 275kV/132kV transformer.
    - Cherry Gardens substation – 275kV and 132kV substation augmentation works.

    - Tungkillo substation – Greenfields 275kV switching station.

- Directlink HVDC facility – Assistance to the ACCC, review of costs and development of scope and cost estimates for alternative projects for the Directlink application for regulated status.
- Review of year 04/05 capital plan for major transmission and distribution utility in Western Australia including a critical review of solutions proposed for network constraints and a review of costs and justification for individual transmission, distribution and SCADA projects.
- Review of 10 year planning report and capital expenditure for major distribution utility in South Australia including critical review of solutions proposed for network constraints and review of the costs for the proposed distribution projects.
- Murraylink HVDC facility – Technical assistance to the Owner's team, and development of CAPEX and OPEX estimates, during the preparation of the application for regulated status.
- Technical due diligence of the National Transmission Corporation (Transco) in the Philippines including a review of all aspects of the business and Opex and Capex plans (including the scope and estimate of all proposed capital projects). Drafting and development of final due diligence report.