APPENDIX L

Capital Program Estimating Risk Analysis

May 2011

Powerlink Queensland

Capital Program Estimating Risk Analysis

16 May 2011

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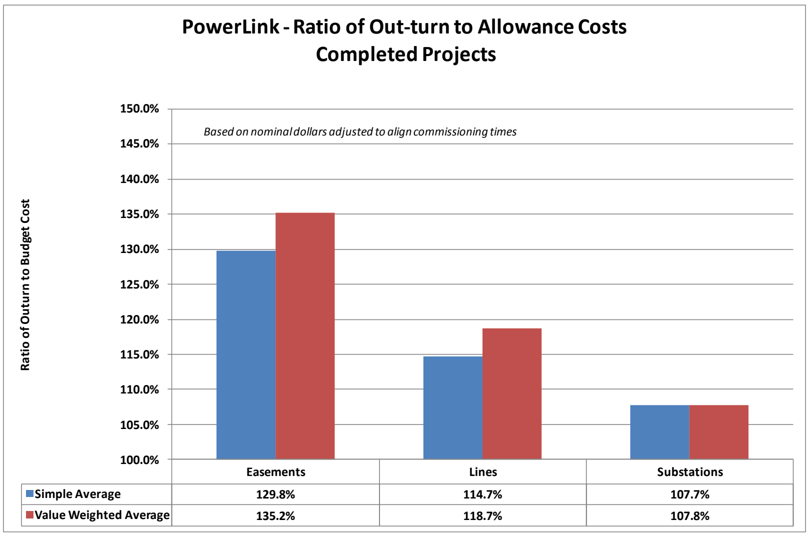
1 EXECUTIVE SUMMARY

Powerlink has engaged Evans & Peck to provide an independent[1i] estimate of the cost estimation risk factors to apply to their forthcoming 2012/13 to 2016/17 regulatory period. This builds on work previously completed by Evans & Peck for Powerlink and other TNSP's in relation to their current regulatory decisions.

In the current Powerlink decision, the AER approved a portfolio cost estimation risk factor of 2.6%. This value was based on Evans & Peck's experience, and analysis of the project cost information available at that time. Evans & Peck's view is that the AER will place significant emphasis on historical data in justifying cost estimate risk factors in forthcoming decisions. As a consequence, this report has focused analysis on data for network capital projects completed in the current regulatory period.

We have examined 50 completed projects, divided into easements, lines and substations (both primary and secondary) that were included in the previous AER decision. The outturn cost has been compared with the regulatory allowance for each project on the basis of nominal dollars. Where commissioning time differences have occurred, the allowance has been adjusted to reflect the associated escalation or de- escalation. Figure 1.1 demonstrates the overall variability between allowance and out-turn costs in each of the asset categories.

Figure 1.1 – Powerlink – Out-turn to Allowance Ratio – 50 Projects



Clearly, cost overruns have occurred in the context of a deterministic P50 "on allowance" expectation. In terms of a probabilistic outcome based on the inherent variability of capital project development, which in our view is more relevant to capital projects, the Lines outcome appears to be at approximately the "P66" level, and the Substations at the "P63" level. We have not been able to statistically assess the equivalent Easement value due to data sparsity and variability. Whilst commercial practice in a competitive bidding process is to bid projects in the range P70 to P90, the

[1] [1] The views expressed in this report are based on our independent analysis of the data provided.

P50 value has generally been adopted by the AER as a "reasonable" allocation of cost estimate risk between NSP's and their customers.

Based on the analysis of the data made available by Powerlink, we have concluded that the appropriate "P50" cost estimation risk factors that should be applied by Powerlink are:

- Lines Projects – 4.5%
- Substation Projects – 1.5%

We have not been able to statistically determine an appropriate risk factor for Easements, but given the higher ratio of outturn cost to allowance compared to line projects, it is proposed that the risk factor for lines also be applied to easement projects. In our view, this provides a conservative estimate of the cost estimate risk involved with easement projects

2 INTRODUCTION

Powerlink has engaged Evans & Peck to provide appropriate risk factors to apply to the capital program associated with their 2012/13 to 2016/17 regulatory period. The intent of the cost estimate risk factor is to recognise the asymmetric nature of risk associated with delivering capital projects. The risk factor recognises that even though estimates are made to determine the most likely cost of a project, there is a greater probability that cost will increase than it will decrease.

In Powerlink's 2007/08 to 2011/12 regulatory proposal, Evans and Peck, based on working knowledge of the range of risks incurred on typical projects, assessed a risk premium of 2.6% should apply to Powerlink's project estimates. In their decision, the AER's final determination concluded:

> *"Overall, the AER considers it reasonable to apply a cost estimation risk factor of 2.6 per cent to Powerlink's forecast capex estimates, to reflect risks outside Powerlink's control when estimating project costs."*[2]

Evans & Peck has subsequently acted to establish a cost estimation risk factor for other transmission operators including Electranet, TransGrid, Transend and SPAusnet. In these subsequent reviews, more detailed workshops were held with subject experts from each utility to arrive at the appropriate cost estimate risk factor. These were generally above 2.6%. Whilst Evans & Peck were of the view that this process was more robust than that applied in the initial Powerlink assessment the AER has rejected the workshop approach, as highlighted in the TransGrid Final Determination:

> *"In the draft decision, the AER accepted the modelling approach applied by Evans & Peck (EP) but considered the process of 'risk workshops' used to arrive at the risk adjustment factors did not lend itself to transparent assessment and had produced bias in expenditure adjustments. Specifically, the AER considered there was a lack of transparency in the factors considered at the workshops that suggested there was scope for the risk adjustment to reflect costs that were captured in other cost factors, including*

[2] AER Powerlink 2007/08 to 2011/12 Final Decision P38

labour and materials escalators. Therefore, on balance, the AER considered the proposed risk adjustment was not appropriate".[3]

Notwithstanding rejection of the workshop approach, the AER went on to conclude:

"However, recognising the reasonableness of providing a risk adjustment for risks outside TransGrid's control, the AER considered that a risk adjustment allowance $11 million ($2007–08) less than that being sought was reflective of the costs that a prudent operator in the circumstances of TransGrid would require to achieve the capex objectives in accordance with the capex criteria".

Consequently the risk allowance of approximately 3.3% sought by TransGrid was decreased to approximately 2.8%.Given Evans and Peck's experience in establishing cost estimation risk factors, and outcomes from previous AER decisions on this matter, the analysis performed for Powerlink was based on the historical performance of Powerlink's projects. This report has established cost estimation risk factors based on the ratio of outturn cost to the regulatory allowance for projects included in Powerlink's 2007/08 to 2011/12 AER decision.

3 OUTTURN TO ALLOWANCE COST – COMPLETED PROJECTS

Powerlink is approximately 75% of the way through the 2007/08 to 2011/12 period. Due to the comparatively long period between project inception and financial close out, there are a limited number of projects that:

- Have a "self contained" estimate in the 2007/08 to 2011/12 decision
- Have been completed and financially "closed out"

Powerlink has provided data on a total of 50 active and future[4] projects that have been completed in the current regulatory period. 8 of these are easement projects, 16 line projects and 26 substation projects including telecommunications and secondary systems.

"Final Decision Allowance" and "Outturn Costs" have been provided on a nominal basis. The Final Decision estimates have been adjusted by the AER approved escalation factors, and out-turn costs is as captured in Powerlink's financial reporting system. Where a difference in timing of commissioning has occurred, the outturn cost has been adjusted up or down at a rate of 3.15% per annum, the CPI value approved in the Final Decision. Whilst not encompassing the portfolio of escalators approved this is, on balance, considered to provide a reasonable proxy to permit a timing adjustment to enable a like for like comparison. Evans & Peck is not aware of any reason why the sample provided should not be considered representative of Powerlink's overall performance.

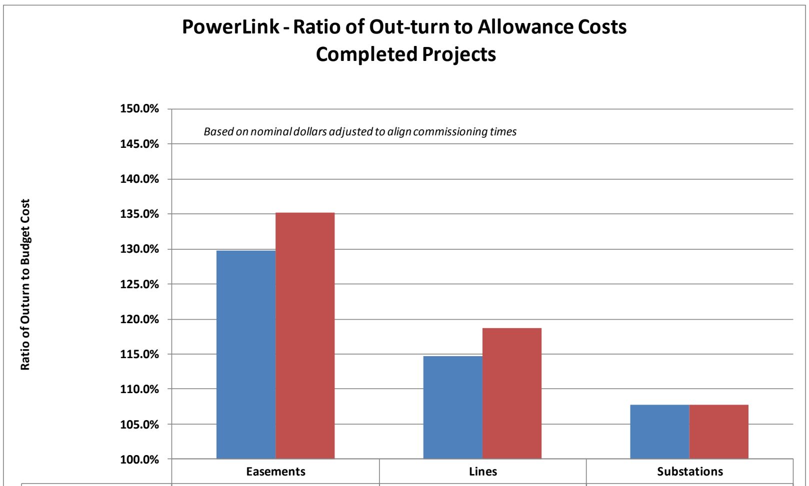
[3] AER TransGrid 2009/10 to 2013/14 Final Determination P34

[4] Active projects include those projects advised to the AER to be in progress at the start of the current regulatory period. Future projects include most likely scenario projects in the current regulator period.

Figure 3.1 shows the resultant outturn cost to final decision allowance ratio across this portfolio of projects. We have examined both the "simple average" (i.e. the average of each individual project) and the overall average based on total cost vs. allowance. In summary:

- There has been a 30 – 35% cost overrun on easements
- There has been a 15 – 19% cost overrun on line projects
- There has been an 8% cost overrun on substation projects.

Figure 3.1 – Powerlink – Out-turn to Allowance Ratio – 50 Projects



	Easements	Lines	Substations
Simple Average	129.8%	114.7%	107.7%
Value Weighted Average	135.2%	118.7%	107.8%

Clearly, these ratios are well outside that envisaged in the original cost estimation risk factor. Evans & Peck has not been tasked with identifying the full cause of this variation, however our strong expectation is that a range of factors other than those envisaged in the cost estimation risk factor analysis are at play. These could include:

- Optimistic estimation underpinning original estimates
- The use of P50 estimates, which by commercial standards, is an optimistic approach.
- Variation between AER approved escalation factors and actual escalation, including changes in market conditions particularly in the area of easements
- Project scope creep, or incomplete scope application in high level estimates

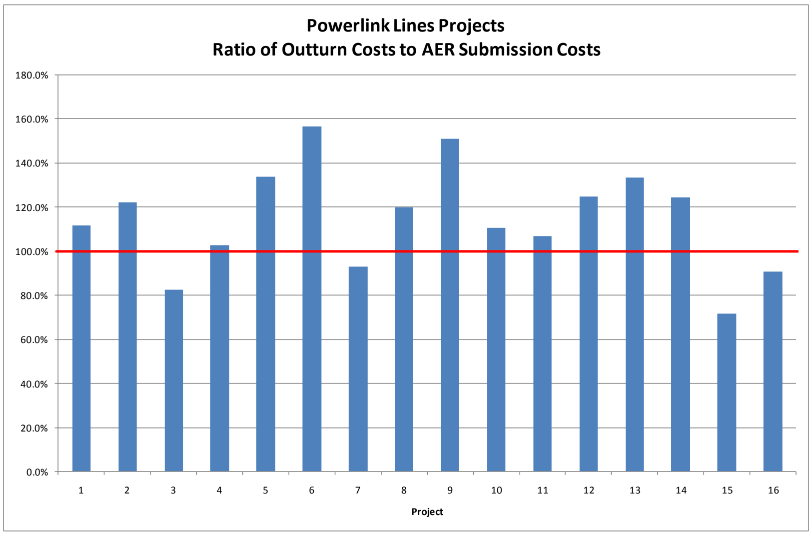
Our underlying assumption is that Powerlink will address many of these issues in their base estimating procedure. Notwithstanding that we would expect to see an upward adjustment in base costs, our expectation is that estimates in relation to the forthcoming decision will still be based on the "most likely" outcome. As a consequence, our approach has been to separate the "asymmetric" risk component from the average shift to provide an estimate of the appropriate factor(s) to apply to the cost estimation risk factor going forward. This analysis follows in Section 4.

4 EVALUATION OF RISK FACTOR IMPLICIT IN HISTORICAL DATA

4.1 Lines

Figure 4.1 demonstrates the range of out-turn to allowance cost ratios across 16 lines projects. 4 projects were completed under allowance with the remaining 12 above allowance. The range was between 71.5% and 156.5%.

Figure 4.1 – Lines Projects – Ratio of Out-turn to Allowance Costs



On average, projects ran 14.7% above AER estimate on a like for like nominal dollar comparison. The cost weighted average was 18.7% above. Utilising @Risk curve fitting functionality, we have determined that the percentile values of this project data as shown in Figure 4.2:

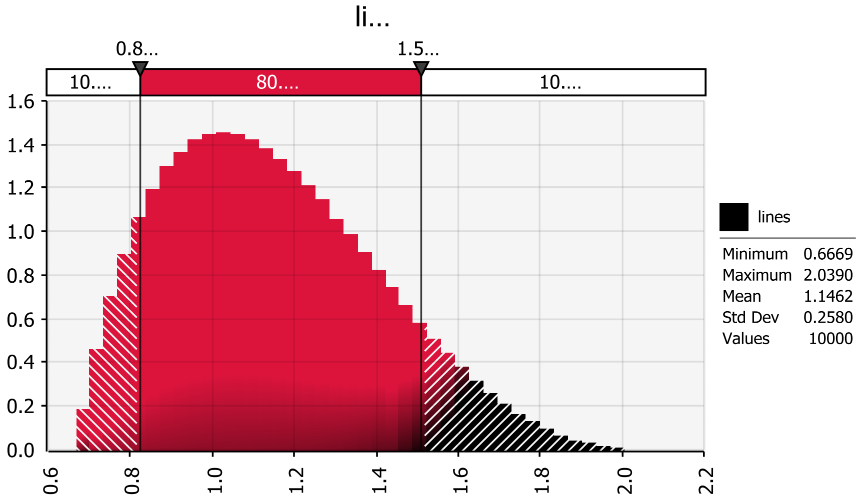
Figure 4.2 – Statistical Representation of Line Project Out-turn to Allowance Ratios

Percentile	Value
P10	0.826
P50	1.118
P90	1.509

Consistent with our approach of using the "conservative"[5] Pert distribution, we have entered these values into a generalised Pert distribution to establish a continuous but bounded distribution as shown in Figure 4.3.

[5] To the extent that it biases toward the most likely outcome in comparison to other distributions such as triangular

Figure 4.3 – Pert Representation of Line Project Out-turn to Allowance Ratios



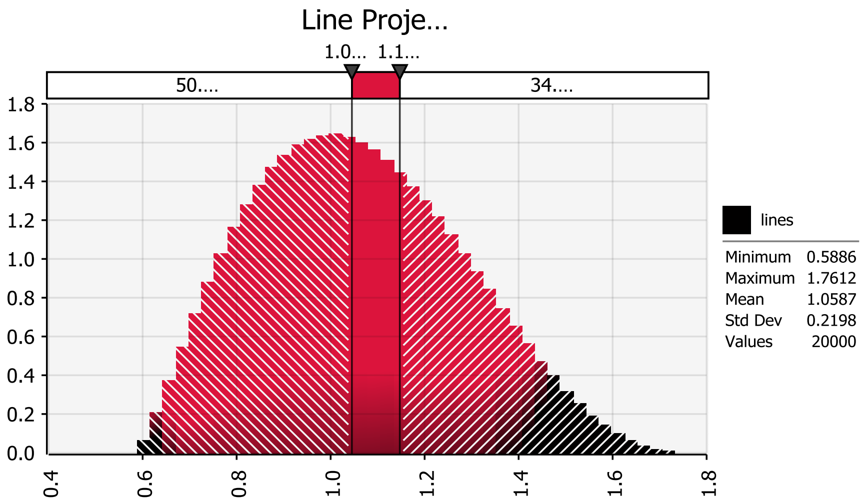
Clear asymmetry of outcome is evident. To account for necessary adjustments in the underlying estimates to achieve a neutral outcome, this curve has been scaled by 1/1.1462.To assess the "residual asymmetry" inherent in the distribution we have re-constructed a Pert distribution with the parameters shown in Figure 4.4:

Figure 4.4 –Pert Parameters Adjusted to Reflect Movement in Base Estimates

Parameter	Value
Minimum	0.58 (i.e. .6669/1.146)
Most Likely	1.000 (reflecting the intent of revised estimates)
Maximum	1.77 (i.e. 2.039/1.146)

The resultant distribution, based on a Monte Carlo simulation, is shown in Figure 4.5.

Figure 4.5 – Pert Distribution Representation of Line Project Outturn to Allowance Ratios

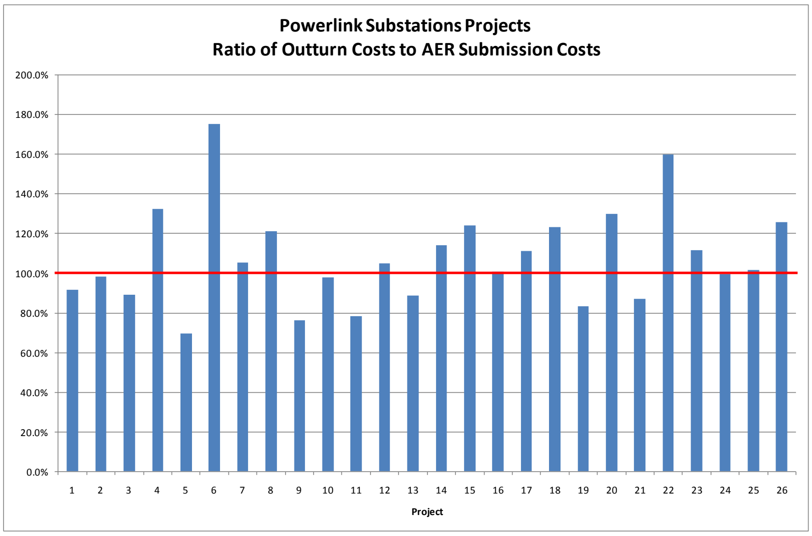


The P50 value of this curve shows an increase of 4.5%, which we believe is the appropriate cost estimation risk factor for line projects with risk allocation based on P50. Whilst the average historical cost overrun is 14.7%, it must be recognised that, based on the variability inherent in the outturn results, this only represents a P66 outcome as demonstrated in Figure 4.5.Within the context of common commercial practice it is usual to bid projects in the range P70 to P90.

4.2 Substation Projects

The above analysis has been repeated on substation projects. In order to avoid data sparsity with sub-groups, we have combined both primary and secondary projects together. Figure 4.6 demonstrates the range of outcomes across individual projects.

Figure 4.6 – Substation Projects – Ratio of Out-turn to Allowance Costs



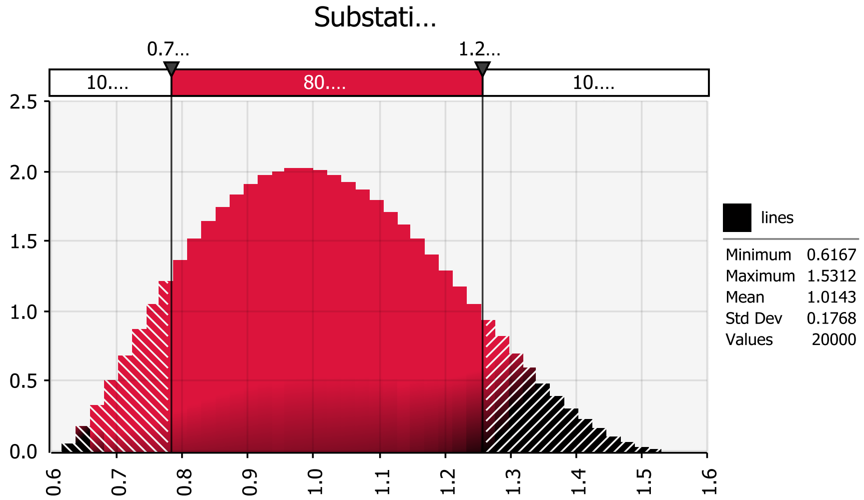
The average overrun on substations projects is 7.7% (7.8% on a value weighted basis), with a range of 69.8% to 175.4%. Utilising @risk curve fitting functionality, we have determined that the percentile values of this data are as shown in Figure 4.7.:

Figure 4.7 – Statistical Representation of Project Out-turn to Allowance Ratios (Substations)

Percentile	Value
P10	.784
P50	1.006
P90	1.257

Consistent with our approach of using the Pert distribution, we have entered these values into a generalised Pert distribution to establish a continuous but bounded distribution as shown in Figure 4.8.

Figure 4.8 – Pert Distribution of Substation Project Out-turn to Allowance Ratios



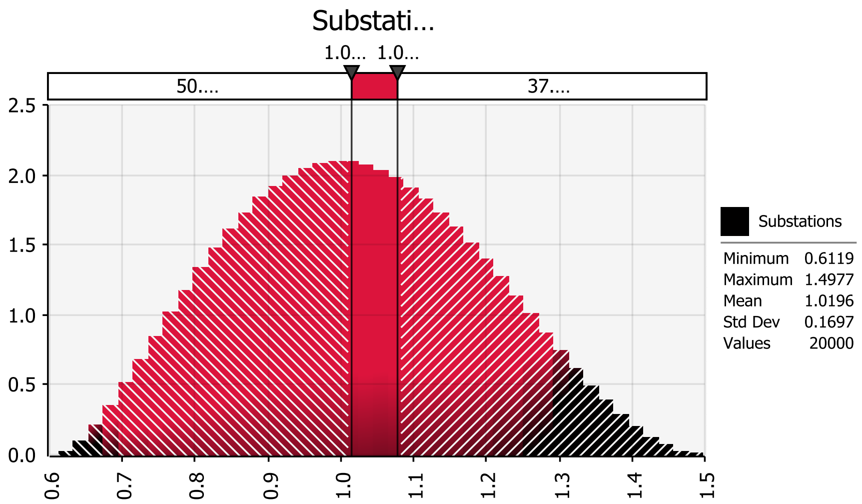
Clearly, there is less asymmetry than in the lines case. This curve has been scaled by 1/1.0143 reflecting an average increase in the original estimates required to approach a mean outcome of 1 across the portfolio. In order to assess the "residual asymmetry" inherent in the distribution we have then constructed a Pert distribution with the parameters shown in Figure 4.9

Figure 4.9 –Pert Parameters Adjusted to Reflect Movement in Base Estimates (Substations)

Parameter	Value
Minimum	0.608(i.e. .6167/1.0143)
Most Likely	1.000 (reflecting the intent of the current estimates)
Maximum	1.510 (i.e. 1.5312/1.0143)

The resultant distribution, based on Monte Carlo simulation, is shown in Figure 4.10.

Figure 4.10 – Pert Representation of Substation Project Out-turn to Allowance Ratios

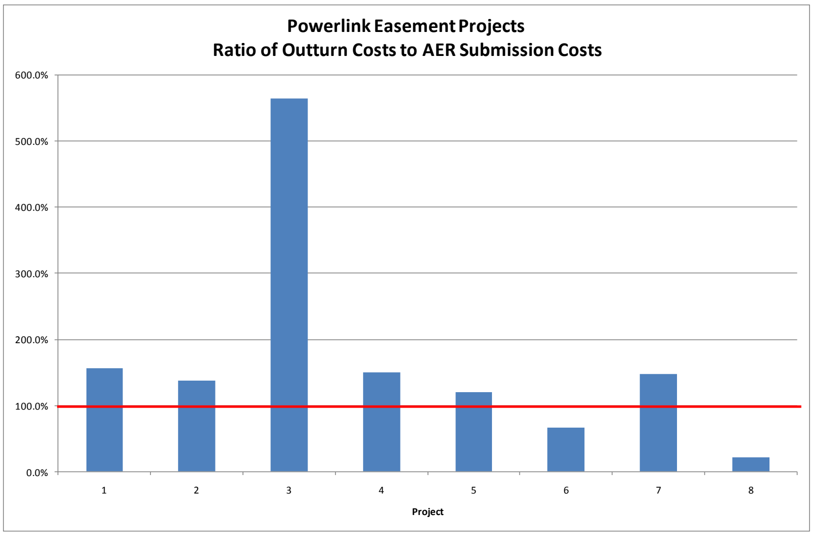


The P50 value of this distribution is 1.015, indicating a risk estimation factor of 1.5%. The 7.7% uplift associated with the out-turn ratio on current projects, equates to the P63 level, again well below the risk level normally associated with bidding commercial projects.

4.3 Easements

The outturn to allowance ratio of the 8 easement projects for which data has been provided is shown in Figure 4.11. The average out-turn ratio is 129.8% on a project basis (and 135.2% on a value basis).

Figure 4.11 – Easement Projects – Ratio of Out-turn to Allowance Costs



Due to the high degree of variability in this data set, the small sample size, and despite the materiality of the outturn to allowance ratio, Evan's & Peck has not been able to produce what we would consider a sufficiently robust statistical analysis of the easement data.

Whilst consideration has been given to combining the easement and line data sets, the high variability of easement data distorts the line data as to increase its risk factor. Given this variability, and the relatively small average size of projects in the easement portfolio compared to the lines portfolio ($9.2m vs. $55.4), the lines data is analysed independently of the easement data. Notwithstanding this computational difficulty, in the context of the high outturn to allowance ratio encountered on average in the easements portfolio, we are of the view that a risk factor consistent with that established for the lines projects, provides a conservative measure of the risk factor applicable to easement projects.

CURRICULUM VITAE
BILL GLYDE

POSITION: Principal

QUALIFICATIONS:

Bachelor of Engineering (Electrical) with Honors, New South Wales Institute of Technology
Master of Commerce, University of New South Wales
Partial Completion – Master of Engineering Science
Graduate – Australian Institute of Company Directors

EXPERIENCE SUMMARY:

Bill has over 38 years experience in electrical distribution, trading and generation. His early technical experience focused heavily on assessing the cause of failure of electrical plant. He has built on his early engineering experience to provide a bridge between the technical/operational aspects and the commercial/customer service side of electrical supply. He has extensive experience in pricing, regulatory management, power purchasing, sales contracting and trading prior to joining Evans & Peck.

Bill was responsible for the commercial development of a gas-fuelled base load power station in North Queensland, including the facilitation of Queensland's largest coal seam methane development at Moranbah, the development of a 400km high pressure gas pipeline and the conversion of a privately owned simple cycle gas turbine to combined cycle.

Since joining Evans & Peck, Bill acted as technical advisor to the Queensland Government's Independent Review of Electricity distribution and Service Delivery in the 21st Century. He was then retained by Government to oversee the implementation of the recommendations arising from that review, including formulation of policy and legislation relating to service standards, reliability and planning. He provides a range of technical and commercial advisory services the Queensland Competition Authority, the current technical regulator in Queensland. He oversees the preparation of Network Management Plans and summer Preparedness Plans by Queensland's Distributors for the QCA. He has also assisted the Queensland Government in an operational review of the distributors in the role of technical advisor.

Other consulting assignments have included the negotiation of transmission network support arrangements, including assistance with the application of the regulatory test applied under National Electricity Rules, negotiation of power purchase and connection arrangements relating to power projects, strategic advice on coal, gas and wind power station acquisition and development and assistance to major network operators in regulatory case preparation.

EXPERIENCE HISTORY:

EVANS & PECK

Mar 2004 - Present

Position: Principal

Role: Development of Energy Sector Business

Assignments:

- Technical advisor to Independent Review of Queensland's electricity distribution companies (Somerville Report)
- Government appointee – oversight of implementation of Somerville recommendations
- Government appointee to oversee preparation of distributor network management plans
- Strategic advice – peaking power plant opportunities in Queensland
- Strategic advice – Australian generation development and acquisition
- Strategic review – Victorian electricity network business
- Development cost review – coal seam methane costing
- Contract negotiation – Transmission support contracts – North Queensland
- Project Director – private / public CCGT feasibility study
- Strategic review – outlook for environmental credits relating to power generation in Australia
- Feasibility analysis, construction contracts, off-take agreements (including renewable energy aspects) and connection agreements – small scale hydro plant
- Strategic advice – impact of regulatory review – Victorian electricity network tariffs
- Strategic advisor – power generation company (coal and gas)

acquisition

- Review of planning policies – Victorian electricity network business
- Feasibility analysis – small scale LNG facility
- Lead negotiator – gas transportation and storage arrangements, compressor acquisition for 670 MW gas fired power station
- Regulatory assistance – reliability and capital program regulatory submission– NSW network business
- Regulatory Assistance – Queensland Transmission AER Revenue Reset
- Regulatory Assistance – South Australian Transmission AER Revenue Reset
- Regulatory Assistance NSW and Tasmanian AER Revenue Reset
- Regulatory assistance – Queensland network tariff reform
- Project Management – registration of generator technical standards
- Advice and negotiation – wind farm acquisition
- Regulatory assistance – Ergon Energy pass through applications
- Technical assistance – operational review of Queensland Distributors.
- Regulatory assistance – service standards, service performance incentive scheme
- Strategic advice – risk based project modelling - wind
- Project Manager – hydro power plant feasibility analysis
- Project Manager – gas tolling arrangements – LNG ramp gas

ENERTRADE

Oct 2002 – Mar 2004

Position: General Manager

Role: Responsible for all structured deals including gas, network support and major electricity sale contracts such as Aldoga/Boyne Island Smelters.

Responsible for management of power purchase agreement – Gladstone Power Station.

Resposible for implementation of gas purchase and sale agreements.

Assignments: Led successful second bid for the construction of a gas fired baseload power station in Townsville. Commercial operation 7 February 2005.

Led unsuccessful bid for the purchase of Mt Stuart Power Station from AES Corporation.

Successfully lead the acquisition of Barcaldine Power Station.

Manage relationship with Comalco re Gladstone Power Station.

Mar 2000 – Oct 2002

Position: Manager, Business Development/Manager Trading and Business Development

Role: **Managing Front Office Activities**
Built trading team with employees replacing consultants Oversight of system developments including energy trading and ancillary service software.

Responsible for Management of Power Purchase Agreements relating to power stations including Gladstone, Townsville, Collinsville, Mt Stuart, Oakey and Barcaldine.

Assignments: Responsible for bidding and dispatch of 2680 MW peaking and mid merit plant.
Responsible for trading of swaps and options with retailers and generators.

Responsible for business development activities including negotiations with aluminium smelters and baseload power station proposals in North Queensland.
Oversight of fuel sourcing – coal, gas and liquid fuels

NORTHPOWER

Sept 1996 – Mar 2000	**Position:**	Manager, Retail Markets/National Sales Manager

Role:

- Contestable electricity Sales Strategy Development and Implementation in four states
- Managing State Business Managers, Account Executives, Regional Account Representatives, administrative staff
- Lead generation, tendering, quoting, contract negotiation and administration, NEMMCO transfers, billing, debt management, meter data management, network account reconciliation
- Development and implementation of retail risk management policy
- Management of interface with network operators
- Liaison with generators on wholesale hedge products
- Franchise price formulation and implementation, including liaison with Independent Pricing and Regulatory Tribunal
- Negotiation of embedded generation Power Purchase Agreements (bagasse, mini-hydro)
- Project Manager – hydro power plant feasibility analysis (in progress)
- Project Manager – gas tolling arrangements – LNG ramp gas

ENERGY AUSTRALIA

Nov 1993 - Sep 1996	**Position:**	Manager, Energy Trading

Role:

- Reported to the General Manager - Marketing and directly to Chief Executive/Board
- Liaison with National Grid Management Council (NGMC), including membership of Market Trading Working Group (responsible for market design)
- Wholesale purchasing including initial vesting contracts and competitive contracts
- Lead negotiator on power purchase agreements - Redbank 128 MW Power Station, Lucas Heights 1 Landfill, Belrose Landfill
- Retail pricing policy formulation and implementation, including regulatory IPART management of established customer
- Major sales contract management including negotioan and implementation
- Sales forecasting
- Load Research, inlcuding first end use local survey of residential energy consumption

July 1987 - Nov 1993	**Position:**	Manager, Demand Management & Pricing/Engineer, Electricity Utilisation

Role:

- Oversight of relationship with wholesale supplier on power purchase matters
- Retail pricing policy formulation and implementation including liaison with Government Pricing Tribunal
- Demand management policy formulation and implementation
- Sales Forecasting
- Load research including commercial load analysis product
- NGMC liaison
- Supervision of marketing and advisory services to major industrial/commercial customers

Jun 1983 - Jul 1987	**Position:**	Engineer, Pricing and Load Research

	Role:	• Pricing policy • Reported to Personal assistant to General Manager • Established load research program • Performed economic modeling and forecasting role
Oct 1977 - Jun 1983	**Position:**	Distribution Engineer
	Role:	• Substation engineering including failure investigation • Protection engineering • Overseas study tour of companies such as Reyrolle (including the Bushing Company), Hazemeyer and Krone • Mains engineering including failure investigation • Supervision of large construction forces in Sydney CBD • Problem solving, diagnostic analysis of likely failure modes, etc.
Jan 1972 – Oct 1977	**Position:**	Cadet Enginner
	Role:	• Sandwich Pattern Training • Practical experience in all aspects of electricity distribution