EVANS & PECK
think through the future

SP Ausnet

Capital Works Program

Risk Model Report

ISSUED – 11 October 2007

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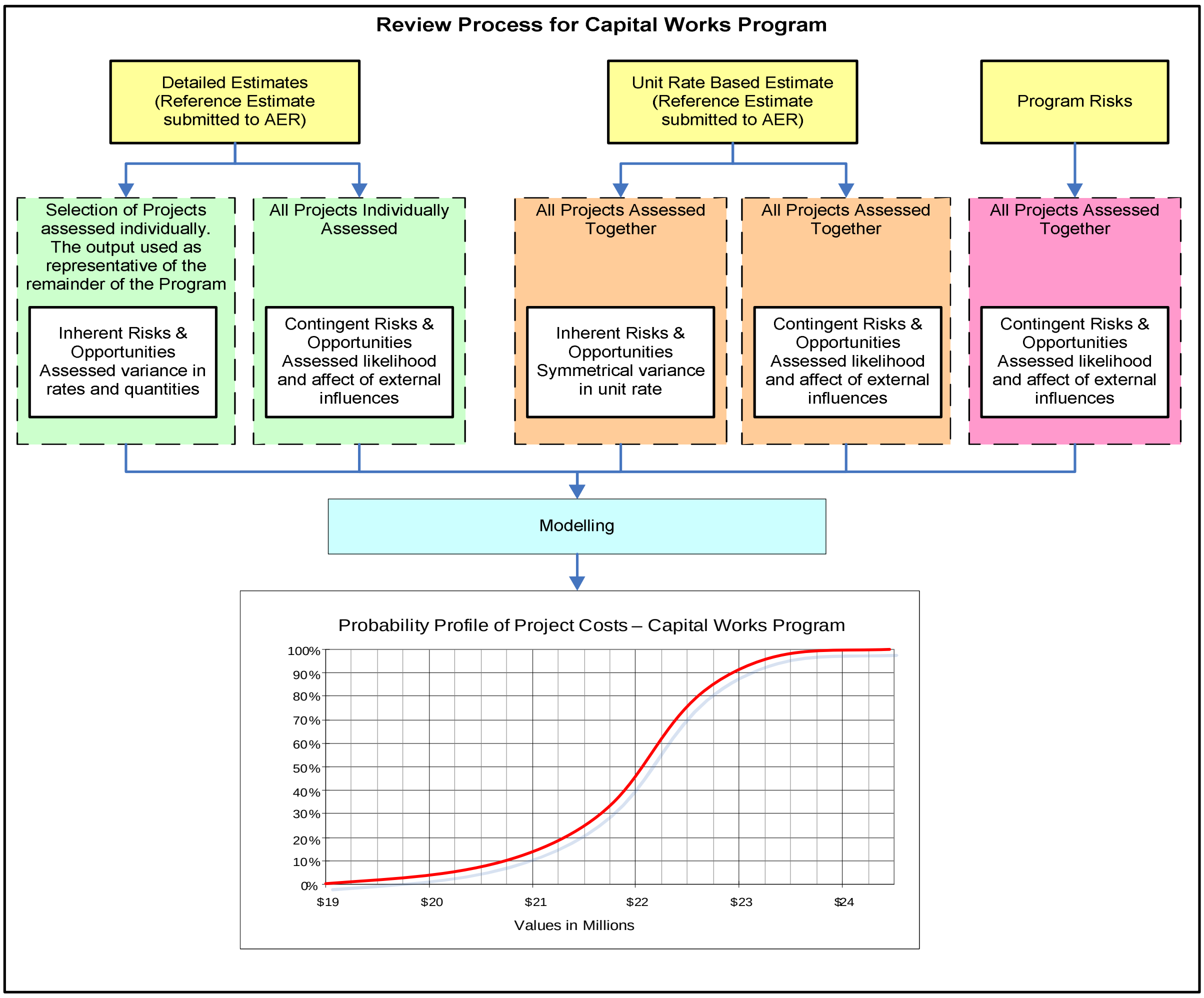
Appendices

EXECUTIVE SUMMARY

Evans & Peck was engaged by SP Ausnet to develop a risk adjusted estimate for SP Ausnet's capital works program for the 6 year regulatory period from 1 July 2008 to 30 June 2014. Evans & Peck has undertaken similar reviews for Powerlink and Electranet as part of their Regulatory Reset submissions to the AER. This report analyses the cost impact of the risks and opportunities associated with the Capital Works Program, however the analysis specifically excludes the examination of cost escalation risks.

The reference estimate used for the development of the risk adjusted capital works program reflects the SP Ausnet submission provided to the AER as part of the regulatory reset process for 2008- 2014. We are advised by SP Ausnet that the reference estimates provided to us exclude any contingency built into the estimates.

In developing the risk adjusted estimate of the capital works program, Evans & Peck was provided with the details of the proposed Station Rebuild work program. Each project was supported by a detailed estimate developed from first principles by SP Ausnet. In addition, we examined the remainder of the works program which has been estimated by SP Ausnet based on a Unit Rate approach. We were advised by SP Ausnet that the Unit Rate estimate collates the actual costs incurred for a typical activity and uses this information as the basis for future forecasting.



Evans & Peck facilitated a risk workshop with key SP Ausnet personnel, responsible for management and development of the detailed reference estimates to understand the risk and opportunities associated with these estimates.

The outcomes of risk analysis are expressed as probabilities that the actual outturn cost will not exceed a certain amount. The value represented on the cost profile (known as P50) represents a 50% probability that the outturn cost will not exceed this value, or conversely a 50% probability that the outturn costs will exceed that value. A P50 value is often used to establish a target cost estimate in contracting. The value represented on the cost profile (known as P80) represents 80% probability that the out turn cost will not exceed this value. A P80 value is commonly used in industry to establish a budget estimate.

In our experience, for a project portfolio of this nature, a P80 would normally be used for a budget figure. The selection of a P50 value would, in our opinion, represent a very aggressive business position for SP Ausnet, with equal probability of delivering or not delivering the projects at this cost. At this position there is a significant probability of having to adjust and reprioritise the projects to be delivered within the budget.

Should the Reference Estimate including contingency as nominated in the SP Ausnet draft submission ($756m) be adopted, the E&P risk model indicates that there is greater than 95% probability that the outturn costs to deliver the capital works program as scoped, will not be contained below this value.

The results of Evans & Peck's analysis are summarised in the table below.

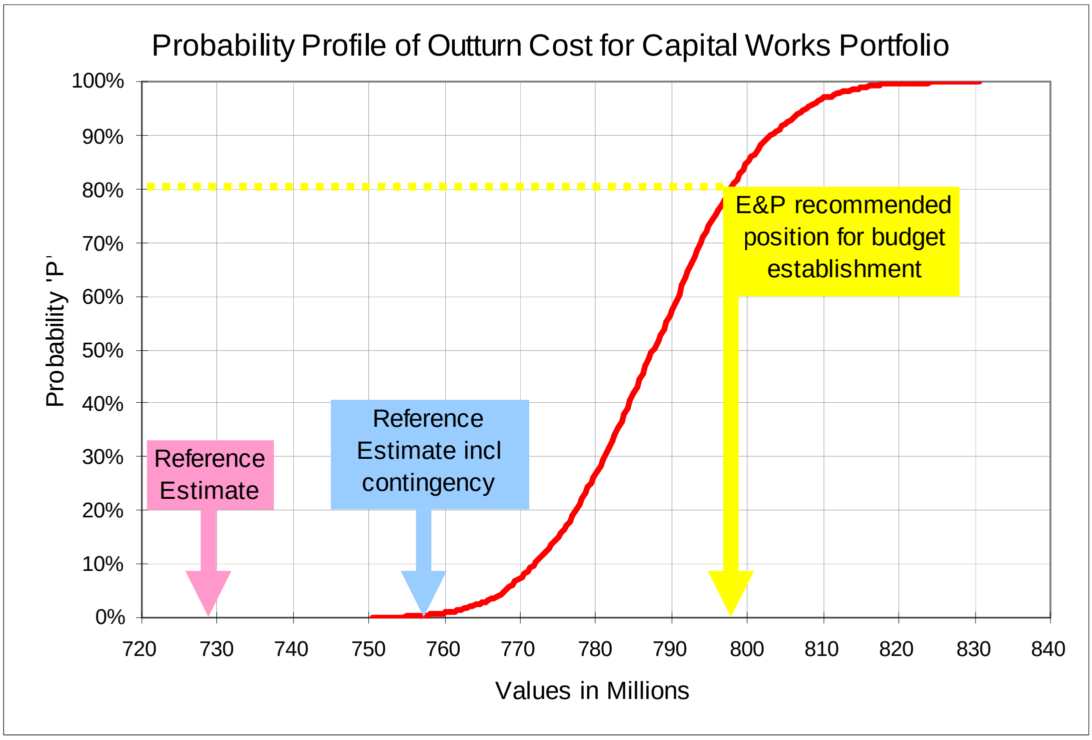
			Probability Profile of Modelled Cost			
2007-08 Dollars	Reference Estimate (SP Ausnet)	Reference Estimate incl contingency	P90	P80	P50	P10
Station Rebuild Model Output	$337,293,237	$364,633,562	$377,734,203	$375,482,399	$371,967,172	$367,219,019
% increase in reference estimate		8.1%	12.0%	11.3%	10.3%	8.9%
Unit Rate Model Output	$392,260,143	$392,260,143	$410,719,865	$407,202,293	$400,344,662	$390,352,603
% increase in reference estimate		0.0%	4.7%	3.8%	2.1%	-0.5%
Program Risk Model Output			$25,481,257	$21,524,070	$14,465,437	$ -
Total Model Output	$729,553,380	$756,893,705	$803,166,809	$797,710,782	$787,576,716	$771,847,330
% increase in reference estimate		3.7%	10.1%	9.3%	8.0%	5.8%

The Station Rebuild works at the P80 value of $375.5m represents an increase from the reference estimate of 11.3%. In our opinion this increase from the reference estimate is reasonable for projects of this nature, particularly given the duration between the preparation of the initial scope document and the approval to proceed. This compares with the single value contingency value initially provided by SP Ausnet of $364.6m. Should the Reference Estimate including contingency as nominated in the SP Ausnet draft submission for the Station Rebuild Program ($364m) be adopted, the E&P risk model indicates that there is greater than 95% probability that the outturn costs to deliver the Rebuild Station program as scoped, will not be contained below this value, necessitating revision of the scope. This supports the position that SP Ausnet in the initial submission underestimated the risks associated with the Station Rebuild projects.

The detailed risk assessment and modelling exercise has calculated an increase in the outturn cost of SP Ausnet's capital works project portfolio of between 8% - 10% above the non-risk adjusted "reference" estimate. This is lower than industry experience would typically suggest, and shows that SP Ausnet has been optimistic in estimating the amount of risk that is contained in its portfolio of projects. A result of being optimistic in estimating the amount of risk in its portfolio, SP Ausnet has produced a conservative (low) cost to deliver SP Ausnet's portfolio of projects.

Based on our experience and supported by the risk model, there is a greater than 95% probability that the cost of delivering the portfolio of Capital Works will exceed the reference estimate including contingency ($756.9m). There is only a 10% chance that the costs will not exceed $771.8m, 50% chance of being delivered for less than $787.6m and 80% chance of being delivered for less than $797.7m.

The forecast range of out turn costs for SP Ausnet's portfolio is shown graphically as follows:



The relative range between the P10 ($770m) and P90 ($803m) values is also very narrow. This is reflective of the significant quantity of work estimated using unit rates (55%), for which a symmetrical and relatively small risk profile has been adopted. In additional the boundaries established for the external (unplanned) risks are constrained and represent an optimistic (aggressive) position.

An examination of the current regulatory period costs indicates approximately $51.8m of capital work was undertaken which was not initially scoped as part of the Regulatory Submission. This scope was delivered through the reallocation of budgets and deferring works and increasing the overall risk level of the business.

Confirmation of the appropriateness of the P80 value would go a long way to ensuring that the works program nominated by SP Ausnet was delivered. This position is commensurate with the risk and condition assessment undertaken in support of the works program. Any reduction from this figure will in our opinion necessitate the reallocation of budgets and repositioning of the risk levels at which SP Ausnet operate.

The outcome of this process, should the risk adjusted value not be adopted by the AER, is likely to necessitate the revision and reprioritisation of the works program by SP Ausnet in order to fit within the reference estimate including contingency as submitted in the initial draft to the AER.

Evans & Peck would recommend that at this stage of the project procurement cycle that a P80 figure would be more appropriate. And be reflective of the level of risk which exists, particularly given the longevity of the reset period.

1 INTRODUCTION

SP Ausnet engaged Evans & Peck to assess and quantify the risks and opportunities associated with the delivery of the 2008-2014 Capital Works Program, for the purposes of providing a risk-adjusted portfolio cost to the Australian Energy Regulator.

The development of major capital works projects involves complex transactions with considerable uncertainty. While risk management measures can reduce risk, they cannot and do not fully remove risk.

The long duration of SP Ausnet's capital works program from the initial scoping and cost estimation through to procurement, completion and commissioning, combined with the exposure of these projects to outside influences, means that at any point in time up until all costs have been expended, the forecast cost at completion will be a range, rather than a single number. This uncertainty is directly related to the risk profile of each project, which is related to the way that risk is managed on that project.

The reference estimates developed by SP Ausnet to support the Capital Work Program represent the costs at a point in time for a defined scope of work. The estimates doe not consider and take into account any cost or quantity uncertainty. For all projects the costs and quantities are not static, but dynamic and subject to change depending on external influences affecting the procurement of the works.

The E&P process takes these uncertainties into account in a manner that is capable of being subject to rigorous external review. The E&P process also takes the external and non project specific uncertainties into account. Our assessment identifies the base estimate as the reference point from which the risks and opportunities are evaluated to better understand the inputs which influence the cost estimate. This information is collated in a systematic and transparent method and modelled using '@Risk' to develop a probabilistic range of costs for each individual project. The collation of these individual projects together with projects developed from unit rates are used to develop the range of costs required to deliver the capital works program. The output from this modelling process is a probabilistic profile of costs. The selection by SP Ausnet and endorsed by the AER at the point along this cost profile is appropriate is determined by the level of confidence in the businesses ability to mitigate risks and realise any opportunities.

This paper addresses cost uncertainty by the construction of a priced risk model. Risk profiles are assigned to each task through the assessment of the likely range of potential cost outcomes. This information is collated to determine a risk profile for the project. The process is undertaken for each project and the then modelled using Monte Carlo analysis to determine the likely range of potential cost outcomes for the total portfolio of capital work projects contained in SP Ausnet's regulatory submission.

Typically, Evans & Peck would recommend that a P80 value or above is an appropriate position to be adopted at the funding stage, particularly given the uncertainties associated with the long term nature of the works program. In our experience most government departments would require the adoption of a P80 or P90 value in a gateway Review Process.

At this value SP Ausnet can have 80% probability that the costs will not exceed the value represented by the P80 point on the cost profile. The residual 20% represents the level of risk that the business (SP Ausnet) is prepared to accept.

2 OBJECTIVES

The objectives of the approach in the development of a risk assessed estimate include:

- To provide a framework for development of risk adjusted cost estimates in projects with considerable uncertainty;
- To undertake both qualitative and quantitative risk analysis for the portfolio of projects.
- The development of a transparent and appropriate risk adjusted cost estimate.
- The development of a risk adjusted cost estimate in accordance with the Australian Energy Regulator requirements.
- The development from the portfolio of projects a framework that realistically captures the uncertainty associated with multiple projects;
- To identify for the areas of cost uncertainty (inherent risks – variance in planned events inherent in the scope of work and external risks – unplanned events);
- To minimise the Capex in line with stakeholder expectations and maintain the level of service acceptable to the business;
- To exclude from the model any adjustment for cost escalation risks.

3 ASSESSMENT OF RISKS

3.1 Why Use Risk Analysis

Traditionally project and portfolio managers have made best estimates of future project costs, and applied a contingency to each project to allow for unforeseen cost increases. Applying contingencies at a project level can give rise to an excessive contingency amount at a portfolio level – this is discussed further in the Definitions.

The US Department of Energy recognises the need to address the uncertainty associated with estimates, with a directive devoted to contingency, which it defines as:

"costs that may result from incomplete design, unforeseen and unpredictable conditions, or uncertainties within the defined project scope. The amount of the contingency will depend on the status of design, procurement, and construction; and the complexity and uncertainties of the component parts of the project."

While contingency allowances and priced risk analysis have the same end goal (ie. to provide an accurate allowance for costs likely to be incurred), priced risk analysis is a more sophisticated and accurate tool which recognises both risks and opportunities within each project and for a portfolio of projects.

In particular, the assessment of the cost implication of specific risks and opportunities, combined with the application of computational techniques such as Monte Carlo simulation, provides an accurate and robust methodology for assessing the likely cost outcome of a project or portfolio of projects, subjected to such risks and opportunities.

3.2 Risk Assessed Estimating for Capital Works

The budgeting and capital approval process for construction and infrastructure projects requires the potential total outturn cost of the works to be identified at an early point in the in the project lifecycle.

The long duration and the exposure of capital works projects to outside influences means that at any point in time up until all costs have been expended, the forecast cost of the projects will be a range, rather than a single number. The uncertainty is directly related to the risk profile of a project.

A typical risk and opportunity profile changes with each stage of a project's life cycle. Such profile can include:

- Strategic
- Feasibility
- Concept
- Funding approval
- Delivery
- Detailed design
- Procurement
- Construction
- Commissioning
- Operation

The risk profile of a project will depend on the measures that are in place to manage risk, including optimising the ability to capitalise on opportunities. Therefore, to measure the potential overall cost of a project, it is necessary to understand:

- The scope of the project;
- The objectives (outcomes sought);
- The basis of the estimate (reference point);
- The potential risks and opportunities;
- How these risks are to be managed, opportunities to be realised;
- Potential financial exposure (ie. residual risk) after risks management;
- The potential cost implications of residual risk.

The development of a risk adjusted estimate for infrastructure projects generally includes the following categories:

3.2.1 Reference Estimate

This may be a detailed cost estimate for the known scope of work that can be quantified for the preferred option. The accuracy of the reference estimate is dependent on the availability of information relating to the scope of work and whether the information is complete and accurate. The typical process requires the project functional requirements to be well defined before project constraints, design criteria and standards can be applied to the functional requirements to arrive at a scope of work. A detailed work breakdown structure commensurate with the information available then enables the calculation of a reference estimate from first principles. The reference estimate excludes contingency and represents the estimate of final costs without consideration for scope and rate uncertainty. The reference estimate does not represent the likely outturn (final) cost of the project. It represents the estimated cost of delivering the known scope of works at the time the estimate was developed. The E&P process uses this information as the starting point to evaluate the risks and opportunities to determine the estimated outturn cost of the project or portfolio of projects.

3.2.2 Inherent Risks & Opportunities (Planned)

Internal risks and opportunities represent the possible variance in either the rate or the quantities documented within the reference estimate. These risks and opportunities are inherent variables in the planned scope of work. This is especially so where assumptions have been made in regard the scope, the size, or the material required for the project. Often these risks and opportunities often relate to productivity and quantification variance. The reference estimate is used as the starting point for this stage of the process and the boundaries of possible rates and quantities examined at a detailed level, to determine what reductions may be identified (opportunities) or the possible exposure (risks).

3.2.3 External Risks & Opportunities (Unplanned)

External risk and opportunities are those which were not considered or contemplated when the reference estimate was developed. In this respect they are unplanned or excluded from the estimate. This category includes items that may arise if the assumptions that form the basis of the reference estimate prove to be invalid, such as stakeholder issues (operators, community), permit conditions, access constraints or the occurrence of an unforseen event. They are often occur as a result of third party intervention which was not considered during the development of the reference estimate. Unforseen events such as a catastrophic natural event causing loss of power to the project, or a major safety incident are also treated as external risks and opportunities. In examining external risks and opportunities we consider the likelihood of occurrence together with the range of cost implications.

3.3 Risk Analysis

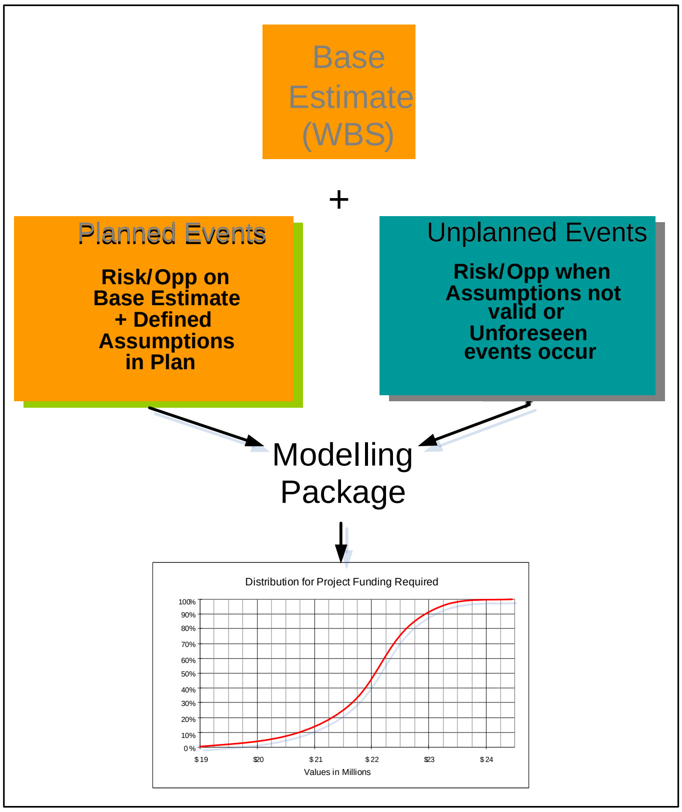
To develop a price risk model for potential project and portfolio costs involves using statistical techniques and analysis using computational power. The most effective and well recognised of these techniques is Monte Carlo simulation, where very large numbers of potential combinations of risk and opportunity outcomes are randomly sampled within a defined probability distribution.

For a portfolio of capital works, Monte Carlo simulation involves:

- Considering the range of potential cost outcomes for each item of known scope (“inherent risk”), based around the project reference estimate;
- Considering the probability of occurrence of each identified risk event and the probable range of costs (“external (unplanned) risks”); and
- simulating potential combinations of the costs of all of these to develop a likely range of costs for the overall project portfolio.

3.4 Establishing Project Profile of Outturn Cost

The probability profile of outturn cost can be considered as the provision for risk or opportunity arising from inherent (planned) and external (unplanned) elements. The two elements are combined in a probability model as indicated in the following diagram:



In the case of both inherent and external (unplanned) risks, three point estimates are established which are then utilised in the quantitative analysis. The three points are:

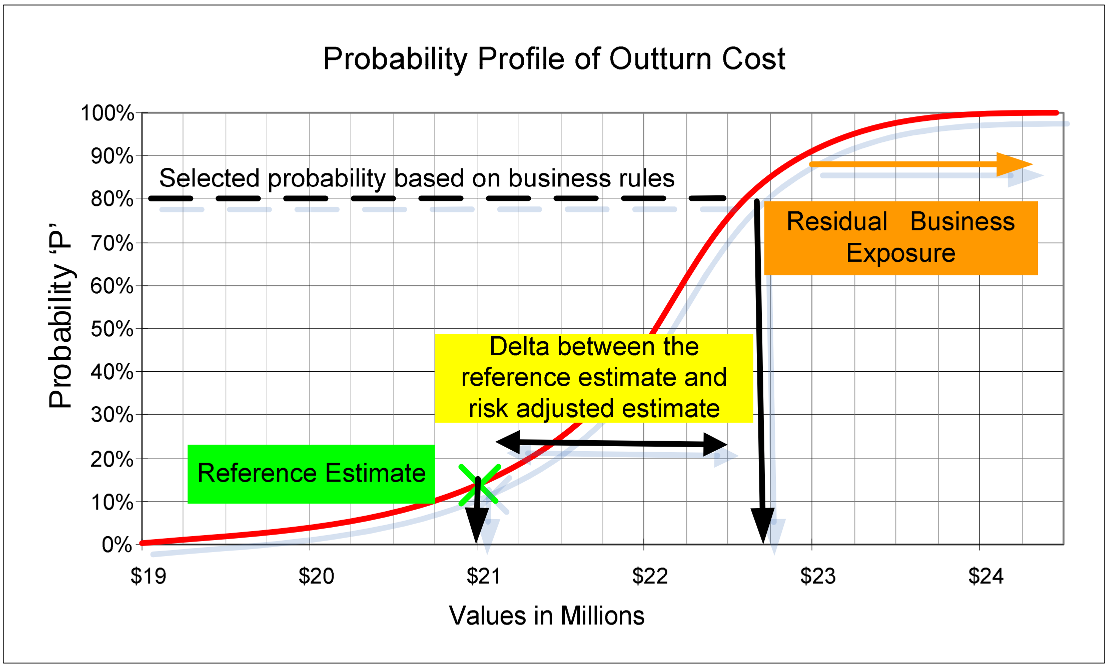
- Best - most favourable outcome or minimum cost;
- Most Likely - anticipated outcome; and
- Worst - least favourable outcome or maximum cost.

In cases where the consequence on the schedule is modelled, the cost of the estimated delay is inserted into the cost model to gain a complete view of the cost implication.

A quantitative analysis of risk will enable the project sponsor to make an informed decision regarding further treatment of risk, the acceptable risk exposure and setting of an appropriate project contingency.

E&P uses the computer software application '@Risk' to perform quantitative analysis on the cost of inherent risk and external risk, in order to obtain an objective view of the cost of the risk in the project. '@Risk' is able to simulate the likelihood of various combinations of risks occurring by using the 'Monte Carlo' simulation technique.

The output from the Monte Carlo simulation provides a graph of the probability profile of the outturn cost. The results of the quantitative analysis are presented as a range of values of likelihood with the associated values of consequence. Informed decisions can then be made by the business based on the likely outturn cost of the project and what represents a reasonable level of risk and reward. The reference estimate represents the starting point in understanding the likely overall cost of the project. The example in the following diagram illustrates how this output graph (for cumulative risk) is interpreted in order to calculate the delta between the reference estimate and the risk adjusted estimate.



3.5 Appropriate Use of Probability ('P' Numbers)

The selection of a 'P' number, that is, the probability that the total project outturn cost will not exceed a certain $ value, is principally a commercial decision reflecting the project sponsors business requirements and risk exposure. The 'P' number is independent of the current phase of the project within the project life cycle.

The selection of a 'P' number and a corresponding total project outturn value, directly relates to:

- The delta between the reference estimate and the risk adjusted estimate and;
- The residual risk exposure that the business is prepared to accept.

The selection of the appropriate point on the probability profile will vary from project to project depending on the detail, the understanding of the project and the nature of the risks and opportunities. The probabilistic risk assessed approach provides improved confidence and understanding of the factors which drive the project costs. This information may be extended to determine where resources and effort should be allocated to achieve the preferred outcomes.

Typically we identify and define the following risk classifications:

- P10 - Best Case / Stretch Target
- P50 - Most Likely / Target Cost
- P80 - Budget Requirement
- P100 - Worst Case / Residual Risk Exposure / Insurance

3.6 Benefits of the Risk Assessed Approach to Budgeting

The evaluation and modelling process recognises the variability in the cost of elements of the project and combines this information to provide a distribution profile of the outturn cost. This enables the business to better understand the level of risk associated with the project and select the appropriate value.

The systematic evaluation also enables those risks and opportunities which are likely to have the greatest impact on the outturn costs to be identified and this provides an indicator as to where resource effort should be focussed to have the greatest benefit during the delivery of the project.

The process forces participants to:

- Focus on Project Objectives
- Identify the Desired Outcomes
- Identify the Scope
- Document any Assumptions
- Identify Constraints on the Project
- Analyse Project Risks
- Develop appropriate Response Plans
- This leads to:
- A disciplined approach to estimating
- Consistency of the Estimating Process
- The development of more Realistic Contingency Provisions
- Provide reviewers with confidence in the estimate.
- Understanding of Risk Allocation
- Improved allocation of effort and resources to mitigate the risks and realise the opportunities.

4 SP AUSNET'S ESTIMATING FRAMEWORK

SP Ausnet has developed the estimate of costs associated with its works program into two main categories as follows:

- First Principle estimates for Station Rebuild Projects;
- Unit Rate estimates for the remainder of the works program.

4.1 Station Rebuilds

The following stations have been identified by SP Ausnet as requiring significant rebuild over the forthcoming regulatory period.

- Keilor 500 – X577;
- Brooklyn – X578;
- Hazelwood – X711;
- Thomastown 66kv & 220kv – X4B4;
- Ringwood – X576;
- Keilor 66kv & 220kv – X577;
- Hazelwood 500 – X580;
- Glenrowan – X575;
- Richmond – X7C3;
- Geelong – X508.

The Evans & Peck review of the station rebuild works is based on the documentation and justification submitted by SP Ausnet as part of the submission to the AER. The purpose of our involvement is to develop an independent risk assessed estimate of the station rebuild program. The initial submission to the AER provides the reference point for this exercise. A summary of the estimates submitted to the AER used as the reference point for our assessment is identified as follows:

Category	Reference Estimate (excluding contingency)
Keilor 500 – X577	$11,271,861
Brooklyn – X578	$49,053,202
Hazelwood – X711	$33,982,443
Thomastown – X4B4	$40,025,638
Ringwood – X576	$27,782,321
Keilor 220 & 66 – X577	$24,928,019
Hazelwood 500 – X580	$17,997,486
Glenrowan – X575	$19,824,269
Richmond –X7C3	$102,979,675
Geelong – X508	$9,448,323
Total	**$337,293,237**

A detailed estimate based on first principles and the concept design has been developed for each of these station rebuild projects. SP Ausnet used 'Expert Estimator' to develop and collate the costs associated with the work. This package is commonly used in the construction industry to prepare estimates for capital works projects.

We understand that as part of the review undertaken by Parsons Brinkerhoff that a detailed evaluation of the estimating process was undertaken.

4.2 Unit Rate Work

The remainder of the works have been scoped based on concept designs. The estimate is based on unit rates developed from the collation of actual costs incurred recently for similar projects. This reference estimate for the work to be undertaken by unit rates is summarised in the following categories:

Category	Reference Estimate
Communications	$39,003,319
Establishment	$87,119,780
Line Work	$29,020,628
Reactive	$36,021,106
Secondary	$84,148,597
Switchbay	$80,433,118
Transformer	$36,513,596
Total	**$392,260,143**

The Unit Rate work represents approximately 55% of the total value of work proposed for the forthcoming regulatory period.

The detailed summary of the proposed works to be undertaken in the forthcoming regulatory period is included as Appendix 1.

5 RISK MODELLING

5.1 Project Cost Inputs

The estimates submitted by SP Ausnet to the AER represent the reference point for the risk assessment undertaken by Evans & Peck.

The detailed 'reference' estimates for the Station Rebuild projects represent SP Ausnet's best estimate of the project cost, based on the known scope of work. These estimates represent a single point estimate for each project, built up from detailed estimates. SP Ausnet has advised that the detailed 'reference' estimates do not include any contingency.

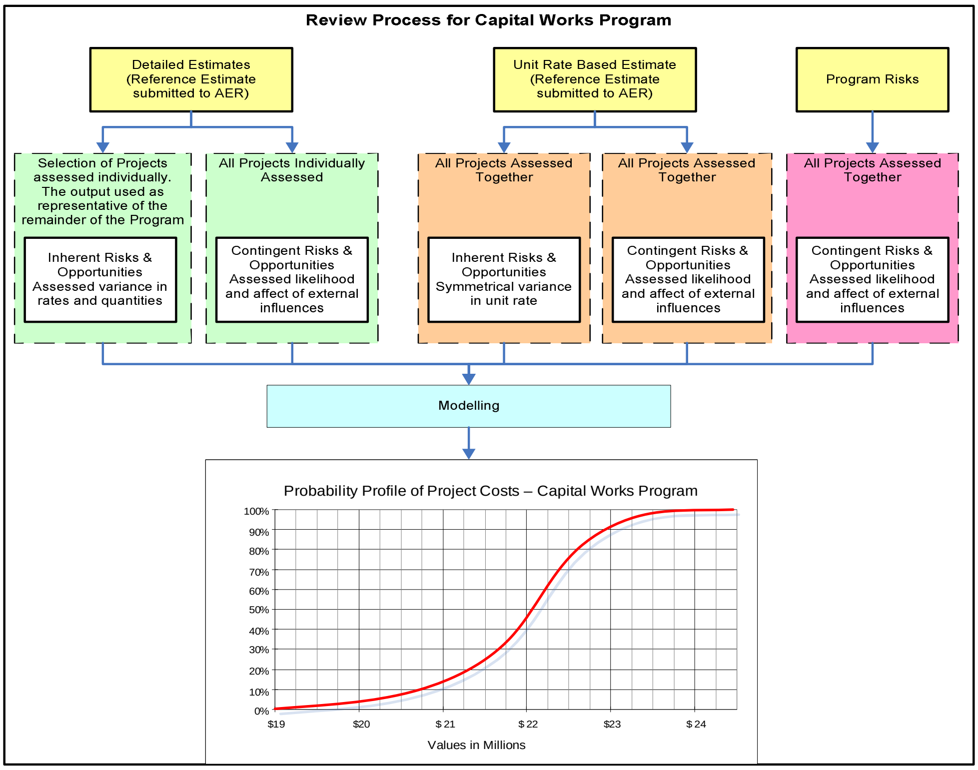
The unit rate estimates for the remainder of the capital works program represents the historical cost of delivering work of the type identified.

Whilst using the most up to date cost components for developing detailed estimates and unit rate estimates will improve the likelihood of forecasting the most likely project cost, this technique does not remove the uncertainty of forecasting or the actual cost of delivering the works.

Evans & Peck has developed a separate risk model for the Station Rebuild projects developed from detailed estimates and the projects undertaken based on Unit Rates. The reference input for both risk models are the estimates provided to the AER in the draft submission.

In addition, the risk model includes provision for program risks and opportunities which have not been captured in either the Rebuild model or the Unit Rate model.

The graphic diagram below identifies the structure of the risk model developed for the SP Ausnet capital works program.



Through the allocation of upper and lower boundaries to the estimated costs for each project risk category, the risk analysis explicitly weights projects according to their relative contribution to the overall capital works portfolio.

A Monte Carlo simulation was run across the entire capital works portfolio to determine the overall portfolio risk profile.

It is almost certain that one or more of the items in the risk categories will cause a measure of cost overrun on each project, relative to an estimate that includes no risk allowance.

5.2 Station Rebuild Risk Model

A detailed analysis of the individual risks and opportunities has been used for the Station Rebuild Projects. A detailed analysis was carried out for these projects as these projects represent approximately 45% of the estimated capital expenditure over the forthcoming regulatory period. The realisation of any risks and opportunities associated with these projects would have a significant impact on the overall regulatory period capital expenditure.

5.3 Structure of Risk Model for Station Rebuilds

Evans & Peck has only had limited time in which to undertake our evaluation. Given this constraint we developed an approach to the risk assessment which examined the inherent risks and opportunities for a number of the projects in detail based on a line by line assessment. We conducted a risk workshop with key members of the regulatory reset and estimating team, at which the possible variance in both the rate and quantity for each detailed line item in the reference estimate was identified.

The risk assessed (modelled) output from this process provided typical ranges for defined activities. This information was then used as the input range for similar activities for the remainder of the rebuild program.

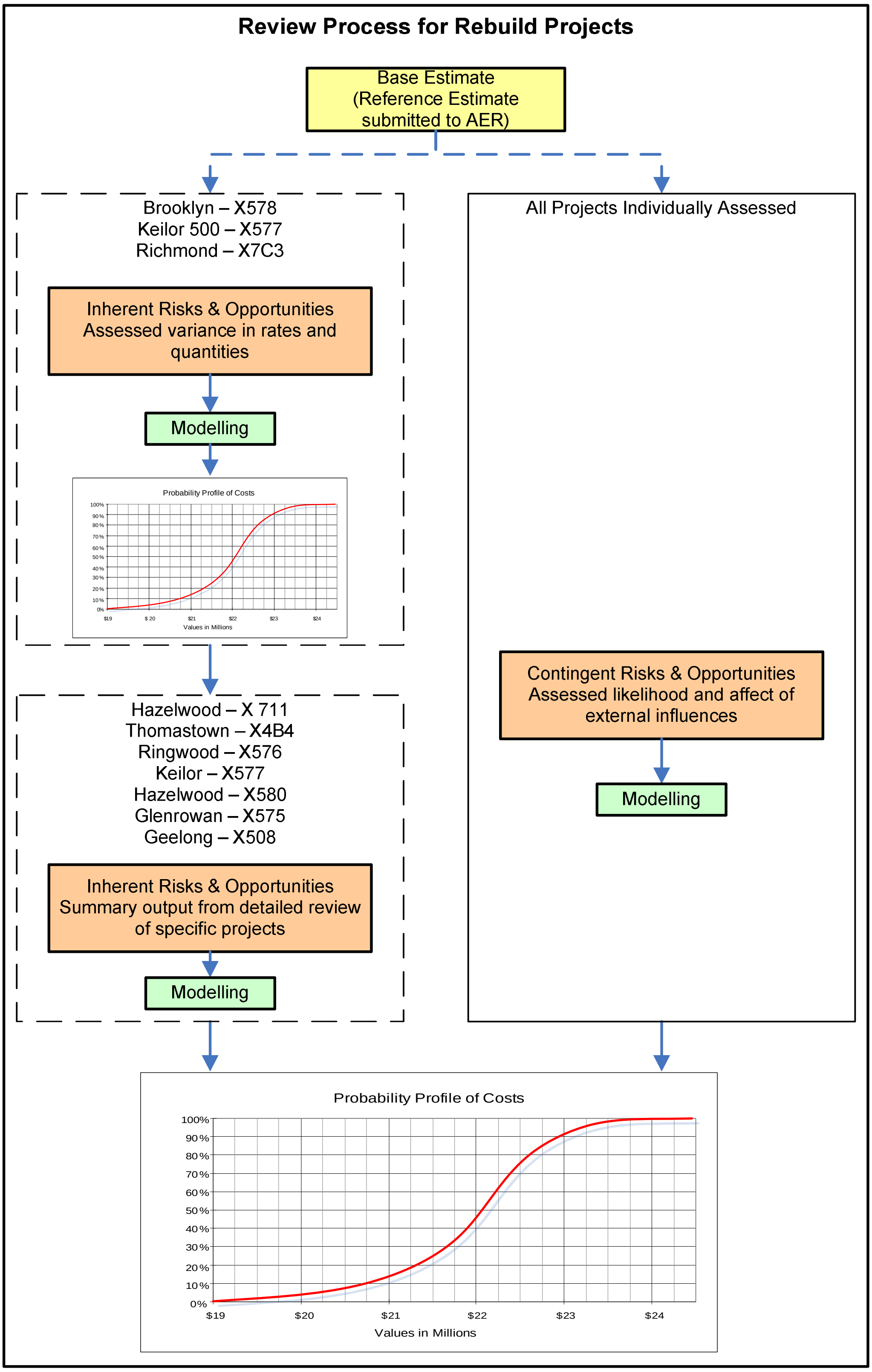
The external (unplanned) risks and opportunities for all the Station Rebuild projects were assessed individually given the varying nature of the project, the status of the design, approvals and influence of external factors.

The following table outlines the type of approach used for each of the Station Rebuild Projects.

Project	Basis of Risk & Opportunity Assessment	
	Inherent (Planned)	External (Unplanned)
Keilor 500 – X577	Assessment of variance in quantities and rates based on **detailed** review of individual line items in Estimate (WBS)	Project assessment of likelihood and affect of external factors (outside the estimate)
Brooklyn – X578	Assessment of variance in quantities and rates based on **detailed** review of individual line items in Estimate (WBS)	Project assessment of likelihood and affect of external factors (outside the estimate)

Project	Basis of Risk & Opportunity Assessment	
	Inherent (Planned)	**External (Unplanned)**
Richmond – X7C3	Assessment of variance in quantities and rates based on **detailed** review of individual line items in Estimate (WBS)	Project assessment of likelihood and affect of external factors (outside the estimate)
Hazelwood – X711	Assessment of variance in **summary** level items based on modelled output from detailed assessment from Brooklyn – X578 (commonality)	Project assessment of likelihood and affect of external factors (outside the estimate)
Thomastown 66kv & 220kv – X4B4	Assessment of variance in **summary** level items based on modelled output from detailed assessment from Brooklyn – X578 (commonality)	Project assessment of likelihood and affect of external factors (outside the estimate)
Ringwood – X576	Assessment of variance in **summary** level items based on modelled output from detailed assessment from Brooklyn – X578 (commonality)	Project assessment of likelihood and affect of external factors (outside the estimate)
Keilor 66kv & 220kv – X577	Assessment of variance in **summary** level items based on modelled output from detailed assessment from Brooklyn – X578 (commonality)	Project assessment of likelihood and affect of external factors (outside the estimate)
Hazelwood 500 – X580	Assessment of variance in **summary** level items based on modelled output from detailed assessment from Keilor– X577 (commonality)	Project assessment of likelihood and affect of external factors (outside the estimate)
Glenrowan – X575	Assessment of variance in **summary** level items based on modelled output from detailed assessment from Brooklyn – X578 (commonality)	Project assessment of likelihood and affect of external factors (outside the estimate)
Geelong – X508	Assessment of variance in **summary** level items based on modelled output from detailed assessment from Brooklyn – X578 (commonality)	Project assessment of likelihood and affect of external factors (outside the estimate)

The diagram as follows provides a graphical overview of the process developed for the Station Rebuild projects, including the inputs and outputs of the risk model.



5.4 Station Rebuild - Inherent Risk Model Input

On 13th September 2007, Evans & Peck facilitated a risk workshop with key SP Ausnet personnel, responsible for management and development of the detailed estimates. An individual risk assessment was carried out for the detailed Station Rebuild projects to be undertaken during the next regulatory reset period, to provide greater understanding of the risks associated with these projects. These assessments represent SP Ausnet's considered professional opinion of the likely range of quantity & rate project cost outcomes.

At this workshop the detailed evaluation of the variances in both quantity and rate were assessed for Keilor – X577 and Brooklyn – X578. The output from this workshop was collated and the risk assessed model developed. Subsequently this data has been refined and additional detailed assessments of Richmond and Hazelwood undertaken.

A sample of the data developed at these workshops is included in the table as follows:

Brooklyn (input data)

		BASE ESTIMATE				RISK ADJUSTMENT													
							Quantity Variance						Rate Variance						
Description		Unit	Qty	Rate	Base Estimate		Min	ost Like	Max	Min	lost Likel	Max	Min	ost Like	Max	Min	Most Likely	Max	Comments
244	Manufacture & erect a 3 bus arrangement switchroom including 2 x transformer incomers, provision for a third transformer incomer, provision for 13 feeders inclluding 2 x busties. SP Ausnet portion only.																		
	Replace the existing 22 kV outdoor switchyard with new indoor switchgear. The new indoor switchgear shall be housed in a new transportable building. SP Ausnet portion only.																		
	The new indoor switchgear s	Each	0.45	$ 1,731,570.87	$ 779,207		100%	100%	100%	0	0	0	100%	110%	120%	$ 1,731,571	$ 1,904,728	$ 2,077,885	Detailed Review
280	Procure & Install Standard 150/150/1MVA 220/66/11kV transformer																		
	220/66/11 kV 150 MVA Pov	Item	1	$ 2,398,458.15	$ 2,398,458		100%	100%	100%	1	1	1	95%	100%	115%	$ 2,278,535	$ 2,398,458	$ 2,758,227	Detailed Review
	Delivery, Installation and Tes	Each	1	$ 120,000.00	$ 120,000		100%	100%	100%	1	1	1	80%	100%	130%	$ 96,000	$ 120,000	$ 156,000	Detailed Review
	Transformer Spares	Item	1	$ 11,000.00	$ 11,000		100%	100%	100%	1	1	1	80%	100%	130%	$ 8,800	$ 11,000	$ 14,300	Detailed Review
	Construction Overview (Conti	hr	150	$ 99.00	$ 14,850		80%	100%	120%	120	150	180	90%	100%	120%	$ 89	$ 99	$ 119	Detailed Review
	Witness Testing (Contract E	hr	100	$ 99.00	$ 9,900		80%	100%	120%	80	100	120	90%	100%	120%	$ 89	$ 99	$ 119	Detailed Review
	220 kV Neutral Current Trans																		
	CURRENT TRANSFORMER	1ph	1	$ 524.00	$ 524		100%	100%	100%	1	1	1	80%	100%	120%	$ 419	$ 524	$ 629	Detailed Review
	Cable - Power, Underground	m	50	$ 140.00	$ 7,000		75%	100%	125%	38	50	63	80%	100%	130%	$ 112	$ 140	$ 182	Detailed Review
	Cable Terminations - 22.1c.(	1ph	2	$ 111.00	$ 222		100%	100%	100%	2	2	2	80%	100%	130%	$ 89	$ 111	$ 144	Detailed Review
	100mm Conduit, Orange $59	metre	50	$ 14.75	$ 738		75%	100%	125%	38	50	63	80%	100%	120%	$ 12	$ 15	$ 18	Detailed Review
	100mm Conduit Bend, Orang	Each	3	$ 40.00	$ 120		75%	100%	125%	2	3	4	80%	100%	120%	$ 32	$ 40	$ 48	Detailed Review
	Field Services - Primary NS(	hr	80	$ 80.00	$ 6,400		90%	100%	130%	72	80	104	95%	100%	110%	$ 76	$ 80	$ 88	Detailed Review
Subtotal					**$ 2,569,212**														

341	220/66kV Transformer B5																		
	Install Venus droppers to tra	Each	3	$ 4,960.45	$ 14,881		80%	100%	120%	2	3	4	90%	100%	120%	$ 4,464	$ 4,960	$ 5,953	Detailed Review
	Conductor - (Orange) 54/7/3.	m	240	$ 8.00	$ 1,920		80%	100%	120%	192	240	288	90%	100%	120%	$ 7	$ 8	$ 10	Detailed Review
	Strain Assy - 220kV (without	Set	3	$ 455.00	$ 1,365		80%	100%	120%	2	3	4	90%	100%	120%	$ 410	$ 455	$ 546	Detailed Review
	Insulator - 220kV, Strain typ	Each	90	$ 220.00	$ 19,800		80%	100%	120%	72	90	108	90%	100%	120%	$ 198	$ 220	$ 264	Detailed Review
	Install single orange conduct	Each	1	$ 13,980.00	$ 13,980		80%	100%	120%	1	1	1	90%	100%	120%	$ 12,582	$ 13,980	$ 16,776	Detailed Review
	Tower to Transformer B5 Rack																		
	Conductor - (Orange) 54/7/3.	m	600	$ 8.00	$ 4,800		80%	100%	120%	480	600	720	90%	100%	120%	$ 7	$ 8	$ 10	Detailed Review
	Strain Assy - 220kV (without	Set	3	$ 455.00	$ 1,365		80%	100%	120%	2	3	4	90%	100%	120%	$ 410	$ 455	$ 546	Detailed Review
	Insulator - 220kV, Strain typ	Each	90	$ 220.00	$ 19,800		80%	100%	120%	72	90	108	90%	100%	120%	$ 198	$ 220	$ 264	Detailed Review
	Install single orange conduct	Each	1	$ 13,980.00	$ 13,980		100%	100%	100%	1	1	1	90%	100%	120%	$ 12,582	$ 13,980	$ 16,776	Detailed Review
Subtotal					**$ 91,891**														
399	220KV Switchyard																		
	Supply & Install earth grid fo	m²	4800	$ 14.58	$ 69,960		75%	100%	125%	3600	4800	6000	80%	100%	130%	$ 12	$ 15	$ 19	Detailed Review
	Modify/Extend existing earth	Each	32	$ 2,558.18	$ 81,862		75%	100%	300%	24	32	96	80%	100%	130%	$ 2,047	$ 2,558	$ 3,326	Detailed Review
Subtotal					**$ 151,822**														

The modelled output takes into consideration the effect of variances in both rate and quantity and the relative contribution (value) of each individual line item to provide a modelled output at the summary level as follows:

Brooklyn

Item 280 - Procure & Install Standard 150/150/1MVA 220/66/11kV transformer

- Modelled Minimum 95.0%
- Modelled Mode 100.1%
- Modelled Maximum 113.3%

Item 341 - 220/66kV Transformer B5

- Modelled Minimum 90.8%
- Modelled Mode 101.6%
- Modelled Maximum 114.5%

Item 399 - 220kV Switchyard

- Modelled Minimum 72.9%
- Modelled Mode 105.8%
- Modelled Maximum 213.1%

This information has then be used as the summary level input into the remainder of the station rebuild projects based on the commonality of the activity. The sample as flows demonstrates how the detailed assessment from Brooklyn has been incorporated into the risk assessment for Thomastown.

Thomastown (input data)

Thomastown - X4B4 220KV & 66KV								INHERENT RISK MODEL						
			BASE ESTIMATE					RISK ADJUSTMENT						
								Variance						
Item	Description		Unit	Qty	Rate	Base Estimate		Min	Most Likey	Max	Min	Most Likely	Max	Comments
	2.3	SITE WORK / SITE SERVICES												
	2.3.1	Primary Connections - 220kV Switchyard	Item	1	$165,372	$ 165,372		89%	100%	114%	$ 147,169	$ 165,401	$ 188,933	BLTS 331
	2.3.2	Earth Grid - Modify/Extend existing earth grid for 220kV Switchyard	Item	1	$25,582	$ 25,582		73%	106%	213%	$ 18,655	$ 27,078	$ 54,524	BLTS 399
	2.3.3	Structures - 220 kV Switchyard	Item	1	$198,109	$ 198,109		93%	101%	120%	$ 184,016	$ 200,803	$ 238,283	BLTS 422
	2.3.4	Ground Wires	Item	1	$67,450	$ 67,450		76%	100%	135%	$ 51,263	$ 67,736	$ 90,729	BLTS 427
	2.3.5	220kV & 66kV Switchyard Outdoor Yard Lighting	Item	1	$160,345	$ 160,345		84%	98%	123%	$ 134,069	$ 157,791	$ 197,106	BLTS 430
	2.3.6	Switchyard Power supplies	Item	1	$164,716	$ 164,716		85%	101%	121%	$ 139,519	$ 166,350	$ 199,390	BLTS 437
	2.4	CIVIL												
	2.4.1	Control Building	Item	1	$583,000	$ 583,000		91%	101%	114%	$ 532,806	$ 588,625	$ 661,732	BLTS 448
	2.4.2	Dismantling and Removal Works	Item	1	$1,577,405	$ 1,577,405		64%	103%	163%	$ 1,007,170	$ 1,628,468	$ 2,568,957	BLTS 123
	2.4.3	Earthworks - Re-establish switchyard surface	Item	1	$627,510	$ 627,510		75%	103%	131%	$ 469,908	$ 643,325	$ 824,252	BLTS 313
	2.4.4	Transformer Foundations inc Water drainage and oil containment	Item	1	$1,140,895	$ 1,140,895		82%	104%	126%	$ 933,305	$ 1,188,278	$ 1,442,907	BLTS 306
	2.4.5.1	Cable Trenching	Item	1	$729,140	$ 729,140		69%	99%	149%	$ 501,472	$ 719,832	$ 1,084,723	BLTS 461

The inherent risk assessment data for each of the Station Rebuild Projects are included in Appendices 2 - 11.

5.5 Station Rebuild – External (unplanned) Risk Model Input

External (unplanned) risks include items that may arise if the underlying assumptions that form the basis of the base estimate do not prove to be valid or constant, or if an unforeseen event occurs. These (unplanned) risks associated with the delivery of the Station Rebuild program have been assessed separately to the inherent (planned) risks which are incorporated in the detailed project risk assessments.

A separate workshop was undertaken to assess the external (unplanned) risks. This process recognises that the external factors which influence the project costs vary for each Station Rebuild depending on the nature of the work and the condition of the asset or the proximity of the station to housing. Typically in developing external (unplanned) risks for project examine risks and opportunities within the following categories:

- Political;
- Feasibility / Funding;
- Planning / Environmental;
- Stakeholders / Community;
- Design;
- Delivery;
- Commercial; and
- Operations / Maintenance & Licensing.

Each of these categories provides a trigger to identify appropriate risks and opportunities for the specific project.

The outcome of this workshop identified the following risks and opportunities. For completeness we have identified the risk or opportunity, even if it does not form an input into the model to demonstrate that a particular risk was considered, but not considered applicable.

Brooklyn

Item	Description	Consequences
1	Political	
	No risks or opportunities identified	Not Used
2	Feasibility & Funding	
2.1	Delays in funding approval (business case)	Projects are often delayed due to the various levels of funding approval required in the organisation. This can result in further reports, rework of the scope of work and re-estimating of the project. This allows for this risk in accordance with historical processes.
2.2	Mismatch between SPA business requirements and AER approval	Not Used
3	Planning & Environmental	
3.1	Delays in approvals from Authorities	Projects may be delayed due to approvals for buildings, environmental works, easements, etc. It is expected that some delays will occur during this process that will require additional resources.
3.2	Additional conditions of consent from Approval Authorities necessitate additional work not originally scoped	BLTS is located in an industrial zone, however it is likely that before the planning permits are submitted that the areas will be rezoned to provide predominately residential requirements. This will increase the costs associated with the buildings, fencing and landscaping associated with this project.
3.3	Additional conditions of consent require noise mitigation of the transformers	The rezoning possibility in Item 3.2 highlights the potential need for noise enclosures on all transformers. Due to the industrial nature of the existing area, these are not required, however by the time the project is approved the zoning approvals may include the need to suppress the noise emanating from the transformers.
3.4	Restrictions on proposed construction access hours	Access is required to the site through residential streets. Deliveries will need to be negotiated and timed to meet the local residential needs. This may increase the cost of the delivery, especially in view of the transformer deliveries.
3.5	Delay in environmental approval	Not used
3.6	Additional environmental obligations constrain work practices	Not used
3.7	Unidentified endangered Flora / Fauna	Not considered applicable as work in area already disturbed

Item	Description	Consequences
3.8	Unidentified endangered Aquatic Species	Not considered applicable as work in area already disturbed
3.9	Additional Cultural Heritage Requirements (introduction of Aboriginal & Heritage Act 2006)	Not considered applicable as work in area already disturbed
3.10	Change in Statutory Legislation (law)	It is possible that prior to the completion of the project, legislative requirements increase the scope of the project (eg working at heights, electric fields). Necessitates change in work practices not considered in reference estimate
4	Stakeholders / Community	
4.1	Community concerns requires additional mitigation action	Due to the proximity of residents, community consultation may result in landscaping and improvement in aesthetics.
4.2	Customer works changing the nature of work forecasts	Funded by customer at no additional cost to SPA
4.3	Smorgan's outage duration and timing requirements necessitate work arounds to undertake the works	While the project has been scoped to reduce the outage requirements of the Smorgon Steel Mill, SP AusNet has not yet confirmed the requirements with this stakeholder. This makes some allowance for any unknown conditions that may be imposed.
5	Design	
5.1	Design optimisation of Project	As part of the design, scope may be reduced or n=more effective methods found to implement the project. This illustrates the opportunity to reduce costs based on this possibility.
5.2	Inadequate initial scope requiring additional design	As the estimates are produced prior to detailed design, there is a significant probability that additional unknown items will need to be designed. This makes an allowance of approximately 5% for increased design scope.
5.3	Delay in internal design approvals by SP Ausnet	SP AusNet approves the DSP designs. Historically some projects have suffered delays due to the slow approval or the need for rework due to the approval process.
6	Delivery	
6.1	Delays in award of Contract	For award of orders for major purchase items including the DSP and ISP contracts an internal approval process is required. This item reflects the additional costs of reworking the information to obtain approvals and the subsequent delays in the project in the initial stages.

Item	Description	Consequences
6.2	Restrictions on available time for outages requiring modified work practices	The transmission network is highly loaded and outages are limited so that additional costs may be incurred if an outage of (say) one week is limited to (say) one day. While SP AusNet believes that these are considered during the planning process, there is still a good chance that there will be further restrictions.
6.3	Need to reschedule the works to meet outages	Similar to 6.2, outages may be cancelled without notice. It is expected that several outages will be cancelled without notice during the project and that this will incur delay claims from the installation contractor and rework requirements to enable site works to continue.
6.4	Wet Weather during delivery delays the works	Risk transferred to the Contractor (no provision within estimate)
6.5	Incorrect design or sequencing of the works that leads to significant rework or additional new works	During works on a Brownfield site, it is expected that there will be some design and installation inconsistencies that will require modifications to work already performed and additional scope. This item provides an allowance for this item based on historical occurrences.
6.6	Scope Creep post award of contract	The basis design process provides an overall scope that is further developed during the detailed design process. This aligns with Item 5.2 above and makes allowance for the actual works to be implemented following the design of the scope changes. Some examples of this include necessary secondary changes to effectively sequence the works given the operational constraints, additional platforms and access to safely operate equipment and additional works required to comply with current occupational health and safety regulations associated with the changes to the existing plant.
6.7	Impact of Customer Works (Vencorp of Distribution company works necessitate a change in the scope of the works)	Funded by customer (no provision within estimate)

Item	Description	Consequences
6.8	Asset failures during construction requiring additional works	These Brownfield works require modification of existing equipment to provide connection to, or infrastructure and support for the new equipment. If a failure of the existing equipment occurs during the project (eg an isolator palm is damaged during the removal of a high voltage connection due to corrosion of the existing palm), additional costs are incurred by the project.
6.9	Ground conditions / Existing works not as expected requiring additional support or rock excavation (latent conditions)	This is normal allowance on projects of this type to consider the risks associated with unknown subterranean conditions.
6.10	Industrial Disputes	While unlikely in this location, it is possible that an industrial dispute will occur during the project that will require SP AusNet to provide third party input into the dispute to enable resolution.
6.11	Site Agreements increase labour cost	Not applicable for Brooklyn
6.12	Labour shortages lack of skilled resources and loss of key personnel)	It is a high possibility that the project will loose some of its key resources during the project. This incurs costs on the project.
6.13	Relocation of unknown / unidentified services (not scoped during concept design phase)	While SP AusNet maintain documentation of the services on site, there may be additional unknown services that may impact on the project. This includes the possibility of communications cables, water or drainage piping or distributor feeders being in locations that are not in accordance with the expectations and documentation at the time of basic design. This will incur costs and may require redesign and work arounds to resolve these matters.
6.14	Exchange Rate Risk	No adjustment – Balanced effect based on both positive & negative movements
6.15	Delays in delivery of overseas items	Historically delays are experienced in the delivery of overseas items that will incur additional costs on the project. These involve issues such as a mismatch in the specifications and the designs, manufacturers behind schedule, shipping issues, etc. This may require the use of air freight or additional costs in expediting to ensure that equipment is delivered in the minimum possible time.

Item	Description	Consequences
6.16	Delays in delivery of local items	Historically delays are experienced in the delivery of locally sourced items that will incur additional costs on the project. These involve issues such as a mismatch in the specifications and the designs, manufacturers behind schedule, incorrect ordering of equipment, incorrect delivery of items, etc. This may require the use of air freight, express delivery or additional costs in expediting to ensure that equipment is delivered in the minimum possible time.
6.17	Damage to associated equipment during construction necessitates rectification / replacement	These Brownfield works require connection to existing equipment to provide connection to, or infrastructure and support for the new equipment. If, during these works, damage occurs to the existing equipment (eg adjacent equipment on a panel is damaged during modifications requiring replacement of additional equipment), additional costs are incurred by the project.
6.18	Materials price escalation (steel)	Dealt with separately (no provision within risk model)
6.19	Contractor Insolvency	This is an allowance in the event of a major contractor such as the ISP or DSP becoming insolvent and the costs associated with awarding a new contract (including the premium that would need to be paid to the new contractor).
6.20	Subcontractor Insolvency	Similar to 6.19, this relates to the failure of a subcontractor to the above major contractors and the costs incurred to the project due to delays and additional supervision, management, documentation, etc.
6.21	Theft of materials / Vandalism of equipment	Historically SP AusNet have suffered from the theft of materials from sites during projects. This is in line with these historical losses.
6.22	Impact of major fire / flood / storm	This is normal allowance on projects of this type to consider the risks associated with unknown events.
6.23	Acceleration to meet construction window (summer / winter peak / outages)	To enable continued work fronts during the high load periods of the year, work fronts need to be completed to enable suitable outages in the shoulder periods. This may require additional costs due to the compression of the program due to other events. This reflects the need to man-up and pay penalty rates for the weeks leading up to these times.

Item	Description	Consequences
6.24	Major safety incident delays construction	This reflects the cost of a major safety incident's impact on the project cost due to direct and indirect causes. This amount is in line with industry accepted risks and costs.
6.25	Extra ordinary delays during Commissioning	This reflects the impact on the project cost for delays associated with commissioning issues. Commissioning issues on projects of this type impact directly on the availability of work fronts to continue productive work. They are also positioned in the project schedule to cause unrecoverable delays and are likely to impact on the completion date of the project, hence incurring substantial costs in maintaining the site and labour.
6.26	Value of lost revenue during construction (over & above base provision)	Accommodated at Program Level (not included in at specific project level)
6.27	Oil is found to be contaminated and requires special disposal	Contamination by PCBs or silicates have previously led to high cost of disposal of this oil in other projects. The SP AusNet oil register has recently been found to be unreliable. The transformer contain a high volume of oil that may incur additional cost due to contamination.
6.28	Equipment for disposal is found to be contaminated and requires special disposal	If equipment is found to contain contaminated oils, special disposal techniques may be required that will incur additional costs. These costs are typical based on historical information.
6.29	Failure of equipment to meet specification	Although of low probability, the performance of equipment may not meet the requirements of the specification. Although this may be covered by warranty, issues such as installation, use within the stated parameters, maintenance practices, etc may void such claims on the manufacturers. This risk provides some protection should alternative works be required due to the inability of equipment to meet its stated specification.

Item	Description	Consequences
6.30	Removal of Contaminated Soil (excluded from base estimate)	BLTS is an old site that until recently had the transformer sitting directly on a prepared gravel surface with little or no oil collection and treatment. It is possible that in excavating the footings of these transformers that contaminated soils may be encountered. This would need to be cleared due to environmental issues. This probability and cost reflects the expectation and historical costs in removing and treating the appropriate amount of soil.
7	Commercial	
7.1	Post construction defect rectification	It is likely that contractor claims will be made throughout the project and negotiations will be required to finalise these claims at the completion of the project. This amount reflects the likely internal costs associated with settling these claims.
7.2	Contractor claims settlement (managing claims)	Provision to resolve contractor claims
8	Operations, Maintenance & Licensing	
	No risks or opportunities identified	Not Used

For each of the external (unplanned) risks identified an assessment of the likelihood and the range of costs were identified. Similar to the inherent risk model a three point assessment was used (minimum, most likely and maximum values).

In undertaking this assessment, every effort was made to ensure that any overlap in cost impact was considered when determining the appropriate likelihood and cost inputs into the model.

Each of the Station Rebuild projects was assessed separately. The detailed external (unplanned) risks identified for each Station Rebuild and the associated likelihood and cost ranges are included in Appendices 2 - 11.

5.6 Unit Rate Inherent Risk Model Input.

As the unit rate data has been developed based on actual costs incurred, it incorporates any inherent risks incurred and opportunities realised in procurement of the works. Notwithstanding this inclusion, the unit rate estimate represents a single point estimate. The unit rate estimate is likely to have a range. Given the inclusive nature of inherent risks and opportunities this is likely to be symmetrical.

The risk model assumes +/- range of 25% for each of the inherent inputs into the Unit Rate risk model.

This Unit Rate work is summarised in the following categories:

- Communications;
- Establishment;
- Line Work;
- Reactive
- Secondary;
- Switchbay;
- Transformer.

Typically the risks and opportunities which would be incorporate within the unit rate estimates would include:

Category	Risks / Opportunities
Communications	▪ generic estimates ▪ installation by Telco providers ▪ technology changes - technology can be difficult to assess as part of the evaluation cycles ▪ difficult to scope. ▪ brown fields sites ▪ individual site variations ▪ cost will be limited to the extent that the project will be scaled back to keep within this cost range ▪ Interface with existing equipment
Establishment	▪ volume of design input required ▪ project management costs, including staffing levels and associated salary and contract costs ▪ extent of overtime in estimate ▪ provision for site allowances, travel allowances ▪ some planning approval and approval condition risk ▪ land price is highly variable, with price driven by demand and social factors ▪ variations in route, since route typically not fully

Category	Risks / Opportunities
	established prior to approval ▪ Uncertainty in this category includes variances in staging and outage costs ▪ Access to established sites ▪ Special environmental requirements
Line Work	▪ total line length, due to terrain complexity and deviations around sensitive areas ▪ number of poles, footings and crossarms ▪ ratio of strain to suspension structures ▪ lines crossings over or under the base planning object assumption of 0.5 crossings per kilometre of line length ▪ soil variations affecting footing design and cost ▪ urban/rural differences ▪ adverse environmental conditions ▪ design risk ▪ construction completion risk ▪ limited skilled resources ▪ changes in legal requirements – for example, cultural and heritage, environmental, workplace health and safety ▪ variances in soil type, different from the typical soil type assumed in the Base Planning Objects ▪ variances in topology, different from the level ground assumed in the Unit Rate Estimates, potentially requiring cut and fill ▪ geotechnical risk – no geotechnical studies are conducted at time of development of the estimate ▪ risk that sub-contractors will require additional funds (variations) in order to complete construction works ▪ short length cables (minimum order quantity) ▪ brown fields issues - directional boring compared with trenching ▪ high level of design risk ▪ construction completion risk ▪ difficult access conditions in live sites
Reactive	▪ purchase price subject to market forces and manufacturing capacity ▪ difficult access conditions in live sites ▪ need to minimise outages of existing equipment
Secondary	▪ difficulties in interfacing with old equipment in brown fields substations, and also existing protection equipment outside green fields substation ▪ individual site variations ▪ Recommissioning

Category	Risks / Opportunities
	▪ Interface with existing equipment ▪ Incorporating equipment into asset management and condition monitoring systems ▪ Inconsistent documentation of information technology systems
Switchbay	▪ modifications to the standard model due to special requirements of the site ▪ purchase price risk outside of the three-year contracts, subject to market forces ▪ difficult access conditions in live sites
Transformer	▪ purchase price subject to market forces and manufacturing capacity ▪ difficult access conditions in live sites ▪ individual site variations ▪ difficult to adequately size and scope requirements for oil separation plant (which is a large component of this category) ▪ primary plant ancillary items can be easy to leave out of scope ▪ environmental risk ▪ planning risk

5.7 Capital Works Program External (unplanned) Risk Model Input

External (unplanned) risks include items that may arise if the underlying assumptions that form the basis of the base estimate do not prove to be valid or constant, or if an unforeseen event occurs. These external (unplanned) risks associated with the delivery of the Unit Rate works program have been assessed separately to the inherent (planned) risks which are incorporated in the development of the unit rates.

The Unit Rates capture the costs of delivering the works over the current regulatory period and in particular the previous three years.

In this element of the risk model we have identified those risks and opportunities which would not normally be captured by collation of unit rate estimates.

We have specifically excluded any typical risks which could reasonably be expected and included within the unit rates. The risk identified applies to the whole of the unit rate works program.

The risks identified reflect a fundamental change in the cost of delivering the unit rate works program. Included in the table below are the details of the external (unplanned) risks identified.

Item	Description	Consequences
1	Political	
2	Feasibility & Funding	
3	Planning & Environmental	
3.1	Change in Statutory Legislation (law)	Necessitates change in the work practices requiring additional costs to deliver same level of service.
4	Stakeholders / Community	
5	Design	
6	Delivery	
6.1	Increased demand for resources results in increased costs of services (market driven)	80% of the Unit Rate work is undertaken by external contractors. The construction industry and in particular the power industry is experiencing a shortage of resources largely driven by the resources boom. This has enabled contractors to be more selective about the work undertaken and resulted in increased margins. This would not be adequately reflected in the Unit Rates which tend to be retrospective. The consequence of this increased demand has been reflected in the model by an increase in the margin payable to Contractors.
6.2	Wet Weather during delivery delays the works (over & above that experienced in recent history) Inefficiencies in delivery of the works	Victoria has experienced a very dry period over the past three years. This has influenced the unit rates with minimal time lost due to wet weather. Should the weather return to a more normalised pattern it is likely to result in increased costs due to more down-time. The labour component represents approximately 30% of unit rates.
6.3	Major safety incident delays construction	Impact of significant safety incident which delays the work whilst investigations undertaken and mitigation actions established.
7	Commercial	
8	Operations, Maintenance & Licensing	

5.8 Capital Works Program External (unplanned) Risk Model Input.

In addition to the Station Rebuild and Unit Rate risk assessment, there remains other external influences which may impact on the cost of delivering the capital works program. These costs are not capture in any of the previous risk models.

The assumption in this assessment is that the works identified are additional works. The remainder of the works program identified by SP Ausnet is not compromised by the inclusion of these works.

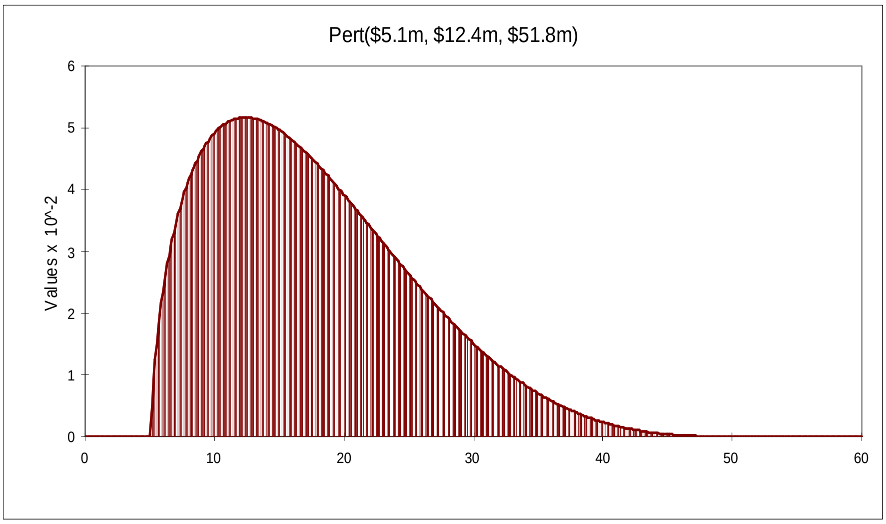
The risks identified reflect a fundamental change in the cost of delivering the capital works program. Included in the table below are the details of the external (unplanned) risks identified.

Description	Consequences
Failure of an Asset requiring immediate replacement (not previously included within capital replacement program)	Additional Works added to program
Upgrade of replacement criteria (benchmark risk assessment at which failure rate considered unreliable / risk level unacceptable by the Business)	Additional Works added to program
Change in Legislation necessitates additional projects be added to the works program (Environmental / Security / OH&S)	Additional Works added to program
Impact of Extreme Event impacts on Assets requiring immediate attention (Fire / Flood / Storm)	Additional Works added to program to rectify, replace damaged assets.

In order to quantify the consequences of this aspect of the risk model we examined the historical records over the current regulatory period to identify the extent of additional works included, which had not been identified, scoped or priced at the commencement of the regulatory period.

- $51.8m was the total value of work which delivered in the current reset period which was not forecast. Work of this nature has been included in the forthcoming regulatory period, which reflects the improvement in the forecasting of SP Ausnet. In the risk model this equates to the maximum value identified.
- $5.1m was the value of work delivered which could not reasonably have been forecast or could be forecast at time of the regulatory submission. In the risk model this equates to the minimum value identified.
- $12.4m was the total value of work delivered in the current reset period which was not forecast. No provision has been made within the forthcoming period for work of this nature. In the risk model this equates to the most likely value identified.

Based on the historical information extracted from the current reset period, we have heavily skewed the risk model towards the lower end of the spectrum which reflects the improvement in the SP Ausnet scoping and estimating processes. This is graphically represented as follows:



6 RISK MODEL OUTCOMES

The estimated expenditure and risk profile of each project was combined using a Monte Carlo based software package (@RISK) to determine the risk-adjusted distribution of the total Capital Works Expenditure.

The model establishes a cost profile for each of the Station Rebuild Projects, the Unit Rate Works program and provides an overall risk-adjusted outturn cost for the complete Capital Works program.

The range of possible outcomes can be represented as a histogram or as a cumulative distribution of the probability of the cost being less than a given amount. The cumulative distribution allows the probability of the cost being less than a given amount to be interpreted directly from the graphs. Conversely for any chosen probability, the appropriate cost value can also be interpreted directly from the profile.

6.1 Station Rebuild Risk Model Outcome

The risk model outputs for the Station Rebuilds provides a probabilistic cost profile for each station together with a profile for the portfolio of Station Rebuilds. The table as follows provides the key values extracted from the model for each of the Station Rebuild projects.

	Reference Estimate	Reference Estimate incl. contingency	Probability Profile of Modelled Cost			
			P90	P80	P50	P10
Station Rebuild						
Keilor 500 - X577	$11,271,861	$12,258,011	$12,845,345	$12,737,456	$12,544,392	$12,282,273
Brooklyn - X578	$49,053,202	$51,855,202	$56,390,524	$55,986,215	$55,149,209	$52,760,992
Hazelwood - X711	$33,982,443	$35,680,000	$39,345,012	$39,115,491	$38,691,763	$38,076,574
Thomastown - X4B4 220KV & 66KV	$40,025,638	$43,727,938	$44,223,919	$43,899,917	$43,283,025	$42,329,976
Ringwood - X576	$27,782,321	$29,375,951	$31,001,499	$30,752,943	$30,284,938	$29,569,709
Keilor 220 66 - X577	$24,928,019	$27,357,440	$27,671,246	$27,435,401	$27,023,193	$26,418,293
Hazelwood 500 - X580	$17,997,486	$19,409,686	$19,872,371	$19,737,021	$19,489,937	$19,116,252
Glenrowan - X725	$19,824,269	$21,324,369	$21,989,142	$21,807,692	$21,471,770	$20,964,957
Richmond – 7C3	$102,979,675	$113,277,642	$118,681,877	$116,681,826	$113,532,495	$109,522,600
Geelong - X508	$9,448,323	$10,367,323	$11,178,951	$11,000,716	$10,665,774	$10,202,026
Station Rebuild Cumulative Output *	$337,293,237	$364,633,562	$383,199,887	$379,154,678	$372,136,493	$361,243,651
Station Rebuild Portfolio Output *	$337,293,237	$364,633,562	$377,734,203	$375,482,399	$371,967,172	$367,219,019
% increase from reference estimate		8.1%	12.0%	11.3%	10.3%	8.9%

*It is noted that the cumulative sum of each of the individual P90, P80, P50 and P10 values provides a greater range of costs than the portfolio output of the Station Rebuilds. This reflects the reality that not all the projects will realise the risks and opportunities at the same time. Whilst some projects incur cost overruns, other projects will not. The portfolio of Station Rebuild model outcome reflects this, with the range between the P10 and the P90 values reduced.

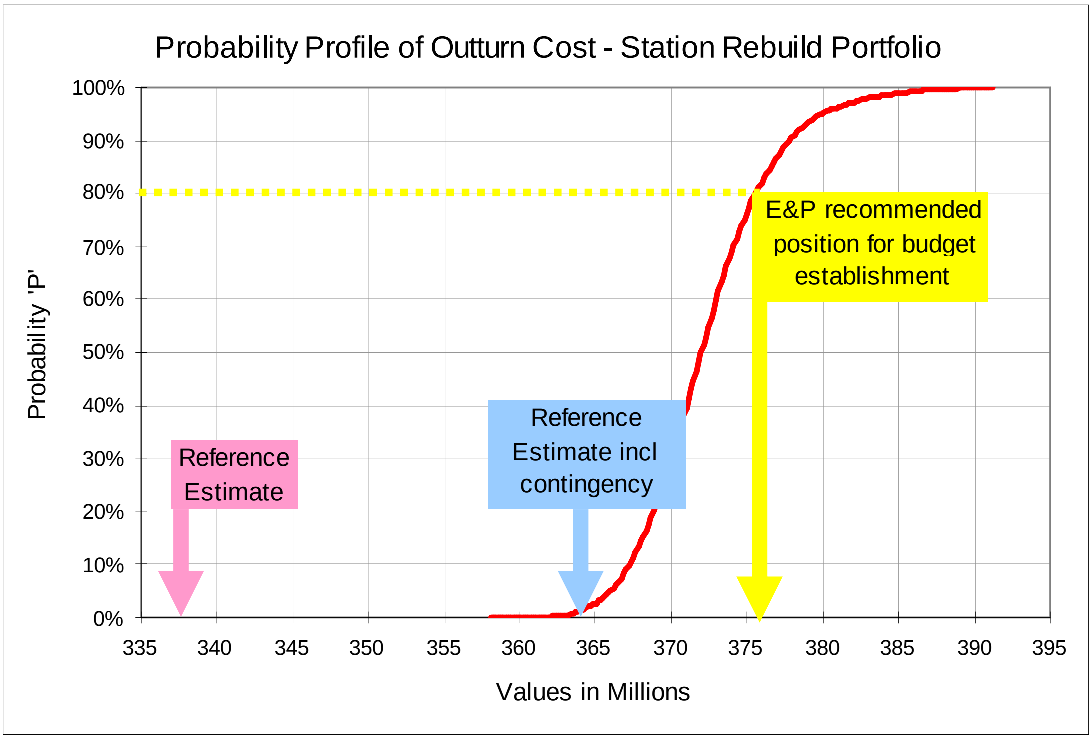
We have included for both the reference estimate and the reference including the single value contingency developed for the Station Rebuild projects provided to the AER as part of the initial SP Ausnet submission. This contingency value was not supported by any additional documentation to justify its inclusion.

Through the risk assessed cost estimating process developed by Evans & Peck our objective is to provide a SP Ausnet and the AER with a logical and transparent approach to demonstrate the likely outturn cost of the Station Rebuild program of works.

The risk model outcomes may be presented as the percentage increase over the reference estimate. This is summarised for the key values identified as follows:

	% increase from reference estimate
Reference Estimate including Contingency	7.1%
P90 Outcome	12.0%
P80 Outcome	11.3%
P50 Outcome	10.3%
P10 Outcome	8.9%

The probability profile for the portfolio of Station Rebuild projects represented graphically as follows:



The graph provides both the probability profile of the inherent risks and opportunities, as well as the probability profile including the external (unplanned) risks and opportunities.

The model indicates that should the Reference Estimate including contingency as nominated in the SP Ausnet draft submission ($364m) be adopted, the E&P risk model indicates that there is greater than 95% probability that the outturn costs to deliver the Station Rebuild program as scoped, will not be contained below this value. Based on this outcome, elements of the station rebuild program will need to be deferred or re-scoped.

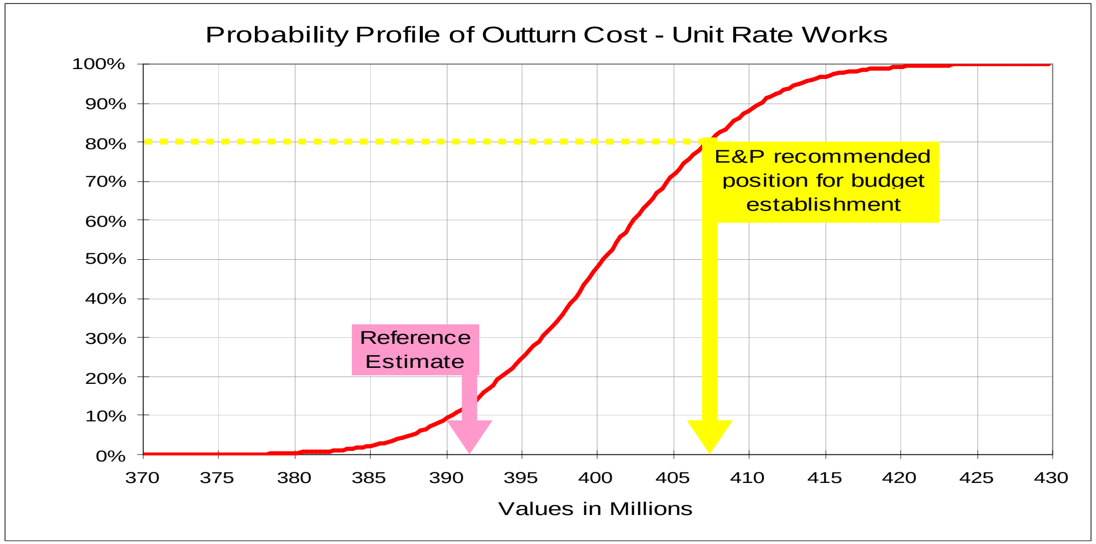
The individual inputs and model output for each of the Station Rebuild projects are included in Appendices 2 - 11.

6.2 Unit Rate Risk Model Outcome

The outcome from the Unit Rate risk model provides a probabilistic cost profile for the portfolio of Unit Rate projects. The table as follows provides the key values extracted from the risk model.

	Reference Estimate	Reference Estimate incl contingency	Probability Profile of Modelled Cost			
			P90	P80	P50	P10
Unit Rate Model Output	$392,260,143	$392,260,143	$410,719,865	$407,202,293	$400,344,662	$390,352,603
% increase on reference estimate			4.7%	3.8%	2.1%	-0.5%

The following graph provides the sum probability profile of the inherent risks and opportunities, and the probability profile including the external (unplanned) risks and opportunities. The model indicates that should the Reference Estimate as nominated in the SP Ausnet draft submission ($392m) be adopted, there is an 85% probability that the outturn costs to deliver the Unit Rate Capital Works program as scoped, will not be contained below this value. Based on this outcome, elements of the unit rate capital works program will need to be deferred or re-scoped.

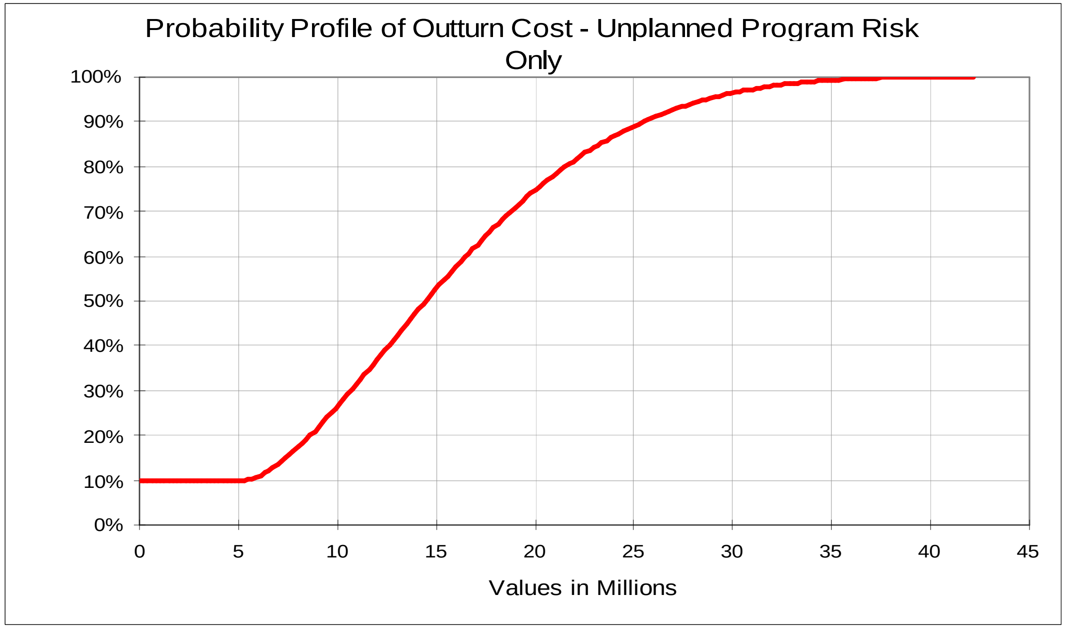


6.3 Capital Works Program Risk Model Outcome

The risk model also provides a probabilistic cost profile for the risks associated with the complete portfolio of Capital Works projects in 2076-08 dollars. The table as follows provides the key output values extracted from the risk model.

	Reference Estimate	Reference Estimate incl. contingency	Probability Profile of Modelled Cost			
			P90	P80	P50	P10
Program Risk Model Output	$0	$0	$25,481,257	$21,524,070	$14,465,437	$ -

The graph as follows provides the probability profile for the external (unplanned) risks and opportunities associated with the program of Capital Works.

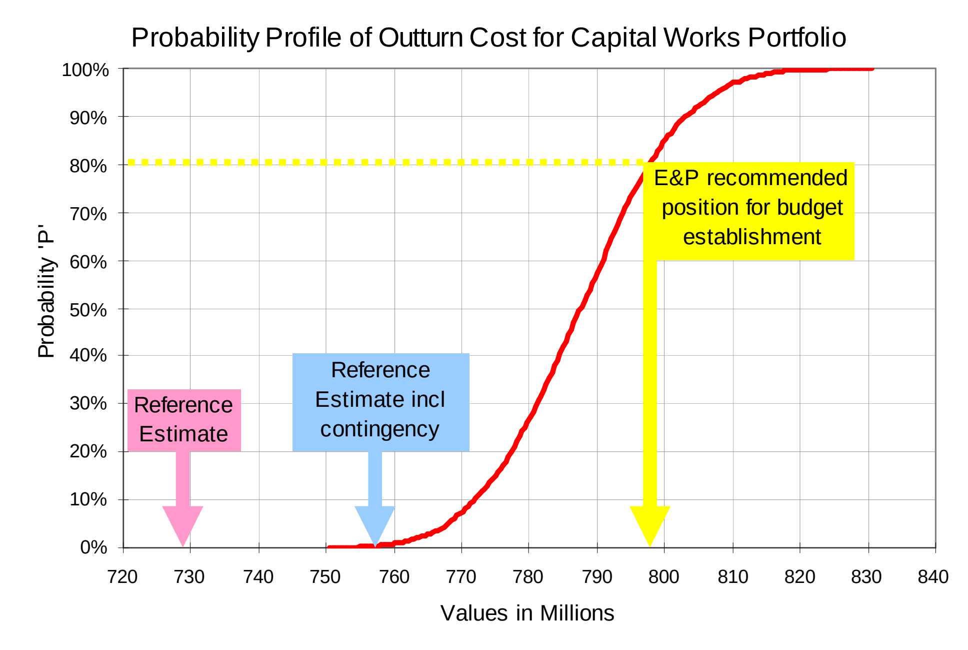


7 CONCLUSION

The risk model also provides a probabilistic cost profile for the complete portfolio of Capital Works projects in 2007-08 dollars. The table as follows provides the key output values extracted from the risk model.

			Probability Profile of Modelled Cost			
2007-08 Dollars	Reference Estimate (SP Ausnet)	Reference Estimate incl contingency	P90	P80	P50	P10
Station Rebuild Model Output	$337,293,237	$364,633,562	$377,734,203	$375,482,399	$371,967,172	$367,219,019
% increase in reference estimate		8.1%	12.0%	11.3%	10.3%	8.9%
Unit Rate Model Output	$392,260,143	$392,260,143	$410,719,865	$407,202,293	$400,344,662	$390,352,603
% increase in reference estimate		0.0%	4.7%	3.8%	2.1%	-0.5%
Program Risk Model Output			$25,481,257	$21,524,070	$14,465,437	$ -
Total Model Output	**$729,553,380**	**$756,893,705**	**$803,166,809**	**$797,710,782**	**$787,576,716**	**$771,847,330**
% increase in reference estimate		**3.7%**	**10.1%**	**9.3%**	**8.0%**	**5.8%**

The graph as follows provides both the probability profile of the inherent risks and opportunities only, as well as the probability profile including the external (unplanned) risks and opportunities.



Based on discussions with SP Ausnet, it is Evans & Peck's view that SP Ausnet has improved its estimating processes, and that the differential between outturn costs and estimates has narrowed and will continue to narrow over time.

In relation to the Station Rebuild projects the reference estimate provides the starting point from which this risk model has been developed. Based on our experience there is no way the program of Station Rebuild's can be delivered for the cost identified in the reference estimate ($337.2m). There is only a 10% chance that the costs will not exceed $367.2, 50% chance of being delivered for less than $372.0m and 80% chance of being delivered for less than $375.5m.

A detailed risk assessment and modelling exercise has calculated an increase in the outturn cost of SP Ausnet's capital works project portfolio of between 8% - 10% above the non-risk adjusted "reference" estimate. This is lower than industry experience would typically suggest, and shows that SP Ausnet has been conservative (ie. optimistic) in estimating the amount of risk that is contained in its portfolio of projects. By being conservative in estimating the amount of risk in its portfolio, SP Ausnet has produced a conservative (low) cost of delivering it's portfolio of projects. Based on our experience and supported by the risk model, there is a greater than 95% probability that the cost of delivering the portfolio of Capital Works will exceed the reference estimate including contingency ($756.9m). There is only a 10% chance that the costs will not exceed $771.8m, 50% chance of being delivered for less than $787.6 and 80% chance of being delivered for less than $797.7m.

The outcome of this process is likely to necessitate the revision and reprioritisation of the works program by SP Ausnet in order to fit within the reference estimate including contingency as submitted in the initial draft to the AER.

Evans & Peck would recommend that at this stage of the project procurement cycle that a P80 figure would be more appropriate. And be reflective of the level of risk which exists, particularly given the longevity of the reset period.

Appendix 1 Summary of Unit Rate Works

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Summary of Work by Unit Rate

PROJECT	Communications	Establishment	Line	Reactive	Secondary	Switchbay	Transformer	Total
ROTS 220KV						$11,508		$11,508
DDTS 220KV						$5,478		$5,478
HOTS 220kV						$6,835		$6,835
MWTS 220kV						$2,192		$2,192
Fall restraints on towers		$36,530						$36,530
installation of OPGW	$25,709							$25,709
installation of Radio communication links	$6,311							$6,311
installation of security cameras		$9,450						$9,450
installation of station security fences		$9,366						$9,366
Land Management		$392						$392
Mgmt of Secondary Systems					$8,521			$8,521
mitigation methods for EMF standards		$1,779						$1,779
mitigation of noise from stations		$733						$733
Oil containment		$11,605						$11,605
OPGW Control	$5,143							$5,143

PROJECT	Communications	Establishment	Line	Reactive	Secondary	Switchbay	Transformer	Total
replacement of 22 kV bays						$6,696		$6,696
replacement of 500 kV CB's						$4,170		$4,170
replacement of 66 kV CB's						3,485		$3,485
replacement of capacitor banks				$5,329				$5,329
replacement of energy metering					$212			$212
replacement of insulators and fittings			$27,189					$27,189
replacement of post type CT's						$24,483		$24,483
replacement of reactive switchgear				$1,465				$1,465
replacement of shunt reactors				$2,641				$2,641
replacement of station AC&DC supplies					$ 5,998			$5,998
replacement of station air conditioners		$265						$265
replacement of station and control centre SCADA					$42,908			$42,908
replacement of station controls					$9,030			$9,030
replacement of station EHV protection systems					$7,419			$7,419

PROJECT	Communications	Establishment	Line	Reactive	Secondary	Switchbay	Transformer	Total
replacement of station HV protection systems					$4,494			$4,494
replacement of station hydrant systems		$11,397						$11,397
replacement of station service supplies							$557	$557
replacement of SVC thyristors and controls				$22,667				$22,667
replacement of transformer bushings							$2,772	$2,772
Response capability for Communications equipment	$1,840							$1,840
response capability for lines			$1,831					$1,831
response capability for primary equipment failures						$8,553		$8,553
response capability for secondary equipment					$5,566			$5,566
response capability for transformer failures							$2,672	$2,672
Station access control		$19						$19
Surge Arrestor replacement program						$7,034		$7,034

EVANS & PECK

PROJECT	Communications	Establishment	Line	Reactive	Secondary	Switchbay	Transformer	Total
synchronous condenser refurbishment				$3,919				$3,919
transformer refurbishment							$1,670	$1,670
transformer replacement							$28,843	$28,843
upgrade station earthing installations		$994						$994
works to satisfy Insurance underwriters		$4,589						$4,589
TOTAL $'000	$39,003	$87,120	$29,021	$36,021	$84,149	$80,433	$36,514	$392,260

Appendix 2 Keilor 500 – X577 Risk Model

Appendix 3 Brooklyn – X578 Risk Model

Appendix 4 Hazelwood – X711 Risk Model

Appendix 5 Thomastown – X4B4 Risk Model

Appendix 6 Ringwood – X576 Risk Model

Appendix 7 Keilor 220 – X577 Risk Model

Appendix 8 Hazelwood 500 – X580 Risk Model

Appendix 9 Glenrowan – X725 Risk Model

Appendix 10 Richmond – X73C Risk Model

Appendix 11 Geelong – X508 Risk Model

Appendix 12 Risk Definitions

Risk Item	Definition
Minimum	The minimum value that could reasonably be expected to occur. Used as an input to the risk distribution.
Maximum	The maximum value that could reasonably be expected to occur. Used as an input to the risk distribution.
Mean	The mean value of the risk distribution.
Monte Carlo Simulation	A simulation technique whereby a very large number of random samples are taken and a range of results is obtained. For risk analysis, this involves randomly sampling all of the input distributions and calculating a result to give one simulated result, then re-sampling all of the distributions repeatedly to build up a range of simulated outcomes (the output risk distribution). The random nature of each sample for the Monte Carlo simulation in this report means that there will be a cross-section of project costs from within the defined risk profiles, with some sampled costs being at the higher end of the risk profile, while others will be from the lower end. By assigning no correlation between the risks, the random sampling of this technique treats the different risks as diversifiable.
Outturn Cost	The final cost of delivering the project including all direct, indirect and client costs.
Most Likely	The most likely value that could reasonably be expected to occur. Used as an input to the risk distribution.
Mode	The most likely value of the risk distribution.
Risk Distribution	The input distribution determined by the minimum, most likely, and maximum values. Also the output distribution determined by the risk simulation model.
P50	The probability that 50% of the time, the out turn cost will not exceed the P50 amount. Typically used as a "most likely" or target cost estimate.
P80	The probability that 80% of the time, the out turn cost will not exceed the P80 amount. Typically used as a budget estimate.

Risk Item	Definition
Pert	There are a number of uncertainty distributions that can be applied to the range of expected cost outcomes. The PERT distribution was chosen for the risks in this report. The PERT distribution was created in the late 1950's by the US Navy to provide insight as to the likely time to complete major capital projects, and is also applicable to the likely cost to complete these projects. The minimum value in a PERT distribution is the minimum value that could be reasonably expected to occur, with the maximum value providing the upper bound of the range of values which could be reasonably expected to occur. The most likely value in the PERT distribution is the value which has the highest probability of occurrence (ie. the value that is most likely to occur). For the purposes of this analysis, the base estimate for each project is considered to be the value which is most likely to occur. The PERT distribution emphasizes the "most likely" value over the minimum and maximum estimates and constructs a smooth curve that places progressively more emphasis on values near the most likely value, in favour of values at the extremes. In practice, this means that the expected outcome is weighted toward the most likely value. Even if it is not exactly accurate (as estimates seldom are), there is an expectation that the resulting value will be close to that estimate. This means that the PERT distribution is implicitly conservative (i.e. optimistic) in determining the likely final cost outcome. This implicit conservatism provides the appropriate driver to ensure that prudent project management and control is essential to mitigate cost overrun, and is therefore an appropriate distribution to apply to SP Ausnet's regulatory situation.

Risk Item	Definition
Portfolio Effect	A portfolio of projects such as SP Ausnet's capital works program will have a combined level of risk which is less than the arithmetic sums of the risks for the component projects. For example, the probability of five projects, assuming no correlation between projects, being completed at a cost in the top 35% of the estimated range is: 35% x 35% x 35% x 35% x 35% = 0.5%. This is much less than the 35% likelihood that a single project will be completed in the top 35% of the estimated range. The corollary of this is that a portfolio manager can have a lower overall "contingency provision" that is smaller than the arithmetic sum of the contingencies required for individual projects, while still having sufficient contingency for each project. The concept of using a risk distribution for each project supersedes the requirement for a prudent business owner to allow for contingency, as the risk distribution considers the likely range of cost outcomes for a particular project. The impact of the portfolio effect on capital expenditure over the regulatory period can be calculated by the use of Monte Carlo simulation techniques. By conducting repeated random samples of each project, and adding these samples together, the expected risk distribution of the final capital works cost can be established.