Capital Cost Estimating Review

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TRANSGRID

Capital Cost Estimating Review - Summary

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TransGrid

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SKM

Capital Cost Estimating Review

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Document history and status

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Contents

No table of contents entries found.

Executive summary

Sinclair Knight Merz (SKM) undertook an independent review of TransGrid's capital estimating database in order to evaluate the following:

- The reasonableness of the base unit cost data and its comparability with recent costs applied in the electricity utility industry; and

- The operation of the database with respect to the use of the unit cost data to generate project cost estimates.

The review involved consideration of 249 individual unit costs, and an assessment of the estimate calculations for 19 projects that covered a range of scopes for TransGrid's upcoming capital expenditure.

SKM's opinion in relation to the abovementioned aspects are:

- SKM considers that TransGrid's unit cost data is reasonable and consistent with recent costs applied in the electricity utility industry;

- SKM considers that the calculation algorithms within the estimating software, based on the templates and estimate components in the database, are functioning correctly and result in accurate project estimates; and

- SKM considers that there are no systematic errors in the database and therefore consider that the forecast capital cost estimates can be relied upon.

Limitation Statement

The sole purpose of this report and the associated services performed by Sinclair Knight Merz (SKM) is to review TransGrid's capital cost estimating database in accordance with the scope of services set out in the contract between SKM and TransGrid. That scope of services, as described in this report, was developed with TransGrid.

In preparing this report, SKM has relied upon, and presumed accurate, any information (or confirmation of the absence thereof) provided by TransGrid and/or from other sources. Except as otherwise stated in the report, SKM has not attempted to verify the accuracy or completeness of any such information. If the information is subsequently determined to be false, inaccurate or incomplete then it is possible that our observations and conclusions as expressed in this report may change.

The passage of time, manifestation of latent conditions or impacts of future events may require further examination of the project and subsequent data analysis, and re-evaluation of the data, findings, observations and conclusions expressed in this report. SKM has prepared this report in accordance with the usual care and thoroughness of the consulting profession, for the sole purpose described above and by reference to applicable standards, guidelines, procedures and practices at the date of issue of this report. For the reasons outlined above, however, no other warranty or guarantee, whether expressed or implied, is made as to the data, observations and findings expressed in this report, to the extent permitted by law.

This report should be read in full and no excerpts are to be taken as representative of the findings. No responsibility is accepted by SKM for use of any part of this report in any other context.

This assignment is based on sample review of TransGrid's cost information and the functioning of its project estimate build-up. The selection of the sample was dependent on the project delivery time constraints and budget. Nevertheless, it has been ensured the selected sample contains diverse range of cost information included in a variety of assets and projects types and classes that forms TransGrid's common asset base.

This report has been prepared on behalf of, and for the exclusive use of TransGrid, and is subject to, and issued in accordance with, the provisions of the contract between SKM and TransGrid. SKM accepts no liability or responsibility whatsoever for, or in respect of, any use of, or reliance upon, this report by any third party.

1. Introduction

1.1 Background Information

TransGrid is currently preparing documentation to support the 2014-19 Revenue Proposal to the Australian Energy Regulator (AER). As part of the preparatory works, TransGrid requested an independent review and validation of:

- the unit costs contained within its capital estimating database; and

- the correct functioning of estimate calculations or algorithms used in Success Estimator™ to generate project cost estimates.

The accuracy of unit costs and validity of capital estimates is of vital importance to the capital investment governance process.

TransGrid's Capital Project Delivery (CPD) group is responsible for the preparation of estimates used during all stages of the project development process. TransGrid uses US Cost Success Estimator™ to generate cost estimates. Success Estimator™ is an estimation application business tool that draws on an integrated database of unit costs as the source for the cost of its capital projects.

1.2 Scope and Objective

The aim of this assignment was to review and validate the following:

- Unit cost values contained within TransGrid's capital cost estimating database in the Success Estimator™; and

- The correct functioning of estimate build-up calculations in Success Estimator™, which are used to generate project cost estimates.

The review and validation of the cost factor values used in TransGrid's estimating methods is excluded from this assignment, with the exception of confirming that they correctly apply during calculations.

2. Methodology

The following subsections describe the activities that SKM performed in undertaking this assignment.

2.1 Kick off meeting

SKM held a teleconference meeting with TransGrid to confirm the project objectives, scope and to identify cost item samples for comparison and review.

TransGrid also clarified the scope of unit cost values for most of the selected cost items which enabled SKM to ensure scoping consistency to allow like-for-like cost comparison.

2.2 Review and validation of unit cost values

SKM reviewed the unit cost values by comparing them against independently obtained cost information for the same items. For this, SKM relied on the cost information from the following sources:

- SKM's electricity network capital cost estimate database (NABU) which exists in Microsoft Access and allows user interface for building up project estimate from various low level unit cost items. SKM maintains this database by regularly updating the cost information as it becomes available from various projects that SKM performs for its utility clients as part of its business. The capital asset unit cost details gathered from the two Australian multi-utility price surveys that SKM conducted in the recent past forms a large portion of cost information in this database. The old cost information is tested against the latest available credible information, and if required it is replaced by new information. Old cost information for which latest pricing is not readily available is updated to current dollar values by using various factors ranging from inflation measured by Australian CPI to asset specific cost escalation indices. SKM have extensively used this database for various assignments assisting the Australian electricity network utilities and the regulators during the revenue reset/review process. It has also been extensively used for project option feasibility studies, unit cost value reviews, and for preparation of budget estimates for negotiation and approval processes for its various clients. The underlying information can be exported to Microsoft Excel files for further analysis;

- In instances where SKM has current and credible cost information from a suite of its recent or on-going projects in this utility sector which is not yet captured in the NABU database, SKM referred to those particular projects and used the cost information;

- SKM staff with relevant knowledge and recent project experience were called upon to provide capital cost information for cost items;

- Rawlinson Construction Handbook 2013 edition was referred to for a number of low level civil work cost items; and

- SKM contacted a number of equipment and asset manufacturers/suppliers to obtain budgetary quotes.

Where significant differences were found, further investigation was completed to ensure that a like-for-like comparison was being made. Highest priority was given to those rates that have the potential to impact significantly on the upcoming revenue period proposed program budget (high volume, low value rates and low volume, high value rates).

Consideration and scrutiny of such cost items involved the following activities:

- In-depth discussions between TransGrid and SKM on underlying low level details making up the respective unit cost values to confirm the makeup components of the cost item are consistent. This involved referring to TransGrid's library for a number of standard design drawings to verify the inclusion or exclusion of underlying components that made up the cost items. Inconsistencies found during such an exercise were addressed by adjusting the SKM unit to include or exclude the relevant underlying component so that the comparison was done on a like-for-like basis;

- ▪ Testing the source or the basis of the cost estimate. This involved TransGrid tracing back the source of the unit cost value and, in a number of cases, referring to the recent actual commercially confidential competitive tender quotations received from the market. Similarly, SKM revealed its source and the currency of its cost information in confirming the suitability of its use for this assignment. Cost information based on recent competitive market tender offerings for actual projects, manufacturers/suppliers firm quotations in actual project contracts, and actual cost records or performance of Australian utilities were prioritised over budgetary quotations or estimates obtained from the market or statistical extrapolation.

The above activities were performed to achieve consistency between TransGrid's estimate and SKM's estimate to enable like-for-like asset comparison.

2.3 Site visit to understand the functioning of TransGrid's capital cost estimating database

A site visit was undertaken by the SKM project team to TransGrid's Waratah office to understand the structural details and the functioning of TransGrid's estimating tool, namely Success Estimator™, an estimating application and product from RIB U.S.COST. Success Estimator™ contains TransGrid's capital cost estimating database along with the application algorithm that builds up project estimates based on user inputs.

Discussions with TransGrid's CPD personnel responsible for maintaining and using the Success Estimator™ tool provided insight and enabled SKM to better understand the functioning of TransGrid's capital cost estimating database, its inputs, outputs, and calculation or data processing algorithms.

2.4 Review and validation of the database calculation

With an operational understanding of TransGrid's Success Estimator™ tool and its details, SKM was able to validate the database calculation methodology. SKM were provided with a selection of diverse projects, using a variety of project templates, which had been estimated using the capital cost estimating database. SKM replicated these project cost estimates independently in an alternate environment (Microsoft Excel) using the same cost entries list.

SKM built up the TransGrid library within an Excel environment using the same cost structures seen in the database, i.e. Resources, Cost Items, Assemblies and Bays. This library was then utilised to create estimates for each project based on the various templates, cost structures and rules on which the estimate is created in the Success Estimator™ database environment.

By comparing the project estimate output from the Success Estimator™ database and the independent Excel model, SKM was able to confirm the functioning of Success Estimator™ database algorithm and identify any discrepancies.

2.5 Reporting

This document presents the details of this assignment and the findings of the review.

3. Validation of Unit Cost Value

3.1 Selection of unit costs for review

TransGrid's database contains 614 unique entries or cost items. While a significant proportion of these items are commonly used items across the industry, others were project specific one-off cost items. SKM performed an initial desktop review of the units and identified approximately half of the cost items suitable for detailed assessment. The initial review considered the following factors:

- Selecting a range of cost item values that formed a significant proportion of the value of estimates used in the current Revenue Reset Proposal being prepared by TransGrid for the 2014-19 period;

- Capturing a diverse range of projects and asset types forming TransGrid's typical asset base. The chosen sample size covered substation civil works, substation primary plant, substation secondary systems, transmission lines and underground cables; and

- The availability of recent cost information from a credible source.

Following the initial review, the sample size for detailed assessment was 359 unit costs. As this represented a material reduction to the total number of unit costs in the database, Table 1 provides details of the broad categories not reviewed, the typical units in those categories and provides commentary on the justification for omission from the review. It provides details for the majority of the unit costs not reviewed.

Table 1 - Unit costs not reviewed

Category (quantity omitted)	Typical Units	Comments
Building Works (11 units)	1. Building specific GIS equipment (e.g. crane, lift, building services)	GIS related building works are specific to the particular building design and construction and are difficult to establish a unitised cost for (i.e. they are scope specific). TransGrid have estimated these costs based on a specific building design and layout (e.g. Holroyd / Rookwood / Beaconsfield / Haymarket) and therefore typical industry costs would not be readily available.
Civil Works (61 units)	1. Equipment relocation 2. Miscellaneous (gates, pumps, landscaping) 3. Upgrades (not new installations) 4. Demolition 5. Comms towers and poles	TransGrid's database contained a number of specific and low level items (such as fire pumps, replacement of tower members, upgrade to existing civil works, demolition of fire walls) that are not contained in SKM's database. For these cost items, SKM would typically estimate the costs by engaging with suppliers and contractors. These unit costs were considered to be site and scope specific and not used across a large proportion of estimates.
Clearing (20 units)	1. Very light through to very heavy clearing	SKM's database did not include up-to-date costs for clearing and therefore these costs were unable to be assessed.
Contract Establishment (12 units)	1. Manuals, training 2. Contractor leave and return to site	SKM considers that these costs are project specific and as such, a typical unit cost could not be developed.

Category (quantity omitted)	Typical Units	Comments
Electrical Works (31 units)	1. Equipment disposal (PCB) 2. Transformer dismantle and re-erect 3. Transformer transport	SKM's database did not include up-to-date costs for these items and therefore these costs were unable to be assessed.
Panels (15 units)	1. Secondary Systems Building (SSB)	TransGrid has developed a SSB to facilitate the efficient replacement of secondary systems during the lifetime of the substation. SKM did not have an equivalent cost item for SSB's that was suitable for comparison against TransGrid's SSB.
Plant Procurement (23 units)	1. Phase shifting transformers 2. Transport 3. Equipment ID labels	SKM's database did not include up-to-date costs for these items and therefore these costs were unable to be assessed.
Stringing (10 units)	1. Stringing OH conductors on various tower arrangements	SKM's database included stringing costs as part of the total transmission line costs and not as a separate line item of the estimate and therefore these costs was unable to be assessed.
Telecommunications (32 units)	1. Specific communications equipment (radio, microwave, PLC)	SKM's database did not include up-to-date costs for these items and therefore these costs were unable to be assessed.

Following the initial review, SKM undertook a detailed assessment of the 359 unit costs; however, based on the suitability and applicability of cost items within SKM's database and lack of responses from market enquiries made by SKM, the number of units for which costs could be satisfactorily compared reduced to 249 items.

SKM's opinion is based on the final iteration of unit cost values after adjustment, as explained in Section 2.2, to ensure a like-for-like asset unit cost value comparison.

3.2 Findings

3.2.1 General observations

After comparing TransGrid's and SKM's unit cost values, SKM found that the difference between unit rates was generally consistent with a normal distribution as shown in Figure 1. The median value of 2.64% indicates that SKM's rates are slightly higher than TransGrid's rates, which, in the main, suggests that TransGrid's unit rates may be considered efficient.

Figure 1 - Percentage distribution of unit rates
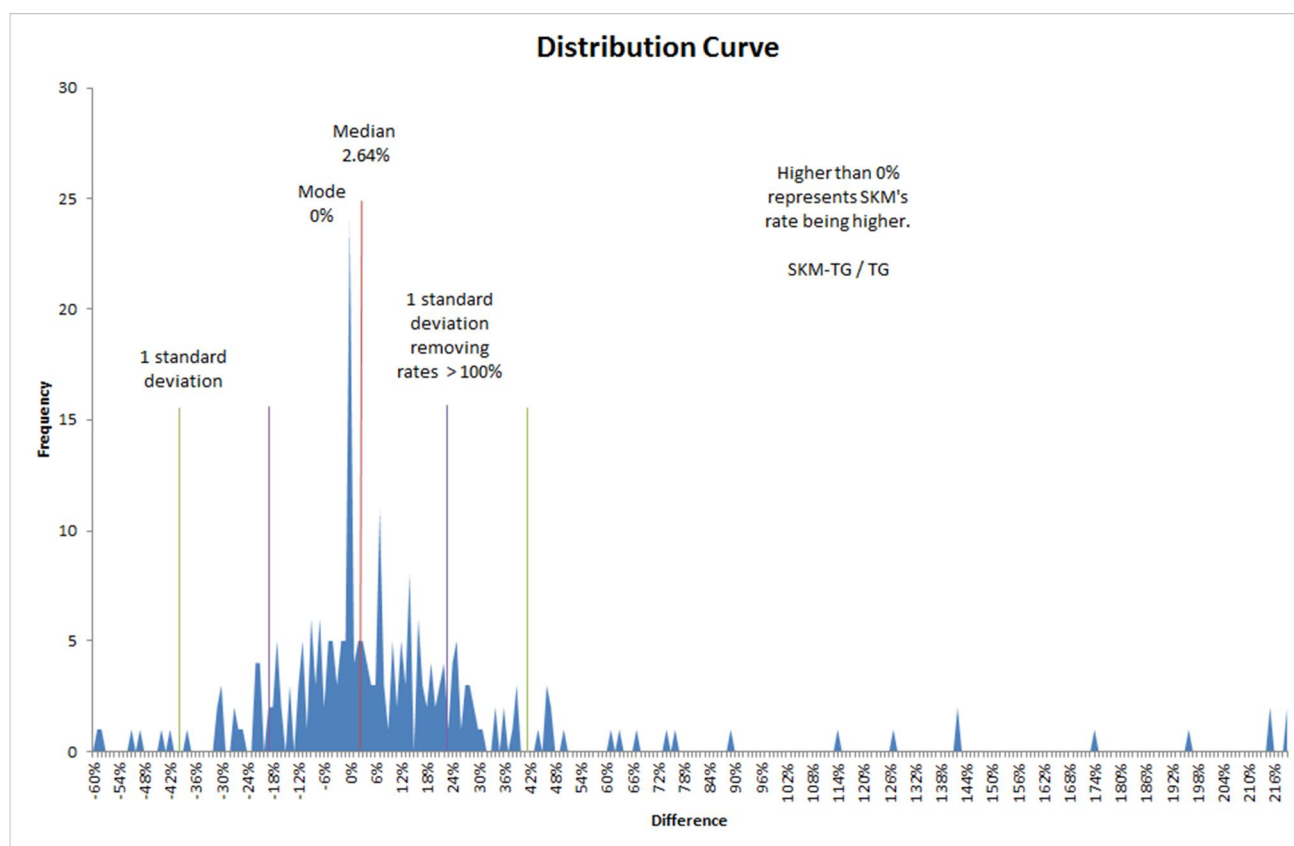
The relatively large standard deviation (40.5%) does present some concern however. Further analysis indicates that the standard deviation is materially impacted by the unit rates on the high side (i.e. SKM's rate is higher than TransGrid's). Removing the units where SKM's rate is greater than 100% of TransGrid's rate, returns the standard deviation to a more acceptable range of ± 20%.

While unit rates where SKM is higher than TransGrid provide a degree of confidence that TransGrid's rate may be considered efficient, greater focus and attention was given to unit rates were TransGrid's rates were materially (+25%) higher than SKM's.

3.2.2 Unit rate themes by voltage level

The following three general themes were observed based on the unit cost comparison:

SKM's unit costs for distribution (i.e. ≤33kV) level assets are, on average, slightly less than TransGrid's unit cost. Such assets are made up of 11kV auxiliary transformers, 11kV underground cables and 33kV switchgear. The cost information used by SKM for this asset level are referred from the most recent capital asset Australian multi-utility price survey and are the reflection of actual prices that the distribution utilities around Australian recently paid for their assets. Given that TransGrid is an electricity transmission network utility and does not have large or common asset base involving distribution level assets, TransGrid's estimates for these distribution assets is, as expected, slightly higher.

TransGrid's unit costs for sub-transmission and transmission level assets in the 66-132kV range are generally slightly lower than SKM's rates. TransGrid's assets in this range are based on competitive tender and period contract pricing and would be considered market prices.

TransGrid's unit costs for high voltage (i.e. ≥330kV) transmission level switchgear, transformers and capacitor bank assets are generally below SKM's rates. Notwithstanding this finding, it should be noted that the amount

of information available in the market for assets at this voltage level is generally limited given the small volume of projects undertaken in Australia in recent years. SKM's cost data for such assets has been collected from ABB Australia (budgetary quotations), a previous assignment with the Australian Energy Market Operator (AEMO), and various Australian transmission utilities including TransGrid itself, with all information updated to present dollar values. It is noted that TransGrid has more detailed and current cost information based on actual competitive market offerings and long term period order contracts of major plant items providing pricing certainty. This has resulted in TransGrid having an accurate market value for assets at a high voltage level.

3.2.3 Conclusion

Whilst there were some significant initial differences found between unit cost values, further investigation was completed to ensure that a like-for-like comparison was being made. This consideration and scrutiny mostly resulted in the adjustment of SKM's unit to be consistent with the scope of TransGrid's unit.

Notwithstanding the adjustments to compare like-for-like units, SKM notes that there are some rates that have higher than expected variance between TransGrid and SKM. While these are not expected to have significant impact on estimates, it is recommended that TransGrid review these rates further to determine whether additional changes should be made to rates.

SKM did not find any major discrepancy or anomalous pattern of differences during the unit cost comparison. No major impact to the overall program cost in the upcoming revenue period is expected due to the existing differences between the set of TransGrid's and SKM's unit cost values.

4. Validation of Functioning of Estimate Build-up

4.1 Database structure

Success Estimator™ contains TransGrid's capital cost estimating database along with the application algorithm that builds up project estimates based on user inputs.

The database consists of a Master Cost Library that contains all the cost information that is used to develop project cost estimates. The cost library is a multi-layered structure and consists of the following elements:

- **Resources** are the lowest level of detail and contain the detailed cost information on which all estimates are based. They are made up of individual materials, external labour, internal labour and expense details (e.g. Concrete $/m^3$). These are the unit cost values reviewed above;

- **Cost Items** describe individual asset items and can be made up of either single or multiple Resources (e.g. a current transformer foundation consisting of concrete material, formwork and labour);

- **Assemblies** describe complete asset types by collecting associated individual asset items and therefore are made up of multiple Cost Items (e.g. a current transformer consisting of 3 phases of equipment, foundation, footing, connection and installation work); and

- **Bays** describe a higher level asset class by collecting associated asset types and therefore are made up of multiple Assemblies (e.g. a switch bay consisting of a current transformer along with other switchgear, associated civil works and a secondary system).

TransGrid has also developed a set of standard project templates for the creation of estimates. The templates are based on a range of common projects completed by TransGrid in the areas of substations, transmission lines and underground cables. Each template has a specific set of factors for determining the design, project management, site management and commissioning costs which are dependent on the nature and scale of the project type.

Project estimates are created in Success Estimator™ by utilising the appropriate template and including a mix of standard bays, assemblies and cost items to develop a total project cost for a given scope of work. The template factors are applied to the components of the estimate in accordance with a set of rules defined in the template.

4.2 Project selection

TransGrid provided SKM with cost estimates of eight projects, some containing sub-project divisions, resulting in nineteen individual project estimates to review for validation of the estimating function of the Success Estimator™ tool.

These nineteen project estimates covered a diverse range of projects, assets and sites, and draw their underlying unit cost details from the capital cost estimating database, utilising a large pool of cost items. All these projects for review were developed during preparation of the proposal for the upcoming revenue period. The following subsection describes the project estimates and the result of SKM's review.

4.3 Findings

SKM independently developed the cost estimates from the ground-up using the resource library and found that 16 of TransGrid's 19 estimates exactly matched the independently compiled estimate. SKM found that the remaining three of TransGrid's estimates varied slightly (smaller by <0.13%) from the independently compiled estimates.

It was discovered that the three deviant estimates in the Success Estimator™ used a cost item from a previous version of the library that was current at the time of the estimate's creation. SKM was able to develop these estimates by manually adding the cost to the independent estimate and found that TransGrid's estimate exactly matched the independently compiled estimate under these conditions. Therefore the database mechanics were operating correctly and it is only the item itself which is out-dated.

Two other minor discrepancies detected in this process are described below:

- It was discovered that three estimates in the Success Estimator™ used one bay with different quantities of assemblies when compared to the standard library bays. SKM was able to include these items in the independent estimate by manually adding them to the independent estimate.

- It was discovered that two estimates in the Success Estimator™ contained cost items that were not present in the standard library provided to SKM. SKM was able to include these items in the independent estimate by manually adding them to the independent estimate.

Based on the results of the analysis above, the estimating algorithm in Success Estimator™ is functioning as intended. It is however recommended that TransGrid review estimates against the current library to ensure that all cost items and bays have updated correctly to the current library.

5.   Conclusion

This review provides a rigorous and transparent process through which the cost information values and the mechanics of building up the project estimates using those cost information in TransGrid's Success Estimator™ were independently assessed. SKM did not observed any systematic error or discrepancy during this review process.

From the result of this review exercise, SKM considers that TransGrid's capital cost estimating database and its Success Estimator™ business tool is reasonable and functions as intended. The resulting cost estimates are consistent with the current asset or project costs applied in the electricity transmission utility industry.

SKM found some minor errors in the project estimates produced by Success Estimator™ associated with incorrect reference to the database library version and inconsistent practice of customising project makeup components (i.e. changing standard setup template without using adjustments folder). These instances, however, produced negligible impact to the respective project cost estimates. It is recommended that TransGrid review estimates against the current library to ensure that all cost items and bays have updated correctly to the current library.

Based on the review of sample unit cost items and sample of diverse range of project estimates, SKM concludes that the cost estimate for unit items contained in TransGrid capital cost estimating database is reflective of efficient prices for an Australian electricity network business. Similarly, the functioning of the Success Estimator™ tool to generate project cost estimate is accurate and free of material error. SKM therefore recommends that TransGrid uses this cost information and business tool to generate its proposed project estimates to be included in the forthcoming regulatory expenditure proposal.