Sinclair Knight Merz
100 Christie Street
PO Box 164
St Leonards NSW
Australia 1590

Tel: +61 2 9928 2100
Fax: +61 2 9928 2500
Web: www.skmconsulting.com

John Howland
TransGrid
201 Elizabeth St
Sydney NSW

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HA01143 - Cost Factor Allocation Review (rev 2).docx

Dear John

Review of Cost Factor Allocation for the Replacement of Beaconsfield West 132kV GIS

1. Background

TransGrid has requested SKM provide an independent review of the cost factor allocation on the Beaconsfield West project which is currently being assessed by the AER as part of TransGrid's revenue determination for 2009-2014.

Following a review of the POSE document for the project (6378), SKM has determined that the project is complex in nature. The planned augmentation and replacement work will occur within a live GIS indoor substation which increases the complexity of the civil, structural, installation and commissioning activities. The complexity of an in-situ replacement and augmentation over a green-field project result from the need for specialised design requirements, staging and precautions during installation, outage management, network / personnel safety, operational constraints and other associated issues. The complexity and difficulty involved with undertaking an in-situ replacement of any kind requires significant consideration during both the planning and implementation stage.

The project at Beaconsfield West involves the following tasks:

- An extension of the existing substation building;
- The replacement of all 132kV Indoor GIS switchgear (24 bays);
- Replacement of Control, Protection and Metering equipment;
- Replacement of Batteries;
- Replacement of Communications equipment;
- Upgrade of existing transformer bunds;
- Installation of Neutral Point Earthing Reactors; and
- Installation of Transformer Oil Separation Facilities.

TransGrid estimates that the project will take a minimum of 42 months to complete. In addition, it is emphasised that due to the criticality of Beaconsfield West substation to TransGrid and EnergyAustralia's networks, it is necessary that the substation remains live throughout the duration of the project.

The purpose of this report is to review TransGrid's cost estimate for Beaconsfield West GIS replacement and provide an assessment as to whether the cost factor allocation is reasonable given the complexity and long duration.

2. Review of Cost Factor Allocation

2.1 Calculation of Project Cost in terms of Cost Factors

In estimating the cost of a project, TransGrid applies the following cost factors:

- Network Cost Factor (NCF) – Applied to the materials, construction and ancillary costs;
- Design Cost Factor (DCF) – Applied to the materials, construction and ancillary costs;
- Ancillary Works Factor (AWF) – Applied to construction cost (note: the AWF is not applied to plant procurement).

Assuming the following variables:

- Φ = Total project cost
- $\mathbf{x}$ = Project cost excluding plant
- $\mathbf{y}$ = Plant cost
- $\mathbf{N}$ = NCF
- $\mathbf{D}$ = DCF
- $\mathbf{A}$ = AWF

TransGrid calculates the total project cost to be:

$$\Phi = \mathbf{y}(1 + \mathbf{N} + \mathbf{D}) + \mathbf{x}(1 + \mathbf{A} + \mathbf{N} + \mathbf{D} + \mathbf{AN} + \mathbf{AD}).$$

2.2 Standard Cost Factor Allocation for 330kV Substation Augmentation Projects

TransGrid's standard cost factor allocation for a 330kV AIS Substation Augmentation project is as follows:

- NCF – 15% of the materials, construction and ancillary costs;

- DCF – 10% of the materials, construction and ancillary costs;
- AWF – 15% of the construction cost.

This equates to a total project cost estimate of:

$$\Phi = y(1 + 0.15 + 0.1) + x(1 + 0.15 + 0.15 + 0.1 + 0.0225 + 0.015);$$

$$\Phi = y(1.25) + x(1.4375);$$

Where $\mathbf{x}$ = Project cost excluding plant; $\mathbf{y}$ = Plant cost.

2.3 TransGrid's Cost Factor Allocation for the Beaconsfield West Project

TransGrid does not have a standard set of cost-factors to apply to an in-situ GIS replacement project as there have been no in-situ replacements of this type in the past from which to generate the cost factors. TransGrid has therefore used the 330kV AIS substation augmentation cost factors as a basis and modified these to account for the added complexity of the project. It is anticipated that TransGrid would be in a position to generate standard cost factors for in-situ replacement projects (both GIS and AIS) following the experience with the projects undertaken during the 2009-2014 revenue period. The modified (non-standard) cost factors used for the Beaconsfield West project are:

- NCF – 30% of the materials, construction and ancillary costs;
- DCF – 20% of the materials, construction and ancillary costs;
- AWF – 15% of the construction cost.

This equates to a total project cost estimate of:

$$\Phi = y(1 + 0.3 + 0.2) + x(1 + 0.15 + 0.3 + 0.2 + 0.045 + 0.03);$$

$$\Phi = y(1.5) + x(1.725);$$

Where $\mathbf{x}$ = Project cost excluding plant; $\mathbf{y}$ = Plant cost.

2.4 SKM's Cost Factor Allocation for an In-Situ Substation Replacement

Based on SKM's experience with project estimates and asset valuations in the electricity industry, TransGrid's cost factor allocation for the Beaconsfield West project is considered to have optimism bias. This term is used to refer to the tendency of those estimating a project to over-estimate the benefits and to under-estimate the costs associated with delivery. As a result, it is likely that TransGrid's costs under-estimate the actual cost of delivering the Beaconsfield West GIS replacement project.

As the Beaconsfield West project is an in-situ substation replacement, SKM would, as a minimum, apply an in-situ replacement factor of 30% to the total project cost (including standard cost factors) as estimated by TransGrid. This is calculated as follows:

- NCF – 15% of the materials, construction and ancillary costs;
- DCF – 10% of the materials, construction and ancillary costs;
- AWF – 15% of the construction cost;
- In-Situ replacement factor – 30% of the total project cost.

SKM would therefore estimate the following total project cost for the Beaconsfield West project:

Total project cost = $1.3(\Phi)$

$$\textbf{Total project cost} = 1.3[y(1 + 0.15 + 0.1) + x(1 + 0.15 + 0.15 + 0.1 + 0.0225 + 0.015)];$$

$$\textbf{Total project cost} = y(1.625) + x(1.8688);$$

Where $\mathbf{x}$ = Project cost excluding plant; $\mathbf{y}$ = Plant cost.

It is noted that this project cost estimate is materially larger than TransGrid's project cost estimate for the Beaconsfield West project.

It is emphasized that this cost factor allocation and in-situ replacement factor would be the lower limit of what SKM would consider reasonable for an in-situ substation replacement of this type. Due to the complexity of the Beaconsfield West project, it is likely that SKM would apply an increased cost factor allocation and in-situ replacement factor to the project, although the extent of the increase is difficult to quantify without carrying out more detailed analysis.

SKM notes the following issues relating to the Beaconsfield West project which contribute to the complexity of the project:

- The Beaconsfield West Project is an in-situ replacement; not a substation augmentation;
- The Beaconsfield West 132kV switchgear is indoor GIS. Design requirements are significantly more stringent for GIS as opposed to AIS; and
- The Beaconsfield West Substation needs to remain live throughout the duration of the project. This is a particularly onerous requirement due to the space limitations at the site.

2.4.1 SKM's Experience with GIS Substation Projects

SKM has provided the (lower limit) cost factor allocation and in-situ replacement factor noted in Section 2.4 based on its broad experience with GIS substation projects in the past. This experience includes the provision of consulting services on the following projects:

- Transpower, NZ: Tender evaluation, tender clarifications and preparation of specification for design-build contract 220kV GIS Substation "Otahuhu";
- Transpower, NZ: Inspection of GIS factories in Europe for GIS manufacturer prequalification 220kV;
- TransGrid: Feasibility Studies for two Greenfield 330kV/132kV GIS/AIS Substations and 330kV overhead line routes;
- ElectraNet: High level cost estimate for various options of a new 275kV GIS substation in Adelaide;
- Energy Australia: Preparation of Specification of 132/66kV 50MVA gas insulated transformers and associated earthing transformers;
- CitiPower, Melbourne: Feasibility Study for the replacement of a 66kV indoor air insulated substation with a new 66kV GIS Substation in Melbourne CBD "Victoria Markets";
- Integral Energy: Insulation co-ordination study for 132kV GIS Substation "Springhill" and 132kV GIS Substation "Bella Vista";
- CitiPower, Melbourne: Feasibility Study for a new 220kV GIS Substation in Melbourne CBD; and
- Integral Energy: Cost Estimate of Integral Energy's new 132 kV GIS Springhill Transmission Substation.

In addition, SKM has assisted TransGrid in the concept phase and is currently undertaking a feasibility study for the replacement of Beaconsfield West 132kV GIS. SKM has also carried out extensive laser scanning of Beaconsfield West Substation in order to build a 3D CAD model of the site. As part of SKM's role in the Beaconsfield West project, SKM has conducted numerous internal and external discussions regarding the complexity of the project and a potential in-situ replacement factor for the project.

To support the finding that TransGrid's cost factor is below that typically required for undertaking such a project, SKM attempted to find a similar case of an in-situ GIS replacement project that has been successfully performed. SKM's investigation found only one example of an in-situ replacement in Zurich, Switzerland of a similar scale to that proposed at

Beaconsfield West. However, it was noted that even this project presented less complexity than TransGrid's project. Discussions with the utility involved with the replacement supported the contention that the cost factor allocation proposed by TransGrid appears to be below that typically required for undertaking such a project.

3. Conclusions

As the Beaconsfield West project is an in-situ GIS replacement, as opposed to an AIS substation augmentation, it is considered reasonable for TransGrid to use a non-standard cost factor allocation for the project.

Given the nature of, and the complexities involved with the Beaconsfield West Project, SKM considers the cost factor allocation used by TransGrid to be below that typically required for undertaking such a project.

TransGrid estimate: $\Phi = y(1.5) + x(1.725)$

SKM estimate: $\Phi = y(1.625) + x(1.8688)$

Where:
Φ = Total project cost
y = Project cost excluding plant
x = Plant cost

Yours faithfully

[by email]

Anthony Hadley and Ryan Dudley
Strategic Consulting
Phone: +61 2 9032 1210 / +61 2 9928 2462
Fax: +61 2 9928 2506
E-mail: AHadley@skm.com.au / RDudley@skm.com.au