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19 December 2008 *HA01143 - Opex considerations (rev 1).docx*

Dear John

Considerations on PB's Review of TransGrid's Operating Expenditure

1. Background

TransGrid has requested SKM provide an assessment of the operating expenditure review conducted by PB on TransGrid's controllable operating expenditure for the 2009-2014 revenue determination. In particular, TransGrid was interested in SKM's considered views on the asset growth escalation component of PB's review.

TransGrid's controllable operating expenditure is forecast by taking the cost for routine maintenance for the various asset categories and adding to that the cost of managing and rectifying defects for each asset category. The cost of defects is calculated by multiplying the routine cost by an asset defect ratio. The defect ratios are based on historic performance of asset types and are as follows:

Lines	95%
Substations	115%
Communications	200%
Secondary Systems	30%
Land and Easements	40%

Controllable operating costs associated with new capital expenditure is calculated by multiplying the controllable opex associated with each category by the capital expenditure growth for each category (as a percentage) and an economy of scale factor (typically 95%).

The controllable operating costs for new and existing assets are added (with appropriate adjustments made for operating cost savings due to asset replacement) to provide the total forecast controllable operating cost.

The calculation of controllable opex for each category of asset is summarised in the following table.

Existing assets	=	Routine cost + [Defect Ratio (%)] × [Routine Cost]
New assets	=	Existing assets × Capex growth (%) × Economy of scale (%)
Total controllable opex (TG)	=	Existing assets + New assets

2. Summary of PB's Review of Asset Growth Escalation

Section 7.7.2 of the PB report addresses asset growth escalation. To summarise, PB is of the opinion that a reduction to TransGrid's forecast controllable operating costs should be made that is equal to the difference between the forecast which includes defects associated with new assets and the forecast excluding defects associated with new assets.

PB clarified their view by stating:

"*... we believe that the overwhelming majority of the new assets scheduled for commissioning during the next regulatory period will not require any defect rectification expenditures during that period other than those identified and rectified during the warranty period.*"

Additionally, PB provided the following commentary to pre-empt an argument that assets may experience defects during the regulatory period in which they were commissioned:

"*Whist it may be argued that these new assets could produce some minor number of defects during the next regulatory period PB believes that the reduced routine maintenance resulting from the effects of new technology will offset these minor costs.*"

PB's recommendation was that the defect rectification included in the TransGrid opex model resulting from the new growth assets proposed to be commissioned during the next regulatory period be removed from the annual operating forecasts.

PB's recommendation is summarised in the following table. The change for new assets has been shown in red.

Existing assets	=	Routine cost + [Defect Ratio (%)] × [Routine Cost]
New assets	=	**Routine cost** × Capex growth (%) × Economy of scale (%)
Total controllable opex (PB)	=	Existing assets + New assets
Cost difference (TG – PB)	=	Routine cost × Capex growth (%) × Economy of scale (%) × Defect ratio (%)

3. SKM's Review

SKM has reviewed PB's commentary on asset growth escalation, TransGrid's response to PB's draft report and version 4.5b of TransGrid's Opex model. Subsequently, SKM has identified a number of issues that need to be considered in detail to determine whether removing the defect costs associated with new assets from TransGrid's controllable operating costs is reasonable. These are:

1) Probability of defects on new equipment;
2) Warranty considerations including standard equipment warranty periods, typical warranty coverage and non-recoverable costs; and
3) Routine operating cost variations associated with new technology;

3.1 Probability of Defects on New Equipment

SKM's review of TransGrid's response to PB's draft report identified several examples of defect costs associated with new assets. Of note are the defect rates for transformers and circuit breakers since 2005 as a percentage of total defects, which were 6% and 14% respectively. TransGrid noted in their response that while these defects were typically covered by the manufacturer warranty, TransGrid may be required to provide supervision of the manufacturers personnel or provide their own personnel to be trained to undertake the rectification.

In their response, TransGrid used a typical failure rate over time graph (bathtub curve) to reason that new assets suffer from higher rates of defects than assets in their mid-life. SKM generally accepts that manufacturing defects on new equipment, combined with design and installation errors will result in higher rates of defects on new equipment than mid-life equipment. However, SKM consider that within the mid-life / random failure zone, newer equipment will tend to have fewer defects that older equipment, and therefore in the event that the average age of a network decreases materially (i.e. the average drops several years), the cost of defects should also reduce.

SKM has found in the past that new equipment will sometimes require post commissioning / practical completion modification and adjustment to ensure suitable operation and reliability. This work is typically classified as a defect; however, the manufacturer will not be subject to a defect claim. While certain defect rectification work will be covered by a warranty, there are additional costs incurred by the equipment owner that are typically not covered. These are discussed further in section 3.2.3.

TransGrid's modelling has demonstrated that the average age for various asset categories and the system itself remains largely static over the course of the regulatory period when taking into account the capital expenditure programme. Therefore, SKM consider that the defect rate used in the model and applied to new assets is appropriate.

3.2 Warranty Considerations

As discussed in section 3.1, new equipment can incur defects. The defects liability period and associated warranty are intended to mitigate the risk to the asset owner for omissions and faults caused by the manufacturer in their design / installation and commissioning of the equipment.

PB's assertion is that "*the overwhelming majority of the new assets scheduled for commissioning during the next regulatory period will not require any defect rectification expenditures during that period other than those identified and rectified during the warranty period*."

To assess the validity of PB's assertion, it is important to consider the following issues related to the warranty / defect liability period:

- Equipment warranty periods;
- The warranty coverage; and
- Non-recoverable costs (i.e. costs incurred by the owner that are not covered by the warranty) associated with defects within the warranty period.

3.2.1 Warranty Periods

SKM requested TransGrid provide the standard warranty periods for new equipment that would be installed during the regulatory period. The warranty periods are shown in the table below.

Equipment	Normal Warranty Period
CB	2
CT	2
MVT	2
CVT	2
Disconnector	2
Earthswitch	2
Surge Arrestor	2
Line Trap	2
Capacitor Bank	5
Transformer	2

Shunt Reactor	2
Series Reactor	2
SVC	4
GIS	2
Batteries	10
Battery chargers	2
Distance Relays	1
Transformer Protection Relays	1
132kV Concrete Pole line	1
Steel Tower Lines	2

As can be seen from the table, the warranty period for all but three equipment categories is less than half of the regulatory cycle (i.e. five years). As a result, defects that occur outside the warranty period and inside the regulatory cycle will be wholly borne by TransGrid.

Defects within and outside of the warranty period may arise from either manufacturing deficiencies or issues beyond the control of the supplier (e.g. design deficiencies). Given that the majority of equipment is not covered by a warranty for more than half of the regulatory period and all defects caused by anything other than manufacturing deficiencies will be wholly borne by TransGrid, it is considered prudent to allow for costs associated with the rectification of defects on new equipment during the regulatory period in which they are installed.

3.2.2 Warranty Coverage

SKM has reviewed TransGrid's conditions of contract as they pertain to warranties and defect liability periods.

The equipment supplier is not responsible for any defects or damage arising out of faulty materials, workmanship or design provided by the TransGrid or arising out of improper usage by TransGrid. In these cases, TransGrid would be responsible for the full cost of repair / replacement.

In cases where the defect is shown to be the supplier's responsibility, TransGrid requires the supplier to either repair or replace the damaged / defective equipment. Details as to the coverage and extent of the warranty are not explicitly referenced in documentation other than in the standard conditions of order or conditions of contract prepared by Supply Management.

In the event that goods are to be replaced, the supplier will replace the equipment at the delivery point. Subsequently, the costs associated with outages, dismantling, packing and transporting of the defective equipment to the delivery point is borne by TransGrid. This is the case for both replacements and equipment returned to a factory for repair. When equipment

can be repaired on site, the cost of arranging outages, supervision of the repair team, removal of equipment from its support structure, reinstallation and commissioning of the equipment is borne by TransGrid.

In the case of supply and install contracts, the contractor is required to rectify the defect on site and is responsible for all associated costs. However, costs to arrange outages, access, provide site supervision and re-commission the plant after the repair will be borne by TransGrid.

In summary, defects of any kind will result in costs incurred by TransGrid and these costs are not recoverable from the supplier despite the associated equipment warranty and defect liability period.

3.2.3 Non-recoverable Costs

As mentioned in 3.2.2 the manufacturer's warranty covers the direct cost of repair; that is the materials and labour required to carry out the rectification of the equipment. There are however, a number of associated costs incurred by the equipment owner that cannot be recovered through the warranty from the manufacturer.

SKM has investigated the typical costs associated with defect rectification on new assets. The costs can be divided into several discrete components as follows:

- Call-out and defect identification;
- Contingency measures to mitigate the loss (or potential loss) of supply, damage to other network elements and HSEC (Health Safety Environment and Community);
- Customer interruptions and impacts on service standards obligations;
- Liaison with the manufacturer to determine an effective solution the rectify defective equipment;
- Material to rectify the defective equipment;
- Labour associated with the rectification of the defective equipment;
- Labour associated with the support / supervision of the manufacturer while undertaking the corrective measures; and
- Network outage planning, management and switching associated with the rectification;

It is difficult to apportion a typical breakdown of costs to each of the components as defects by nature are non-typical and vary between different types of equipment. As discussed in section 3.2.2, TransGrid's equipment warranty coverage is only for rectification works associated with

the direct cost of material and labour and does not cover the accompanying costs associated with the defect.

Despite the difficulty in apportioning costs between the components, it is reasonable to assume that TransGrid will incur some costs as a result of defects on new assets. PB has made the observation in their review that "*... if the forecast growth related capital works programs are the same as those in the period up until the 2006/07 base year then the model outputs would be reasonable. However, the forecast growth-related capital works programs are significantly larger than those in place up until 2006/07 and we believe that this has an impact on the reasonableness of the opex forecasts the current model produces.*"

Assuming that TransGrid has historically made claims on the manufacturer for all defects within the warranty period, the defect ratios used in the opex model account for the cost to TransGrid of rectifying defects on new equipment (less than 5 years old) that fall inside and outside the warranty period. As mentioned in section 3.1, TransGrid's modelling has demonstrated that the average system age and average asset type age remains relatively uniform throughout the regulatory period. Using this as a basis for modelling defects (i.e. assets of varying age (new, mid-life and old) will have the same rate of defects now as they have had historically), the defect ratios used by TransGrid in the opex model could be considered representative of defect rates over the course of the next regulatory period for all ages of assets.

Consequently, SKM considers that TransGrid's methodology for modelling defect costs associated with new assets is appropriate as it takes into consideration historic defect rates and costs which are borne by TransGrid. Further, TransGrid's modelling shows that the significantly larger capital works progamme does not materially change the asset class age position on the failure rate over time/age graph (i.e. the rate of defects will remain constant).

3.3 Routine Operating Cost Variations with New Assets

As mentioned in section 2, PB has attempted to pre-empt an argument that assets may experience defects during the regulatory period in which they were commissioned by stating that:

"*Whist it may be argued that these new assets could produce some minor number of defects during the next regulatory period PB believes that the reduced routine maintenance resulting from the effects of new technology will offset these minor costs.*"

As mentioned above, for the purposes of modelling and in lieu of evidence to the contrary (i.e. whether technology will lead to an increase or reduction in defect rates), it is considered

appropriate to use the historic rate of new asset defects to forecast future defect rectification costs. Therefore, the statement that "*these new assets could produce some minor number of defects*" does not seem to recognise that the defect rate on new assets will approximate the historic rate, which is an intrinsic assumption in TransGrid's opex model.

TransGrid's opex model uses the average historical cost of routine maintenance for each asset class to forecast future routine maintenance costs. The accuracy of the forecast will be affected by the breakup of assets in each asset class. SKM considers that changes to the composition of asset classes as a result of TransGrid's capital augmentations (i.e. new assets to old assets) will not be materially affected over the course of a single regulatory period. As such, the methodology used by TransGrid is considered appropriate.

Additionally, SKM questions the methodology of using speculative assumptions of reductions in routine maintenance to offset the cost of rectifying defects across the asset base. PB provided an example of a reduction in routine maintenance on a new transmission line as one case where a saving in routine maintenance is achievable. While SKM would agree that over the life of a transmission line, a concrete pole line will be less costly to maintain than a wood pole line (due to the inspection requirements), SKM does not consider it appropriate to equate reductions in routine maintenance costs with increases in defect costs without appropriate consideration of all the factors involved. Moreover, SKM consider that while reductions in routine maintenance for new technology may be the case for transmission lines, other asset classes may experience an increase in routine maintenance requirements (e.g. secondary systems). It should be noted that TransGrid's opex model does account for reductions in routine maintenance as a result of replacing old assets with newer assets.

It is difficult to predict what impact the changes in technology will have over time on routine and defect maintenance as there is no evidence available at this time to suggest that the proposed benefits of the technology will be realised. SKM has found that technological advancements typically lead to increased defect rectification costs initially due to the complexity of the equipment and staff unfamiliarity.

In considering routine maintenance, routine overhaul maintenance is typically based on time in service and/or number of operations while inspection based routine maintenance is planned on recurring cycles. A prudent network operator would be ill-advised to adjust inspection and major maintenance periods outside manufacturer recommendations and / or good industry practice. SKM's previous work on the inputs to the opex model showed that TransGrid's routine maintenance levels were considered appropriate and in-line with industry practice. As such, efficiency savings in routine maintenance have been captured in the modelling.

4. Conclusions

Following the review of PB's draft report, TransGrid's response and TransGrid's opex modelling, SKM considers that TransGrid's opex forecast for defect rectification of new assets is representative of the cost that will be incurred during the regulatory period and an adjustment is not warranted. TransGrid's modelling is based on historic defect rates (which include defects on new asset) and the proposed capital investment programme does not materially alter the average age of any asset type. Consequently, the defect rate across the network could be expected to remain at the same level as that experienced historically.

TransGrid's warranty periods for equipment are on the whole less than half of the regulatory period. As a result, all defects (including manufacturing defects) within the regulatory period and outside the warranty will be borne by TransGrid. Additionally, the warranty (when it applies) only covers manufacturing defects. Defects caused by external influences are wholly borne by TransGrid. Even in the event that the defect is covered by the warranty, TransGrid incurs costs associated with returning the equipment to the manufacturer, supervising on-site repair, re-installation and commissioning. These costs cannot be recovered under the warranty.

TransGrid has taken into account routine maintenance efficiency savings due to improvements in technology where appropriate in the opex model for assets being replaced. SKM has reservations with respect to PB's methodology of using speculative assumptions of reductions in routine maintenance due to technology advancements to offset the cost of rectifying defects on new assets. SKM consider it inappropriate to argue that a cost offset exists without due consideration of all the factors involved as it may be the case that when all costs are considered, the actual cost of introducing new technology into the network may initially result in higher costs.

SKM considers on the whole that TransGrid has been prudent and efficient in modelling the costs associated with the rectification of defects on new assets.

Yours sincerely

[by email]

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