Submission to the Australian Energy Regulator on Powerlink Queensland's Revenue Application

from the University of Queensland

Introduction

The University of Queensland is pleased to provide this submission on the Revenue Application submitted by Powerlink Queensland for the period 2017 – 2022. The University is a significant user of electricity at its Saint Lucia and Gatton campuses in Queensland. We are also one of Australia's leading universities for teaching and researching the planning, development and operation of transmission networks, to achieve a reliable electricity supply to customers at the lowest cost, which aligns with the National Electricity Objective.

The University also has a growing reputation for the integration of renewable energy generation into power systems. This is a key issue for Australia's transition to much higher levels of renewable generation, firstly in achieving its 20% renewable energy target by 2020, and then achieving Australia's commitment to the Paris Accord of reducing greenhouse gas emissions by 25% - 28% by 2030. The Queensland Government has also adopted a 50% renewable energy target for Queensland by 2030. We note that the next Powerlink regulatory period extends beyond 2020, and ¼ way into the following 10 year period ending to 2030. It is understood that changes driven by Australia's legislated renewable energy targets must be considered by AER in determining Powerlink's revenue for the 2017 to 2022 period.

The main thrust of our submission is to comment on where our research and investigations indicate an apparent misalignment between the Powerlink Application and Australia's legally binding renewable generation commitments, whilst meeting the National Electricity Objective.

Our submission has been prepared by UQ Professor Simon Bartlett, the Australian Chair of Electricity Transmission who has 40 years power industry experience in Australia, Europe and Canada. It incorporates research findings of UQ's Power and Energy Systems group comprising 40 power system academics and researchers.

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1. New Renewable Energy Generation Capacity Needs For Queensland by 2030

UQ is developing an innovative long term power system planning tool that co-optimises the cost of building and operating new generation and transmission assets, including the costs and energy production of new renewable energy resources, limitations of the existing transmission grid and the costs of augmenting the network (if economically justified). UQ is collaborating with the Power industry in this project and has sought participation from AEMO, Powerlink, Transgrid and Electranet. Preliminary studies indicate that, as Australia moves to larger proportions of renewable generation, new renewable energy power generation should be located to:

(a) Roughly match the electricity needs of each state, due to the high cost of augmenting the interstate interconnections, an exception being a possible interconnection to facilitate geo-thermal developments in Central Australia should that technology become viable and economic.

(b) Utilise the existing transmission grid in each state, particularly in Queensland where there is a substantial grid running from North Queensland to South Queensland.

To date, residential solar PV has been the main renewable energy resource developed in Queensland with some 1500MW of rooftop PV already installed by householders at their own cost, mostly in south-east Queensland (SEQ). SEQ now has the highest penetration of residential PV in the world, due to high feed-in tariffs, non-reflective energy only tariff structures and other cross subsidies that have made it economic for households to invest in what, in reality, may not be in the long-term best interests of all consumers. Even so, residential PV currently accounts for less than 5% of Queensland's total electricity needs and is forecast by AEMO to reach around 11% by 2030.

For Queensland to achieve 50% renewable electricity generation by 2030, to satisfy Qld Govt's policy and the Paris Accord, Queensland will need to install about 10,000MW of new renewable generation (beyond the expected growth in new residential PV), depending on the mix of new solar, wind-power, hydro-electric and biomass generation.

2. Queensland's Renewable Energy Resources

UQ's research has identified that Queensland has a wide range of undeveloped renewable energy resources, with the best resources in terms of abundancy, lowest cost per $/mwh and close proximity to the grid being mostly located in North Queensland.

As illustrated in Figure 1, the highest solar energy intensity is in northern and western Queensland, and is closest to the grid in north Queensland from Mackay northwards.

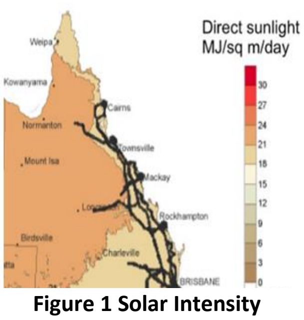

Figure 1 Solar Intensity

Figure 2 shows that Queensland's best wind-power resources are also located in North Queensland in the Cairns – Cooktown area and inland from Townsville. Wind-power is currently the lowest cost renewable

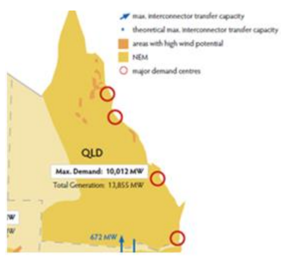

Figure 2 Wind-Power Resources

energy resource (in $/mwh) as evidenced by its predominance of wind-power developments in Australia, USA and Europe.

North Queensland also has some 1,700MW of undeveloped hydro-electric resources, including the 600MW Tully-Millstream, 450MW Herbert River, 450MW Burdekin Falls and the 200MW Barron-Mitchell schemes. Figure 3 shows that these potential new hydro-electric schemes are close to the existing Powerlink high voltage grid. Their future development would require a compromise between lower-cost renewable energy development, environmental impacts, community values and political commitments.

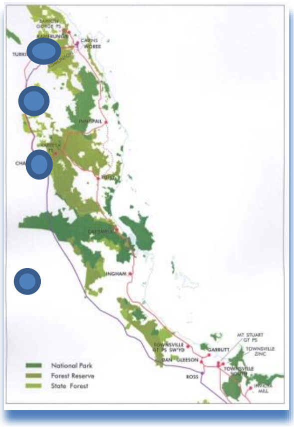

Figure 3 Undeveloped Hydro-electric Resources

As illustrated in Figure 4, North Queensland also hosts most of Australia's existing biomass renewable energy generation fuelled by sugar cane bagasse. The existing 26 sugar mills generate some 1,100 Gwh of renewable energy and are mostly connected to the North Queensland distribution and transmission network. Potential expansion has been estimated at another 250MW generating around 1,000 Gwh and also located in North Queensland.

Figure 4 Sugar Cane Bagasse Biomass Resources

UQ is aware that there are a number of proposals to develop large scale renewable energy power generation in North Queensland particularly in the Townsville and Cairns regions.

3. <u>Implications for Powerlink's Queensland's Transmission Network</u>

The Powerlink 275kV transmission grid in purple in Figure 5 runs from Cairns in Far North Queensland to the Gold Coast near the NSW border. It was driven by the development of the state's low cost coal resources in Central Queensland at the Gladstone, Callide B, Stanwell and Callide C power stations with a combined generating capacity of 4,600MW. The grid's existing limits are around 1,200MW between Central Queensland and North Queensland and 2,100MW between Central Queensland and South Queensland, which could be increased further by the installation of low cost series capacitors.

Figure 5 Powerlink Transmission Grid

The more recent development of 5,000 MW of new coal-fired and gas fired power stations along the Queensland – NSW Interconnection route in the Surat Basin (i.e. Tarong, Braemar1, Braemar 2, Darling Downs, Kogan Creek and Millmerran power stations) has significantly reduced the loading of the CQ – SQ transmission grid and there has also been a smaller reduction in power flows between CQ and NQ.

This is recognised in the Powerlink's Revenue Application, in the Asset Management Plan, Area Plan for CQ-SQ (reference 1) which is based on the flow duration curves in figure 6. In forecasting future CQ – SQ power flows, Powerlink Area Plan only considers the growth in the SQ Surat Basin LNG demand and makes no allowance for the effects of the inevitable shift to high levels of renewable generation in North Queensland in the next regulatory period and beyond. Hence Powerlink's revenue submission assumes that there is no need to maintain the existing capacity (and all existing lines) in their CQ – SQ network for the future needs and benefits of customers.

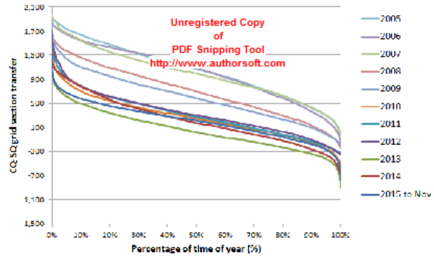

Figure 6 Flow Duration Curve CQ - SQ (Powerlink)

Powerlink's Area Plans for the CQ – SQ network as contained in their Revenue Application (reference 1) indicates that Powerlink rejected the base option of maintaining the current network topology and that the remaining two options significantly reduce the CQ – SQ transmission capacity from 2,100MW to either 1,200 MW (by 43%) or 1750MW (by 17%) by decommissioning two of the existing CQ – SQ transmission lines. Had Powerlink considered the impacts of the likely shift to renewable generation in their 20 year CQ – SQ Area Plan, they would have more rigorously investigated the base option and put a higher priority on retaining or ultimately increasing the existing transmission capacity of their NQ – CQ and CQ - SQ networks.

Preliminary analysis by UQ indicates that both the NQ – CQ and CQ – SQ grids are likely to be utilised to at least their current limits by 2030 and beyond in transmitting large amounts of renewable energy from North Queensland to Central Queensland and Southern Queensland where the bulk of electricity is consumed. UQ's preliminary analysis also identifies that the fossil fuelled power stations most likely to be "sidelined" earlier in the transition to higher renewables are mostly located in Southern Queensland due to the expected high prices and low availability of domestic gas, low efficiency of open cycle gas turbines, ageing plant and high coal costs at some power stations and contractual commitments that are likely to keep the Gladstone Power station operating beyond 2030. The Powerlink analysis, on the other hand assumes the existing mothballed unit at Tarong Power station is returned to service indefinitely, thereby reducing CQ – SQ power flows.

Given Government policy, legislative commitments and targets for 2020 and 2030, the expected transformation of the power flows across the Powerlink main grid are expected to commence during the next Powerlink regulatory period and be progressing towards the 2030 targets by the end of the following regulatory period.

4. <u>Misalignments of the Powerlink Revenue Application</u>

Powerlink is obligated by the National Electricity Rules and its transmission licence to comply with its reliability obligations and to minimise its capital and operating expenditures to deliver the lowest long-run costs of regulated transmission services to its customers in Queensland.

Given the current lower utilisation of the Powerlink main grid between North Queensland and South Queensland, Powerlink has adopted an innovative approach to minimise expenditures on these transmission assets during the next regulatory period 2017 – 2022 that goes beyond those of other TNSP's regulated by AER. Powerlink's Application includes a number of assumed network re-configurations and asset retirements, for assets identified as having no "enduring long term need". Whilst UQ endorses this innovative approach to many of the targeted assets, we have concern with applying this methodology to the NQ – CQ and CQ – SQ main grid assets, as this may not align with the longer term needs for those assets and the National Electricity Objective.

There is a particular concern for the aged 275kV transmission lines between NQ and SQ which are reaching the stage where rusting has already started on some towers and some refurbishment is needed in the next regulatory period to prevent further rusting and to reduce refurbishment costs in the following regulatory periods.

As detailed in Powerlink's CQ – SQ Area Plan in reference 1, detailed tower inspections indicate that:

(a) The Calliope to Gin-Gin and Woolooga to South Pine lines, commissioned in 1972 have sound foundations, conductors and towers, but have some grade 2 and 3 corrosion near Gladstone Power station and Boyne Smelter; and grade 2, 3 and 4 corrosion in the Obi-Obi Valley and Maleny Hinterland. The Area Plan states that both lines (spaning 300km and with 656 towers) will require re-investment in the next five years with the potential for targeted maintenance in the interim.
(b) The condition of the Calliope to Gin-Gin; Woolooga to Palmwoods, and Palmwoods to South Pine lines (spanning 320km and with 713 towers) commissioned by 1976 are tracking slightly behind the above lines and are consider to require re-investment and targeted maintenance in the next 10 years
(c) The two Gin-Gin to Woolooga lines (spanning 300km and with 719 towers) commissioned in 1972 and 1976 are in better condition and are expected to need similar attention in the next 10 to 20 years.

The CQ – SQ area plan concluded that option 2, "increased targeted maintenance" is the preferred short term solution but flagged an indicative time of 2021 -2024 for line rebuilds and refits. Option 2 provides for the demolition of all existing lines, replaced by a new double circuit line and a 17% lower CQ – SQ transmission limit.

The appendices to Powerlink's revenue application indicate that Powerlink has based its estimated OPEX and REPEX expenditures on an assumption "that there is no enduring need" for some of these assets, hence no allowance has been made for necessary expenditure during the next regulatory period to ensure these assets, critical to the longer term development of Queensland's best renewable energy resources, are refurbished as required to minimise the long term cost to customer. This is explained in the following quotation in the Powerlink Revenue application:

Powerlink's asset management planning process has identified a number of network assets that could be retired from service at their end-of-life and not replaced, while the required levels of supply reliability and network security continue to be met. The most significant assets identified for retirement are transmission lines assets. Powerlink has identified a total of 2,725 transmission structures that could be retired in the future without reinvestment. As Powerlink does not intend to spend any capital reinvesting in these identified assets, they have been removed from the asset age profile. The removal of these assets from the age profile ensures that the Repex Model cannot forecast any capital expenditure in relation to these assets. Importantly, it does not mean that all of these assets will be retired within the 2018-22 regulatory period, only that Powerlink does not anticipate the need to reinvest in these assets in the future.

Figure 7 demonstrates how tower degradation varies with age for different environmental conditions, and was developed by Transpower NZ (reference 2). In moderate conditions, similar to those of the coastal routes on the NQ – SQ transmission lines, this figure predicts that the protective galvanised tower coating would have completely eroded in 45 years, and that rusting of the underlying steel then commences. In severe environments, the TransPower model predicts that the rusting would be so advanced within 45 years that the tower must be completely replaced. The Powerlink condition reports indicate that a number of towers in the CQ – SQ network have already reached the stage that the protective galvanised coating has already been completed eroded and that rusting of the exposed steel has already reached class 2 to class 4 in areas in more severe environments.

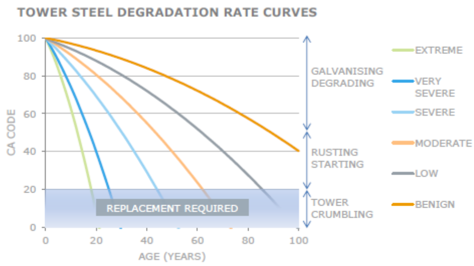

Figure 7 Tower degradation Curves with Age

Overseas practice is to paint towers before the protective galvanising coating has fully eroded and before serious rusting commences. This minimises necessary surface preparation and only requires a single coat of paint, hence refurbishment costs are minimised. Delaying painting until rusting is widespread requires abrasive blasting surface preparation and an additional zinc based primer coat, which can significantly increase tower refurbishment costs (reference 3). Delaying still further until the tower must be completely replaced increases costs still further. This is illustrated by the rapidly increasing tower refurbishment costs in Figure 8 estimated by Transpower NZ in reference 3.

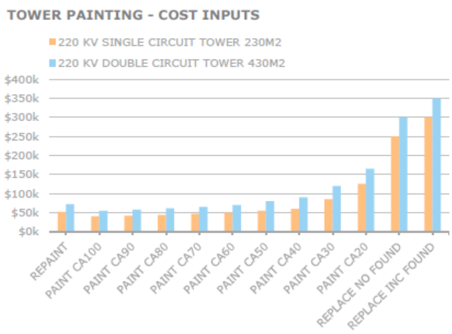

Figure 8 Rapidly Increasing Tower Refurbishment Costs when Tower Rusts

Powerlink's revenue application provides for a 19% reduction in replacement CAPEX and a 7% reduction in OPEX compared with the corresponding actual expenditures in the current regulatory period. This is despite the majority of assets having aged a further 5 years which places a greater proportion of assets reaching an aged condition requiring refurbishment or replacement. The AER's benchmarking and that undertaken by experienced consultants, not engaged by Powerlink (see Figure 9 and reference 4) indicate that Powerlink is already at the forefront for high efficiency of the maintenance of its transmission network. Powerlink's revenue submission incorporates a range of innovative cost reduction initiatives (such as condition based maintenance, remote asset monitoring, extending routine inspections well beyond conventional practice, maintenance outsourcing, eliminating field depots) and this latest initiative of excluding assets that have "no enduring need" is another demonstration of Powerlink's commitment to minimising network maintenance and capital expenditure in the coming regulatory period.

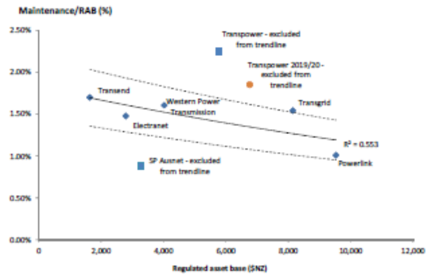

Figure 9 Benchmarking by PB for TransPower NZ

5. <u>Potential Implications for the Long Run Cost of Electricity Supply to Queensland Customers</u>

UQ is currently leading a collaborative university/industry research initiative that will investigate innovative and more cost effective technologies for monitoring and modelling the corrosion of transmission towers so that network companies across Australia can optimise their tower refurbishment and replacement programs. Based on the preliminary work undertaken to date, we are concerned that Powerlink's strategy of minimising OPEX and Capex expenditures on their NQ-SQ transmission lines during the next revenue period 2017 – 2022 may ultimately significantly increase refurbishment and REPEX costs in subsequent regulatory periods and imposed otherwise avoidable constraints on the economic development of Queensland's best renewable resources in Northern and Central Queensland. This could lead to higher long-term costs to customers.

6. <u>Recommendations to AER to Consider in Reviewing Powerlink's Application</u>

It is recommended that the AER give consideration to the following matters in their review of Powerlink Revenue Submission:

(a) Consider the expected development of lower cost, renewable energy resources in North Queensland and its implications to fully utilise and even drive augmentations (in subsequent regulatory periods) of Powerlink existing NQ to SQ backbone transmission grid.

(b) Suggest that Powerlink review, (at a later date), their Area Plans for the CQ – CQ and CQ – NQ networks to take into account the expected transition to higher levels of renewable generation in their 10 and 20 year planning horizons; the likelihood of a significant proportion of Queensland's renewable generation being located outside of Southern Queensland; the likely retirement of fossil fuelled generating plant in South Queensland, and the consequential impacts on the required power flow across the NQ – CQ and CQ – SQ networks.

(c) Recognise that the Powerlink forecasts of maintenance, refurbishment and REPEX costs may not have included sufficient allowance for their final strategy for the NQ – CQ – SQ networks which may require more short-term additional maintenance and limited refurbishment works on the most deteriorated transmission towers, to preserve the option of cost-effectively refurbishing all existing lines in these networks.

(d) Also recognise that the Powerlink estimates for network maintenance, operations, refurbishment and REPEX already incorporate significant efficiency-improvement initiatives to reduce costs and that further regulatory cuts on these items may ultimately increase long term costs to customers.

7. References

1. Powerlink Revenue Submission 2017 – 2022, Asset Management Plans, Area Plans, Section 7 CQ to SQ,
2. Towers and Poles Fleet Strategy, Transpower NZ, TPFL.01.01, 5th November 2013
3. T.E. Jacobs , T.W. Haberecht, “New Zealand Environmental Diversity and Power Lines, CIGRE,
4. Operating Expenditure Benchmarking – Final Report, Parsons Brinckerhoff, 25 October 2013