Expanding NSW - Qld Transmission Transfer Capacity

Submission in Response to Powerlink/TransGrid PSCR

21 February 2019

WalchaEnergy

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Executive Summary

A clear strategy for the development of transmission capacity between New South Wales and Queensland is required. There is an emerging need to strengthen inter-regional grid capacity to provide reliable supply in all Regions and increased competition in the National Electricity Market.

However it is submitted that uncertainties due to rapid transformation of energy sources create very serious risks to reliability of supply necessitating a strategy that mitigates the risks while maximising efficiency of the grid developments and the speed with which they can be delivered.

This submission proposes a “no-regrets” strategy that mitigates the risks by facilitating rapid large scale development of the critically needed renewable energy resources and storage capability of the New England REZ. The strategy also serves as the first stage of duplication of the NSW/QLD grid so that the Regions can back up each other’s generation when RE conditions are unfavourable in either Region.

The strategy proposed in this submission merits adoption as the preferred initial stages of Expansion of the NSW/QLD transfer capacity.

- Uprating and renewal of the existing grid between the Hunter Valley and Armidale, along with reactive plant augmentations to improve the capability of the existing NSW/QLD interconnection, must be the first priority.
- Grid augmentations to double the capacity of the grid between the New England area and the Hunter Valley are also urgently needed and should be commenced as quickly as possible to enable the rapid development of the New England REZ, for wind and solar generation and for PHES.
- The Uralla REZ hub to be established by WalchaEnergy will connect the existing grid and presents the opportunity to create a National Grid hub suitable for the development of the second major NSW/QLD interconnection.
- The uprating and renewal of the existing grid combined with the early development of the New England REZ will facilitate thousands of MW of wind and solar renewable energy to be connected, replacing Liddell Power Station, and will concurrently enable the development of high capacity PHES, all within 200km of the Hunter Valley power stations

It is also proposed that all means be pursued to accelerate the commencement and delivery of these early stages of NSW/QLD grid capacity expansion between the Hunter Valley and Armidale.

Expanding NSW Qld Transmission Transfer Capacity
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1 Nature of Submission

This submission is a response to the PSCR ***Expanding New South Wales Queensland Transmission Transfer Capacity*** *of November 2018. It is a submission by* WalchaEnergy Pty Ltd ACN 629 271 969 (Walcha Energy), a partnership between the principals of MirusWind Pty Ltd ACN 103 586 778 (MirusWind) and Energy Estate Pty Ltd ACN 628 279 905 (Energy Estate). This submission has been developed with the assistance of Aurecon Australasia Pty Ltd (Aurecon)

Walcha Energy is developing and financing renewable energy projects near the town of Walcha, approximately 55km south of Armidale on the New England Tableland in northern New South Wales (together referred to as the Walcha Energy Project). Walcha Energy proposes to connect the initial stages to the existing, 330kV grid south of Armidale at the Uralla Hub which will be established for this purpose.

The Walcha Project will be delivered in stages over a period from 2019 –2030 with the initial stages indicated below targeted to commence in 2019 and be completed in 2023.

Development of the initial stages of the Walcha Energy Project will involve:

- Wind Stage 1 - Winterbourne & Moona – 700MW
- Wind Stage 2 – West of Walcha – 700MW
- Solar Stage 1 Salisbury West – 350MW
- Solar Stage 2 Salisbury East – 350MW

The subsequent stages of wind generation to the south of Walcha and the proposed pumped hydro energy storage project will require major grid augmentation which can be entirely compatible and, it is submitted, is the most strategically desirable early stage of major grid augmentation in the enhancement of the Queensland/NSW interregional transfer capacity.

This submission addresses the stated goals of the proposed expansion of Queensland/NSW transmission capacity as outlined in the PSCR, addresses the assumptions and strategy of the proposal, and comments on the specific options set out in the PSCR. It is based on grid development planning principles, no regrets policies, and risk mitigation rather than simply looking for least cost options that deliver uncertain benefits.

This submission also incorporates documents outlining and supporting the strategy proposed by Walcha Energy for the development of the New England Renewable Energy Zone (REZ), a zone whose urgent development is very likely to be critical for the ongoing reliability of supply in New South Wales through the 2020s. These incorporated documents are parts of the submission. The overview documents included are:

1. Submission to NSW Government: ***The Uralla Renewable Energy Hub,*** MirusWind June 2018
2. Submission: ***NSW Transmission Infrastructure Strategy 2018 – Proposed Approach***, MirusWind/Energy Estate 26-9-18
3. ***WalchaEnergy - Developing the Uralla grid and renewable energy hub,*** Aurecon, December 2018

2 The Need to Augment the NSW-QLD Grid Transfer Capacity

The PSCR overview concisely summarised the expected benefits in the terms set out below.

Benefits of stronger interconnection

Overall potential benefits of stronger interconnection include:

An upgrade could open up further access to the NEM for existing and future renewable generation, helping to meet renewable energy targets more efficiently and support the transition to a lower carbon economy.

There may be benefits to system security, which could further enable renewable generation development in Queensland and NSW.

There is potential for reduced reliance on localised supplies for reserves, increased transfer capability between regions, and improved competition across regions.

An upgrade may provide greater capacity for both states to import power to help respond to unplanned network outages and other network events.

The authors of the PSCR make only qualified statements as to benefits:

An upgrade could …. There may be benefits …. There is potential for … An upgrade may ….

This uncertainty derives from a lack of clarity with regard to a strategy for management of the transition of NEM energy generation from fossil fuels to renewable sources. Yet there is certainty that the economics of energy will drive this transition and a strategy to manage the transition is sorely needed.

In the absence of a well-defined and realistic strategy from government, a realistic strategy is nonetheless needed, and it must take into account the known facts and economic trends that are driving inexorably to our renewable energy future. The economics, if not the politics, may drive the transition to almost 100% renewable energy by 2030. A strategy is needed that can respond to a much faster transition than that assumes in planning documents and must mitigate the risks associated with the transition.

It is submitted that there is no uncertainty as to benefits of the transition to renewables if a suitable strategy is followed. But there are risks of stranded assets, excessive prices, grid separation, inefficient development, and excessive losses, as well as the consequences of grid augmentations not being available when needed. A robust strategy for the Qld-NSW area, under consideration in this PSCR, is available, a strategy that is robust in respect of the specific grid augmentations and their contribution to a well-managed overall transition.

It is submitted that the appropriate strategy must:

1. Encourage the timely connection of new generation
2. Enhance competition
3. Give certainty to investors
4. Manage and enhance grid utilisation
5. Minimise grid losses and energy losses through curtailment.

Such a strategy for the NSW - Queensland inter-regional routes is discussed below.

3 A Strategy to Augment the Capacity of the NSW Queensland Interconnection

It is submitted that a strategy to achieve the objectives must:

6. Support the development of renewable energy zones and grid reinforcement that deliver high grid utilisation and low transmission losses wherever possible.
7. Prioritise initial phase grid augmentations that secure the connection of needed generation types and energy storage while also serve as stages in the development of interregional transmission augmentations.
8. Recognise the importance of large scale wind generation sites in delivering 24 x 7 power and of areas with strong potential for PHES.
9. Capture the synergy of wind and solar in areas with night-time wind, enabling grid connection utilisation as high as 50%, before further enhancement by energy storage.
10. Avoid poor grid utilisation by focusing on grid augmentations reaching out from the major load centres and from the well-connected retiring generation centres to the new REZ.
11. Where possible adopt diverse 330kV routes to improve the security of interconnections and, in the case of inter-regional connections, open up new renewable energy resources.
12. Schedule long inter-regional Qld-NSW capacity augmentation in the light of evolving connections within NSW and southern Qld (generation and storage), taking advantage of better knowledge of the evolving needs for backup reliability and system security.

To convert such generalisations into a plan requires an assessment to be made as to the extent of inter-regional connection required, the reliability enabled by strategic intra-regional development and the realistic timeframes required to deliver large scale pumped hydro energy storage *within each region*.

The Walcha plateau has a critical role to play in achieving a smooth transformation of NSW electricity generation due to its ideal mix of wind and solar resources and the 500m to 700m escarpments on the southern and eastern sides of the plateau offering ideal local locations for PHES. These features are ideal for the first stages of REZ development and expansion of the NSW-Qld power transfer capacity.

Walcha itself is only 170km from Liddell and Bayswater power stations with their strong grid connections. Development can begin by connecting 2,000MW of generation north of Walcha to the existing 330kV grid at the proposed Uralla hub at which connection can be made to both Tamworth-Armidale 330kV lines TL 85 and TL 86.

A further 2000MW can be connected by a new high capacity double circuit 330kV line (equal to QNI) to connecting the Uralla hub to Liddell and Bayswater Power Station switchyards and, with the benefits of diversity, there will be spare capacity to carry the output from more northerly Generators. This development will also facilitate the development of PHES at Dungowan Dam currently under study jointly by Walcha Energy and Tamworth City, and/or alternative PHES schemes. The PHES will also facilitate the connection of more renewable energy generation to the existing lines, increasing the utilisation of the grid and the efficiency of the grid investments.

It is important to recognise that studies of the benefits of colocation of wind and solar, carried out by Aurecon for MirusWind, have shown that on the Walcha Plateau the connection of up to 50% more nameplate generation than the grid entry capacity results in only around 3% energy curtailment before considering the further benefits of storage. This is illustrated in attached study results for 1600MW of hybrid generation connecting via a grid entry capacity of 1000MW: whether it be 1000MW of wind and 600MW of solar, 800MW of each or 1000 MW of solar and 600MW of wind.

4 Mitigation of Risks

Key risks at the present stage of transformation of the NEM include:

- Time to build transmission for when it will be needed.
- Connection of large amounts of solar energy without commensurate storage.
- Early closure of fossil fuel plants unable to compete economically with renewables.
- Early closure of coal plants unable to ramp output sufficiently to accommodate the duck curve effect due to increasing daytime rooftop solar PV generation.
- Unscheduled outages of large fossil fuel generators overstressed by high ambient temperatures and highly variable daily load cycles.

To address these very significant risks, three key strategies are required:

- Early commitment to new NSW/QLD infrastructure
- Maximise the early connections of wind energy.
- Support the connection of large scale storage, located together with renewable energy generation wherever possible.
- Ensure sufficient inter-regional and intra-regional connection capacity is provided in a timely manner.

Given that these major risks could impact on reliability of supply very soon, it is most important to ensure that grid augmentations between NSW and Queensland facilitate the early connection of new major wind energy sources, in particular those of the Walcha plateau where there is a huge area with excellent wind resource on lands that are substantially cleared and compatible with the pastoral activities of the land owners. The efficiency of the necessary grid augmentations is further enhanced by the availability of the solar resource on cleared gently undulating lands.

Pursuit of the above strategy can be expected to mitigate the risks without putting upward pressure on electricity prices.

5 The Uralla Hub

The site for the Uralla hub suits its prospective role as a major grid hub as much as its immediate role as a connection point for the Walcha plateau portion of the New England REZ. The Uralla hub would be developed as a breaker-and-a-half switchyard overcoming the inadequacy of Armidale Substation’s single busbar configuration to serve as a grid hub.

The AEMO ISP considers duplication of the Queensland – New South Wales Interconnection (QNI) as a parallel duplication of the existing Armidale – Dumaresq – Bulli Creek double circuit line.
As Armidale Substation with a single busbar cannot handle the additional connections reliably, it is assumed that an Armidale East breaker-and-a-half switchyard would be developed adjacent to Armidale substation.

From an engineering perspective this is fine, but it will not be deliverable in practice.

The Armidale Substation locality is now surrounded by small rural residential holdings and it will prove impractical to gain a social licence for such a development and for the additional transmission line routes required.

The TransGrid experience in establishing the present QNI was that it was judged to be an unsuitable route notwithstanding that TransGrid went the extra mile in every way to mitigate impacts.

A route further to the west is the only viable way to duplicate QNI. “QNI 2” needs to be routed via the Inverell area and avoid the sensitive vegetation and threatened species on the Northern Tablelands as well as the impacts on residents and resumptions that would be required to construct parallel to QNI.

However a route for QNI2 can be successfully developed if the northern section the route avoids the Armidale area altogether and adopts the proposed Uralla Hub as its staging point.

The development of the Uralla Hub on a 100 hectare site is now being initiated by the Walcha Energy Project with a view to connect up to 2,100MW (nameplate) of solar and wind in 4 tranches as illustrated in Figure 1. Walcha Energy would be happy to design their work to accommodate incorporation into the larger hub concept illustrated in Figure 2.

The Uralla Hub can be developed as the Grid Hub for northern NSW as outlined in included Reference 1 and Figure 2 below included in the project’s recent update to TransGrid.

This would include not only turning in TLs 85 and 86 but also reconstructing the Uralla – Armidale sections of TLs 85 and 86 as double circuits, on the existing easements, so as to bring QNI to the more suitable hub, bypassing Armidale while retaining the circuits to Armidale.

Construction of a new double circuit 330kV line from Uralla to the Hunter Valley on a diverse route from the existing lines can take advantage of 330kV line sections established to bring 2 x 700MW of wind energy from the Walcha plateau to the hub. These single circuit lines could be rated to match QNI and would be extended for the triple purposes of creating the southern portion of QNI 2 (Hunter Valley to Uralla), connect the excellent wind resource south of Walcha, and connect the 1,000MW PHES development proposed for the southern escarpment of the plateau at Dungowan.

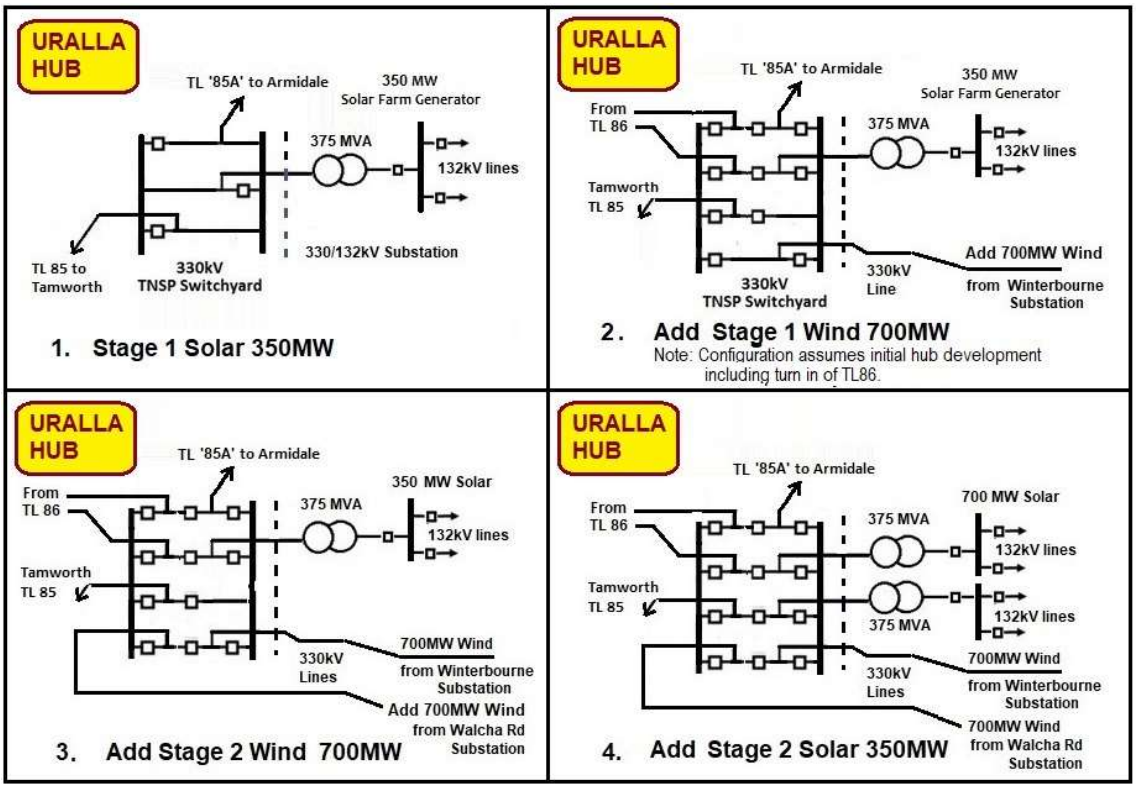

Figure 1 Uralla hub development required for Walcha Energy Project

Uralla can then be connected to Queensland via a diverse route capturing the development of new RE resources and securing the duplication of QNI.

Four 330kV circuits between the Hunter Valley and Queensland, meeting at the Uralla Hub can deliver N-1 secure capacity of equal to that of a double circuit 500kV line, but at a lower cost and facilitating easier new generation connections. Naturally appropriate reactive compensation must be included in the development. The Uralla Hub would be a suitable location for one of the new SVCs to be placed on a greenfield site rather than disrupting Tamworth.

This is a no regrets approach as the lines would achieve multiple purposes, being essential for the critically important renewable energy connections while also delivering the backup of inter-regional power flow.

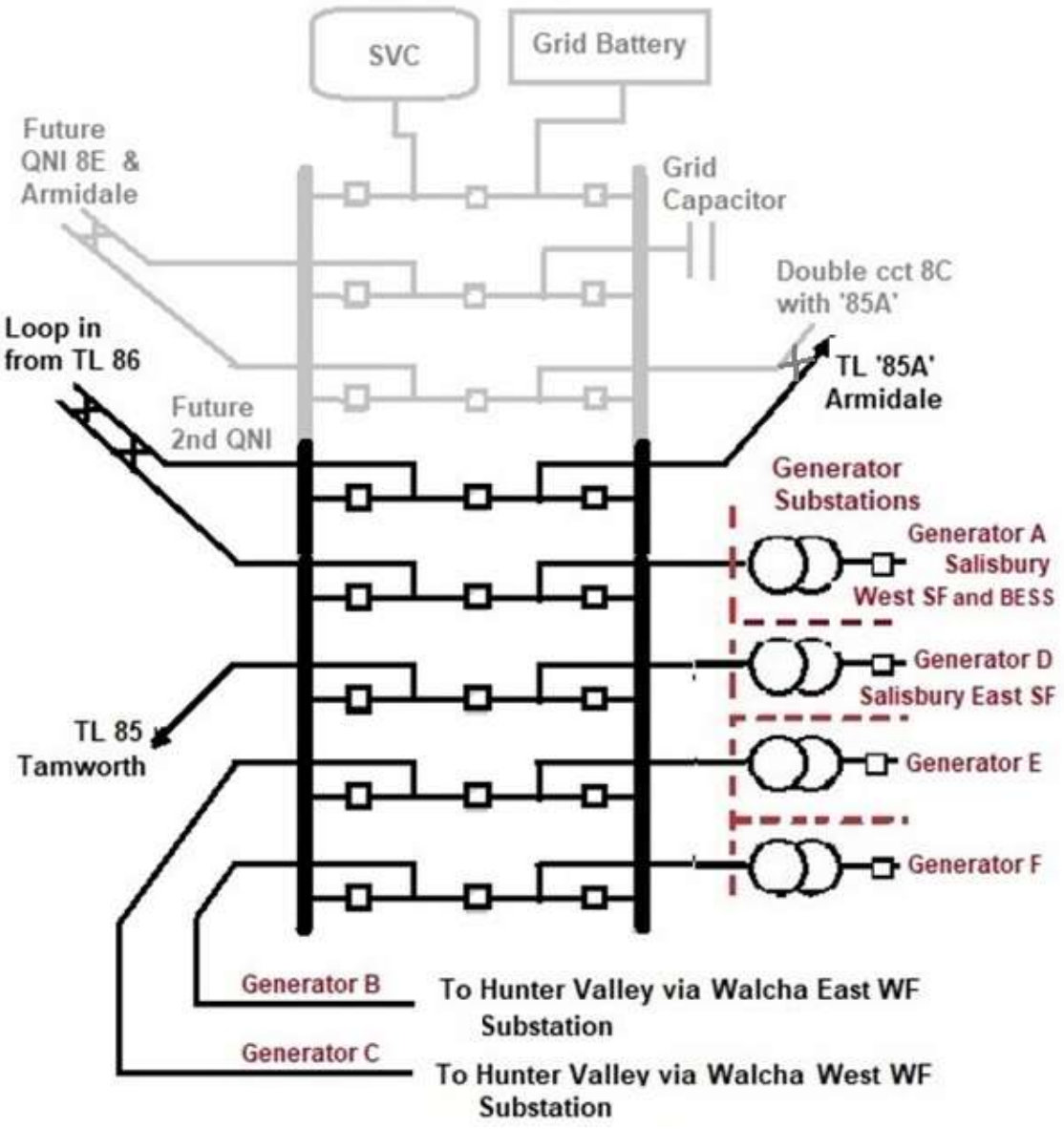

Figure 2 **Uralla hub development as grid and REZ hub including selected RIT-T options**

6 The Action Plan

The above plan can be translated into a step by step plan as follows and illustrated in Figure 3. It should be noted that Figure 3 is not to scale. TL 86 is only 10km from TL 85 at the Uralla Hub.

1. Uprate all the steel tower lines between Liddell and Armidale to 120°C, that is lines 83, 84, 85, 88. Target 2020
2. Reconstruct degraded timber pole line, TL 86, using concrete poles and designed to match the 120°C capacity of the steel tower lines uprated in 1. Target mid 2021
3. Establish the Uralla Grid and REZ hub with its layout planned to facilitate its maximum development, initially connecting TL 85, and reconstruct TL 85 between Uralla Hub and Armidale as a double circuit steel tower line. Target Q3 2021

   Turn TL 86 into the Uralla hub and reconstruct the section between Uralla hub and Armidale as a double circuit or twin circuit concrete pole line. Install the requisite reactive plant at the hub, including SVC if considered appropriate by system planners. Target Q2 2022
4. Expand the hub to receive 330kV connections from Walcha Energy Project wind stages 1 and 2. Targets Q3 2022 and Q1 2023
5. Construct a largely double circuit high capacity 330kV transmission line from the Uralla hub to the Hunter Valley making use of 330kV infrastructure developed for renewable energy connections on the Walcha Plateau. Preliminary target Q1 2024
6. Construct a high capacity double circuit 330kV transmission line from Queensland to Uralla, to complete a second QNI on a diverse route passing through the Inverell area.

Notes to the Action Plan items:

1. The uprating of the existing lines needs to commence very quickly and be completed within 2 years. The work needs to include all the steel tower circuits between Liddell, Muswellbrook, Tamworth and Armidale but in case of TL 85 only as far as the Uralla hub site considering item 3. Uprating of TL 85 was omitted in the ISP, presumably because it was thought that this item would be included in TransGrid's current regulated works plan.
2. TransGrid has reported the need for this line to be reconstructed in several past TAPRs. It was expected to be included in the current works approved under the Regulatory Reset but was excluded due to the sensible proposal to concurrently uprate it at a very small additional cost.
3. The development of the Uralla hub is likely to be commenced by the Walcha Energy Project as a private development to connect generation, however it makes sense to adopt the site for Grid Hub purposes. It is proposed that the development be purchased by TransGrid as part of a regulated development under the RIT-T or with funding from the NSW Transmission Infrastructure Plan, the NSW Government Emerging Energy Program, or the ESB's ISP Action Plan recommendations, No.11 for a Transmission Fund. Generators would be required to contribute appropriate funds to cover their connections.
4. As for the hub itself, the cost of turning in TL 86 to the hub may be borne by others initially but could be taken over as part of the hub and grid development.
5. Expansion to connect Generators would need to be funded by the Generators.
6. Uralla to Hunter Valley Connection: Although Liddell Power Station switchyard and incoming double circuit line sections can readily connect several additional circuits, the connection from Liddell to Bayswater and thence the 500kV network is relatively weak. It is recommended to consider terminating one circuit from Uralla at Liddell and one at Bayswater Power Station

switchyard where there are suitable vacant 330kV switchbays. If this line were initially developed in part to serve as Generator connections on the Walcha plateau, then similar funding arrangements to those in 3 and 4 above could apply.

7. Walcha Energy has no comment of the Queensland terminal point for a Queensland – Uralla 330kV double circuit line. The optimal performance needs to be determined in grid studies. The route should be diversified from the existing QNI, passing near Inverell. Consideration will need to be given as to whether to connect it to Dumaresq.

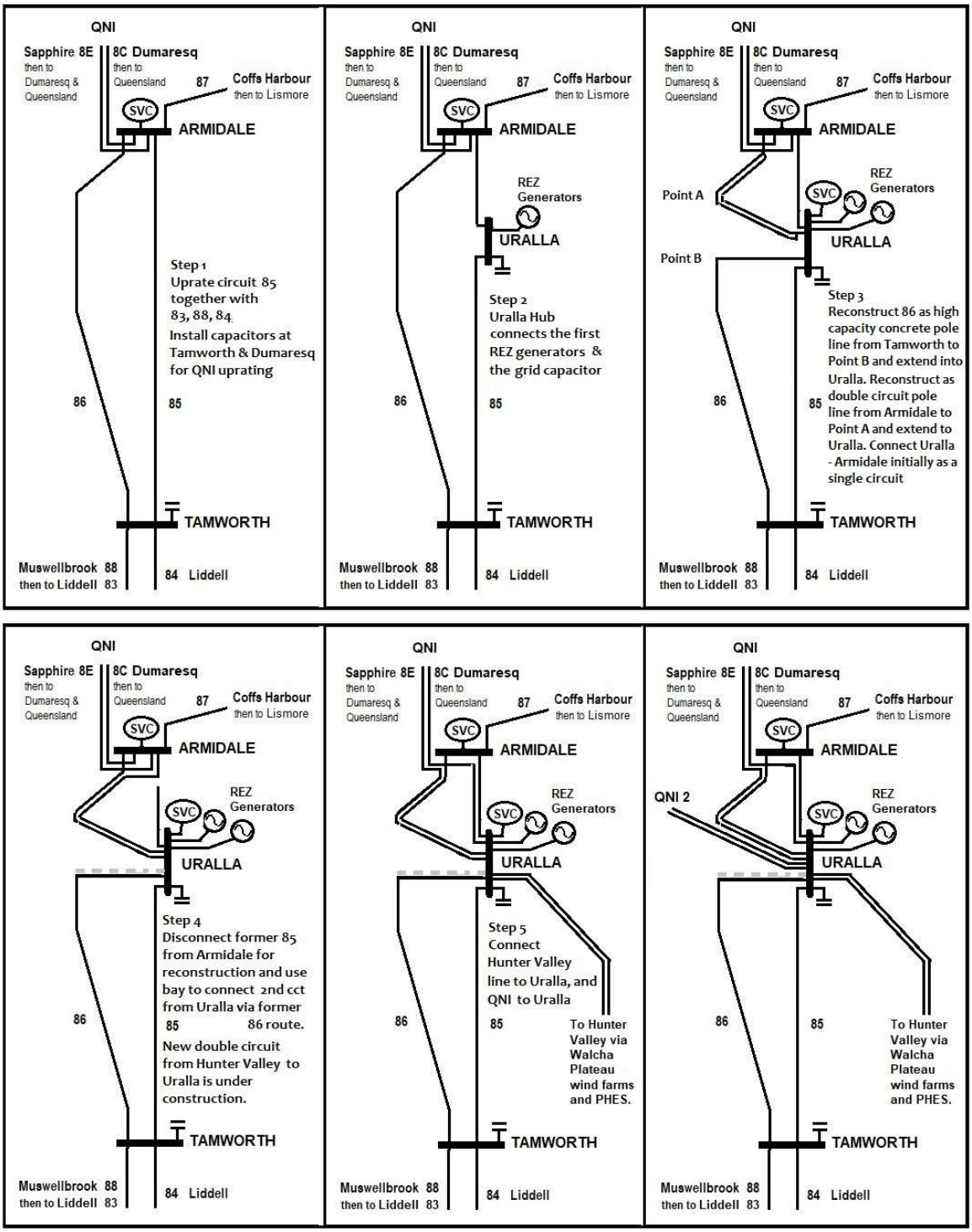

Figure 3 Tamworth – Armidale grid development in 6 steps

7 Comments on the PSCR Options

7.1 Options 1A, 1B, 1C and 1D

Option 1A Uprating of existing lines and addition of reactive plant

In broad terms this option must be supported as the proposed works are urgently needed. However TL 85 Tamworth – Armidale must be included and the replacement of TL 86 with a new concrete pole line is also necessary as part of the same group of works. The cost estimate may be low.

Option 1B Uprate Liddell – Tamworth lines only

This option is not adequate even as a first step. These works are necessary but the larger package of works is essential. The cost estimate may be low as it is not desirable only to convert insulator string arrangements. Some towers are likely to need extension panels.

Option 1C Dynamic and static reactive plant

This option is not adequate even as a first step. These works are necessary but the larger package of works is essential.

Option 1D Sapphire cut in to 2nd circuit and switching station in Queensland

Cut in of Sapphire to circuit 8C is essential. Can it be done as a low cost item not requiring RIT-T approval? This small project will mitigate losses and should proceed. No comment on the switching station between Dumaresq and Bulli Creek.

7.2 Option 2

This option provides for a single circuit 330kV line to be constructed between Braemar and Liddell.

If this option is conceived as a means to export excessive Queensland solar energy generation to NSW, it is a solution that brings with it substantial electrical losses.

This option is opposed as it fails to assist the development of large renewable sources within NSW, especially those of the New England REZ, to replace the retiring Liddell Power Station. Also this option would consume a potential route that should be developed to a higher transfer capability.

7.3 Options 3A, 3B and 3C

Option 3A 330kV double circuit between Bulli Creek and Armidale

This option is not considered to be practicable in terms of environmental impacts and social licence as the ISP description is for a replication of QNI on the same route in close parallel adjacent to the existing QNI. This would have unacceptable impacts.

A double circuit line between Bulli Creek and the New England area on a widely separated route would be acceptable as part of a broader strategy and this is addressed below in option 3B. However it is considered undesirable to develop such a connection to supply northern NSW when northern NSW has ample capacity to generate its own electric energy needs locally by means that utilise the synergy of wind and solar energy sources and are readily supported by local large scale PHES.

Developing such a connection is not a sound strategy as it does not effectively join the load centres and delivers its energy less reliably over a very long distance.

Option 3B 330kV double circuit line between Braemar and Liddell via Uralla

This option is strongly supported as an appropriate option in combination with the expanded Option 1A discussed above, provided that the timing is appropriate to the strategic needs of this time. The Uralla -Hunter Valley portion must be constructed first, and the timing of the Braemar – Uralla section decided in terms of the need and benefits assessed on that basis.

Walcha Energy's extensive comments on this option are provided in sections 3 to 6 above.

Option 3C 330kV between Braemar and Uralla plus a 500kV triangle between Uralla, Wollar and Bayswater

This option has much to commend it in a scenario of a growing electrical load which might develop, for example through rapid take up of electric vehicles and where multiple PHES sites are developed around the Walcha Plateau. It is considered that this option suits NSW transmission Infrastructure quite well and would help to reduce losses in transmission between Sapphire for example and Sydney.

On the other hand this option would increase connection costs within the New England REZ, in particular the cost of connecting the wind resources to the south of Walcha.

It is considered that Option 3B is to be preferred at this time as it is more suitable in terms of recognized present needs and has low risk of premature investment compared with Option 3C which can be further considered at a later stage of grid development. It is considered that the 330kV connection is a superior option at present

7.4 Options 4A, 4B and 4C

Option 4A HVDC back to back

This option has the benefit of controllability and can assist the management of stability system but only modestly enhances grid capability.

Option 4B HVDC between Mudgeeraba and Lismore

This option could be a reasonable no regrets alternative to Braemar – Uralla in Option 3B. It has the advantage of increasing the utilisation of the existing Armidale - Lismore 330kV line but it will not open up substantial new areas of renewable energy resource.

Option 4C HVDC between Western Downs and Bayswater

This option may prove to be very attractive post 2030 when the transition of the NEM to renewables is well advanced as it will make a major contribution to reliability as large scale weather systems move across the regions. It would be premature to make this connection at the present time.

7.5 Option 5

This option provides for a large battery energy storage system. It is a suitable measure that can be delivered in a relatively short time to relieve reliability threats if fossil fuel generators retire or fail in an irremediable manner during the transition.

8 Summary of Conclusions and Recommendations

1. The wind generation potential of Northern NSW with capacity factors of around 40% is an extremely valuable resource that should be developed quickly to strengthen 24 x 7 generation pending the development of large scale pumped hydro energy storage and protecting against early retirement or failure of major coal fired generation in New South Wales.

2. The combination of wind, solar and pumped storage development on the Walcha plateau of the New England REZ represents a strategic opportunity to mitigate emergent risks to electricity supply within New South Wales.

3. Development of the generation capacity of the Walcha plateau and associated intra-regional grid development must precede, not follow, inter-regional grid reinforcement, otherwise the upgrading of existing grid components will become impossible due to impacts on generation.

4. The omission in the ISP of upgrading the 330kV lines between Tamworth and Armidale must be corrected and included in Group 1 projects.

5. Initial stages of development of the Uralla hub are expected to proceed as a private development funded by Generators, however the strategic nature of the development requires that it be incorporated into National Grid development. Mechanisms to achieve this need to be developed.

6. It is not appropriate to depend on supply from Queensland ahead of facilitating new generation seeking to connect within 200km of the Hunter Valley. Inter-regional supply capacity should be progressively enhanced to the extent required to maintain supply reliability considering climatic variation of renewable energy resource availability.

7. The opportunity to advance a first stage, of inter-regional reinforcement, between the Hunter Valley and Uralla, through the uprating and expansion of the grid between Armidale and the Hunter Valley to serve New England REZ development should be taken into account in prioritising grid reinforcement and capacity expansion.

8. If the RIT-T cannot deliver the above in a timely manner, it is critical that it be addressed as a top priority component of the NSW Government's Transmission Infrastructure Plan or other programs and/or via the ESB's action plan recommendations.

9. It is recommended that an accelerated RIT-T process be sought for this NSW/QLD RIT-T in the same manner as the ESB has recently requested for the SA/NSW RIT-T process.

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