S&C ELECTRIC COMPANY
Excellence Through Innovation

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Therese Grace
Australian Energy Markets Commission
201 Elizabeth Street
Sydney
New South Wales 2000

Our Ref: JC 2017-014 16 May 2017

Dear Therese,

S&C Electric Company response to Stage 1 Report on Drivers of Change that Impact Transmission Frameworks (EPR0052)

S&C Electric Company welcomes the opportunity to provide a response to the Stage 1 Report on Drivers of Change that Impact Transmission Frameworks, which seeks to assess whether there has been a significant change in the drivers that impact on transmission network investment plans and whether changes are needed to ensure that transmission networks are fit for purpose in light of policy and low carbon incentives.

S&C Electric Company has been supporting the operation of electricity utilities in Australia for over 60 years, while S&C Electric Company in the USA has been supporting the delivery of secure electricity systems for over 100 years. S&C Electric Company not only supports "wires and poles" activities but has delivered over 8 GW wind and over 1 GW of solar globally. S&C Electric Company has been actively engaged in deploying Battery Energy Storage Systems for over 10 years, supporting a full range of business models and using a range of battery technologies, at the kW and MW scale, and currently has 76 MW/189 MWh in operation. In Australia, S&C projects include the Ergon Grid Utility Support System in Queensland, which reduces peak loads and provides voltage support on rural Single Wire Earth Return lines and the 2 MW battery for PowerCor in Victoria.

S&C Electric are particularly interested in facilitating the development of markets and standards that deliver secure, low carbon and low cost networks and would be very happy to provide further support to the Australian Market Energy Commission on the treatment and potential of these technologies.

Yours Sincerely

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Introduction:

Clearly, the environment in which the transmission networks operate has changed significantly and an assessment of how the increasing connection of low carbon generation, at both the transmission and distribution level, has impacted on operation and investment approaches is needed. The loss of large-scale thermal generation also impacts on the operation of the transmission system and new requirements for managing falling inertia are likely to be in place by end of 2017. This will be a new responsibility for transmission networks and it is critical that planning and investment support those requirements.

It is not immediately obvious whether regulatory test and incentive regime are fit-for-purpose to ensure connections are available to new generators. Often the risk of creating a stranded asset (network) delays reinforcement or new network, so delaying connection of assets that would enhance or support the wider system. A constraint will provide a locational signal that may see new investment by a generator connect elsewhere, on an unconstrained or less constrained part of the network. This unintentional locational signal, may reduce the short-cost to consumer, but may not deliver long-term electricity system or emissions outcomes.

Transmission and Distribution Coordination and Cooperation

While a great deal of the report focuses on the need to better coordinate the interactions and planning of generators and Transmission Network System Providers (TNSPs), there is a surprising lack of focus on developing better coordination and cooperation between the Distribution Network System Providers (DNSPs) and TNSPs.

Significant changes in operation and connections are occurring on the distribution network and this has an impact on the TNSPs. In many other international jurisdictions assets, such as electricity storage, are connecting to the distribution network to deliver services required by the TNSPs. The Enhanced Frequency Response tender for the GB system, procured by National Grid, is a case in point, with all 201 MW of the procured service connecting at the distribution level. The GB TNSP did not consult with the GB DNSPs before going to the market for this new service and this resulted in (a) a significant surge in connection requests to the DNSPs of 20 GW of storage seeking to connect for 200 MW of available contract and (b) the service specification required a fully unconstrained distribution network connection. Additionally, no consideration was given by the TNSP to how delivery of a sub-second export/demand of a maximum of 50 MW would have on the operation of the wider distribution network (e.g power quality) to ensure the response was delivered to the transmission network.

Since it is envisaged that distribution connected assets will provide system services at both the distribution and transmission level, some level of coordination between the two levels of network is needed. Indeed, “sharing” assets may be a critical way to deliver system security and services at lowest cost to the end consumer, but without established methods and standards for the shared use (e.g. who has priority and who has visibility of an asset/service) the ability to use assets connected to the distribution network efficiently for whole-system benefit, will not be realised.

It is no longer possible to treat transmission and distribution as distinct and mutually exclusive activities and AEMC needs to facilitate better planning, management and cooperation between the two levels.

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The UK Energy Networks Association has been leading a "Shared Services" programme since 2014 and in late 2015 formed the Transmission-Distribution Interface Working Group (http://www.energynetworks.org/electricity/futures/tso-dso-project/overview/) and a new Advisory Group of stakeholders and industry participants met in April 2016 (http://www.energynetworks.org/electricity/futures/tso-dso-project/tso-dso-project-stakeholder-engagement.html) to help ensure that investment and price-control plans benefit from whole-system coordination, as well as develop approaches for the transition from Distribution Network Operators (no energy or service procurement function) to Distribution System Operators (a role in balancing their networks, through the procurement of services and the deployment of assets).

There is also the possibility that DNSPs will be able to provide services, using DNSP-owned assets, to the TNSP. This poses a number of regulatory issues that will largely be around allowable income and monopoly operation, but also cover network delivery standards. It is likely that allowing DNSPs to provide services to TNSPs will reduce costs for the end consumer.

The UK Power Network (UKPN) owned and operated 6 MW battery, was installed to avoid reinforcing the network to meet increased winter peak load on less than ten nights. UKPN operated the battery to meet the primary security of supply requirement and outside those times, the battery was released to other parties to generate income that covered the cost of the asset. The operation of the asset would have been less complicated and expensive, if UKPN had been allowed under regulations to sell services to the Transmission System Operator (TSO), however a complex process of management was used to remain within regulatory requirements.

Electricity North-West used voltage control to deliver extremely fast frequency response to the TSO. This was allowable as it was under an innovation project, but the Customer Load Active System Services (CLASS: http://www.enwl.co.uk/class) approach is not currently possible as business as usual in the GB system due to the regulatory bar on DNOs selling services directly to the TSO and supply quality standard requirements (which sets a delivery voltage standard).

In the future, the interaction and coordination of the transmission and distribution networks has the potential to deliver whole-system benefits and do so at lower cost to end consumers.

Response

Impact of Drivers

1. **Government Policies and International Agreements**

   The NEO/NEL make no reference to mitigating climate change, yet Government policy, at both Federal and State level, and international agreements have a critical impact on the operation of the NEM and networks, transmission and distribution.

   The interaction of Federal and State policies has an impact on the operation of the NEM. The most significant system incident in recent times was the result of State policy decisions to ensure South Australia had the lowest carbon electricity supply in Australia. While policy approaches are not within the remit of AEMC, it seems critical that State policy decisions that could have a

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detrimental impact on the operation of the NEM, as a whole or at a Stage/region level, should be scrutinised by AEMC for their potential impact on the NEM and end-consumers across wider Australia. It will not be possible to deliver a low carbon, secure and reliable electricity system at lowest cost, if there is complete freedom and independence for the States when it comes to delivering electricity.

Obviously, the current Federal position on mitigating climate change is more likely to drive independent action by States, but that action should not be at the expense of long-term aspirations for the system or minimising the cost to end consumers. The Finkel Review *may* result in an over-arching plan for the future system and mitigating climate change, but the timing of the development of any plan, is likely to be distant.

Current Federal policy may not deliver international climate change commitments in the near-term and any delay in commencing mitigation in the electricity sector in a Federally-coordinated manner may mean making significant and very rapid changes as Australia tries to deliver targets in a reduced timeframe as 2030 approaches. AEMC should assess the impact of delays followed by rapid acceleration in decarbonisation on transmission system development and investment.

Care is needed with market interventions, either nationally or at the State level (e.g. South Australia's Energy Security Target). The UK Capacity Market was designed to deliver large gas generation (closed-cycle gas turbines, CCGTs) following the early closure of coal plant as a result of EU particulate emission reduction requirements (and the fact that coal remained significantly cheaper than gas, so reaching allowable maximum runtime early). However, the low auction clearing price has consistently presented a challenge to new CCGTs, with the single successful CCGT in the first auction failing to secure investment. Instead the Capacity Market incentivised small-scale diesel generators, which new rules have sought to limit, demonstrating that the design of any market approach needs care and a clear understanding of intended and unintended consequences.

The total solar energy resource in Australia is approximately 10,000 times greater than total demand (http://www.ga.gov.au/scientific-topics/energy/resources/other-renewable-energy-resources/solar-energy) and this excludes other renewable generation resources, such as wind and tidal. If Australia is going to meet its international commitments, then these resources will need to be fully utilised and networks, transmission and distribution, need to be enabled to deliver access to those resources. Currently that access is fragile, fractured and thin and building new networks is hampered by complex investment and assessment processes. A better balance between minimising cost to the end consumer, yet still facilitating timely and widespread connection of generation is needed.

The complete absence of a "Plan" (e.g. Finkel Review) complicates Australia's transition to a secure, low carbon and lowest cost electricity system. Without a plan we may end up with a low carbon and secure system, but it will not be at lowest cost, since efficiencies come from sharing and coordinating the deployment of new assets, be they wires or new technology such as electricity storage. This also applies to efficient management of the development of the physical

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system, which has to deliver the financial system and signals. Understanding that the market may not always send the correct signal and that other approaches (e.g. network planning and innovation incentives) may be needed.

2. Technological Developments

Likely technology developments that will have an impact on the transmission network include:

Microgrids, either as intentional islands, such as stand-alone power systems or the ability to island to provide resiliency, such as in load-shedding are likely to occur first on the distribution system, but will impact on the operation of the transmission network, since they contain generation, storage and possibly stand-by diesel generators.

Microgrids are also being developed internationally as a “premium power” product, to promote business development and jobs by “guaranteeing” security and quality of supply, but may also be used by communities to support their own resilience or drive business opportunities. This will impact on transmission network operation.

Some DNSPs are actively deploying microgrids in remote areas as a “stand-alone” power system to reduce the costs of maintaining overhead lines. This removal of load at a community-scale, either by a DNSP as a reasonable response to network incentives or through community-led initiatives, will impact on the demand a TNSP observes.

Batteries at all scales, but particularly at the utility-scale on the distribution network, will largely have a role in supporting the wider-system, through the delivery of services.

Batteries at the domestic-scale are likely to increase the complexity and cost of managing the system, since they are deployed to benefit the householder (owner) and not the wider-system.

Smaller gas engines may be more attractive economically (to invest in) than larger-scale CCGTs and may deploy on the distribution network, but could have a valuable role providing flexibility.

Again, many of these new technologies will connect on the distribution network, rather than the transmission network and so coordination and cooperation between the TNSPs and DNSPs is essential to deliver whole-system benefits.

3. Establishment and Penetration of New Business Models

New technologies and the rate of uptake and degree of penetration is just as critical as potential new business models.

Australia has not yet fully embraced electric vehicles, but perhaps hydrogen-fueled vehicles will have more appeal, as they do not require such a significant change in user behaviour between the traditional vehicle and low carbon option and, once filling infrastructure is established, have a range analogous to fossil fueled vehicles. However, trying to pick a technology “winner” is just as difficult as picking the likely successful new business models.

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Regulation will constrain the development of some business models, for example some opportunities may sit in the supplier value chain, but this may be hard for non-suppliers, such as innovative aggregators, to access that value.

Tariff innovation e.g. electricity as a service ("comfort") or tariffs modelled on telecommunication "capacity" (block tariffs) are highly likely and consumer protection should be a significant requirement.

Additionally, new business models and businesses will fail, including potentially suppliers, so adequate measures to manage displaced consumers is required.

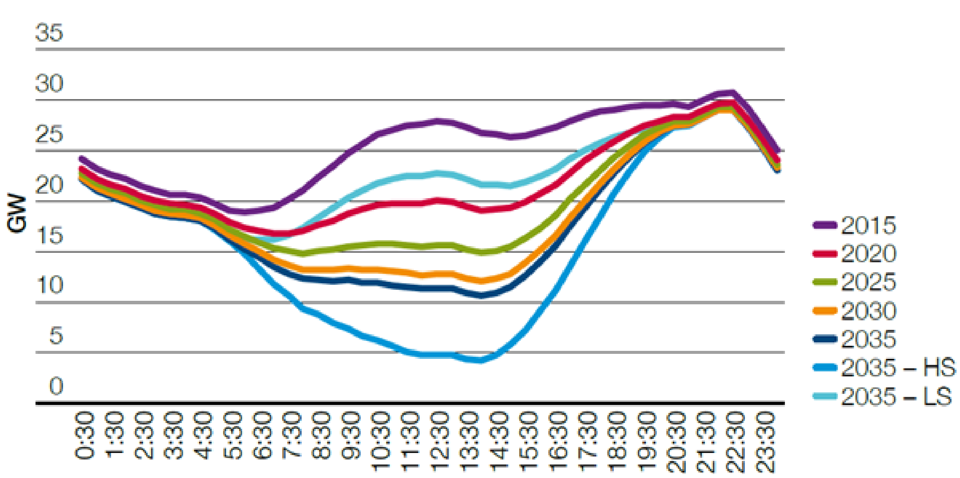
Since picking likely "winners" in either technology or business models is not possible, agile regulation is required to both support novel approaches and protect consumers.

4. Level of Distributed Generation

The "Duck Curve" illustrates the impact that distributed generation has on the demand seen by the transmission system. While this pattern in summer demand results in market issues through negative wholesale prices for electricity, it presents challenging operating issues for the physical system.

Figure 96
Consumer Power summer transmission demand across years

National Grid, FES 2015



As visible demand falls on the transmission system, it reduces the margin within which to operate system services, such as inertia. In the UK and Europe, wind generation is preferentially constrained (it is very flexible generation) to allow unconstrained solar PV generation and the continued operation of large-scale thermal plant to provide frequency regulation.

The afternoon ramp, as demand returns to the system, as solar insolation reduces, is also very hard to manage with conventional plant. The addition of domestic-scale behind-the-meter batteries will increase perceived morning demand on the transmission system (as the battery self-

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consumes solar PV generation) and once the battery is full unconstrained solar will be available to reduce perceived demand, resulting in a steep ramp down to minimum demand in mid-morning. The addition of algorithms to target behind-the-meter charging at midday in response to good weather would ensure that the behind-the-meter provides benefits to both the householder and the system.

5. Level of Variance in Forecasts

The “Duck Curve” demonstrates how the situation on the distribution network is not visible to the TNSP. There is real demand on the distribution network, but it is being met by local generation. This makes forecasting “real” demand and demand growth difficult for a TNSP.

Poor visibility of new technologies needs to be resolved, such that any technology that is likely to have a significant impact on demand, such as rooftop generation, behind-the-meter batteries and electric vehicles is a “notifiable technology”, particularly at the distribution level. In the UK heat pumps (air conditioners) are a notifiable technology, which means connectees need to inform their DNSP of their intention to connect such a device. The EU is exploring whether behind-the-meter batteries need to share their state of charge with network operators at both the distribution and transmission level.

At least if the DNSPs had awareness of what is connected to their networks, this knowledge could be shared with TNSPs. Any transition that would allow DNSPs to have a balancing function on their networks, would help with the management of the transmission network. The major challenge is enforcing notification and ensuring that records are accurate and timely.

Any forecast of future connections and demand is largely based on current knowledge, so anything that improves current knowledge will facilitate better forecasting.

Significant effort has been made to develop forecasting of solar PV generation, both for generators and system operation. The wide-scale deployment of domestic-scale behind-the-meter batteries in conjunction with rooftop solar PV will negate any forecasting. This is because, without the battery (and significant self-consumption), export of solar PV generation is highly dependent on solar resource, which is strongly related to the weather forecast and cloud prediction. The insertion of a large load, like a battery, will negate the inter-relationship between weather and solar PV generation. This is why visibility of large loads (notifiable technologies) is crucial to supporting efficient and cost-effective management of the networks and all levels.

6. National Electricity Market (NEM) Rule and Regulation Changes

A major challenge is the reach of NEM rules and regulation and the tension between Federal/national and State interests. Well thought-out network planning and management in South Australia would mitigate price spikes and system security issues.

As long as there is no single entity that drives planning, policy and management of Australia’s energy system and market then the competing policy aspirations of States and the tension with the Federal approach will always result in less than ideal solutions. It will also, as has been

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demonstrated, result in system failures. The unilateral approach will not deliver a stable system at lowest cost. System operation and market operation can be separate functions, but must be well-coordinated, remembering that a market will never operate successfully if the physics of the system is not well maintained and managed.

How liquid is the NEM? Is all generation purchased by retailers through the wholesale market, or are some of the purchases made outside the common market?

Question 1: Do you agree with the Commission's analysis of the drivers of change in transmission and generation investment?

Yes, see specific comments on the drivers above.

Question 2: How do these drivers impact on transmission and/or generation investment?

Discussed above.

Question 3: Are there any additional areas that should be considered in this Review?

Yes, the interaction and significant coordination of the transmission system and distribution system, which could deliver system-wide benefits at lowest cost (see Introduction).