Third Equation Response

AEMO RIS Stage 1 Report

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RESPONSE

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Third Equation Limited

Introduction

Third Equation Ltd welcomes the opportunity to respond to AEMO's Renewable Integration Study Stage 1 consultation on maintaining security of the NEM with increasing levels of distributed renewable energy.

Third Equation are a UK based company, developing new technology for grid stabilisation and renewable integration including network attached solar to address systemic frequency control, voltage control, power factor correction and harmonics removal. Our Solar Exchanger and Faraday Exchanger technologies directly support increasing levels of utility scale and distribution network renewables integration. Solar Exchangers target increasing grid compatibility of solar generation. Faraday Exchangers target reducing constraints in distribution and transmission by ensuring system signal frequency, voltage, power factor, and removing harmonics.

We make the following comments in response to AEMO's RIS Stage 1 Technical Report published in April 2020.

Distributed Solar PV

We agree with AEMO's recognition of solar energy as having great potential as a significant part of Australia's energy mix. Australia could regularly generate far beyond its consumption needs, despite being currently subject to curtailment. To do so, it must overcome existing system design limits and constraints. For the NEM to be able to rely on DPV it must have supporting technologies and localised resilience built in.

The duck curve illustrates that the relationship between local consumption and generation in the future energy system will be increase in variability. Therefore, increasing the range of operating circumstances can be fully recognised as a feature and not a bug in a system designed for, and not despite, renewable generation. Local volatility can be considered part of the anticipated operating parameters of a dynamically balancing disaggregated energy system, rather than a threat to the system limits of a centrally controlled system.

Issues of local voltage regulation, demand balance, reverse power flows, power factor and harmonics characteristic of a high DPV distribution network are optimally resolved locally so as not to induce instability into the larger grid, including challenges to systemic frequency. For Australia to enable DPV to positively contribute to its broader energy policy objectives, a transition from the historic Distribution Network model to a system of Distributed Networks should be considered. A Distributed Network is a design fully acknowledging prosumers with DPV as a norm and not an exception that destabilises a system predicated on control that has been exerted by traditional generators.

We note that Australia is a leader in deployment of solar at both utility and household levels, and that this presents Australia with the opportunity to be a world leader in the integration of domestic solar to serve the wider network, economy and society. To take advantage of this opportunity means reconsidering the underlying premises that inform both the design and operation of its energy system.

The fundamental coordinating premise of the past was an assumption of a high probability balance between generation and consumption. An energy system relevant to future heterogeneous consumption patterns and inherently volatile renewable generation needs to be designed as fit for uncertainty as the central design premise. A risk mitigation strategy for a system designed for long fat tails is inherently different to the normal statistical distribution of the traditional electricity systems. That uncertainty extends beyond behaviour of consumption and generation to the premise underlying of an optimal system design.

We agree with AEMO's action to incorporate aggregators more extensively as part of the decentralisation of identification of solutions for stability services. Price signals and incentives to aggregators and market participants creates a framework for innovation in a low certainty environment. Avoidance of institutional path-dependent thinking becomes a priority, if we wish to be enabled by the opportunities the new energy system creates. Solutions, as well as problems, can be localised and specific to the particularities of that Distributed Network and community. As the *Future Grid for Distributed Energy* Report[1] made clear that while the physics are universal, network operating conditions are local, specific, varied and emergent. Regulation and institutions need to be open to the competitive provision of alternative solutions.

Managing Frequency

We agree that maintaining systemic frequency is a fundamental underlying consideration for the future of the NEM. The power system's resilience is dependent on the maintenance of primary frequency. Systemic frequency is a product of supply and demand balance. As traditional generation has less capacity to support system inertia or assist in the control of ROCOF system operation must be open to innovation in the provision of such services. This is especially true for control of system frequency in any energy system with the levels of highly distributed PV-based generation necessary to address the climate policy agenda. There are, by definition, limited opportunities to coordinate the supply or load to modulate frequency at the scale necessary to address the anticipated fall in system inertia from 68 to 45 MW/s.

Clearly, the equilibration of supply and or load to maintain system inertia can only occur at generation, in the network or at the point of consumption. The limited opportunities available mean AEMO and the system's institutions should remain not only openminded to technologies that can meaningfully support system stability, but embrace a culture of enabling them to enter the market.

In a distribution network, Third Equation's Faraday Exchangers could materially support systemic frequency, compensating for the lost inertial contribution from traditional

[1] June 2020, ENEA Consulting, Future Grid For Distributed Energy

generation. Dynamically modulating the voltage relationship between primary and secondary within regulatory parameters, Faraday Exchangers deployed in the substation location traditionally occupied transformers are a robust scale appropriate solution to compensate for the loss of inertia.

System Strength (Maintaining Voltage)

We agree that maintaining voltage is a fundamental underlying consideration for the future of the NEM. The very nature of the relationship of generation and consumption is changing, and the imperative is for the provision of stability to be distributed, just as generation has become increasingly distributed.

An electricity system can be agnostic to the nature of supply and demand. To do so requires the basic grid architecture to be tasked with the maintenance of the AC waveform. Regulation of voltage, phase, power factor and power quality, through the removal of harmonics induced by generation and consumption, can be achieved in the substation at the lowest marginal cost to consumers. For example, Faraday Exchangers uniquely optimise power flow by the dynamic modulation of flux within the magnetic domain. Replacing transformers with Faraday Exchangers offers the opportunity to maintain system strength at the lowest system cost as they do not require additional capital expenditure.

Variability and Uncertainty

Global electricity systems have now witnessed an unprecedented natural experiment. The system wide fall in demand brought on by COVID has allowed us to see how vulnerable our systems are to increasing variability and uncertainty in energy mix. And yet, that variability and uncertainty does not need to be understood as a threat. Instead it can be seen as a change to operating parameters of the system, and therefore require a change to nature of system control.

A system predicated on distributed, variable, volatile but low marginal cost generation must essentially provide lowest cost distributed stability. This is not only entirely feasible, but essential. Australia has the opportunity to lead the global agenda not just in renewables adoption, but also in the provision of reliable low-cost clean energy to consumers. To do so it should look to a more dynamic market for bidding services using price signals as a marker for participation and be open to a new generation of enabling technologies such as Third Equation's Exchanger.

Deploying data gathering technologies in LV networks, while useful for increasing visibility have immense potential value in enabling short, and eventually, immediate term balancing markets to stabilise the network at the location of distributed generation, in a cost competitive environment.

Concluding Remarks

We consider it important that AEMO seek to make wind and solar the significant contributor to Australia's energy mix, incorporating utility wind and solar, commercial renewables, and domestic solar to provide a decentralised and distributed generation model.

The opportunity exists for the NEM to transition to a system of systems where resilient local distributed networks function as platforms for a much more local balance of supply and demand. Maximising the benefit of DPV, while balancing the load in their location they can inherently minimise the stress on the transmission grid. Third Equation's technology, in combination with storage, would enable a future of lower cost clean consumer energy.

Exchanger technology can facilitate the building of local robust systems. Third Equation's Exchanger technologies are designed for this purpose and are a compatible solution with existing grids and technologies. They are also the most cost-effective solution where transformers are replaced and upgraded.

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