SUMITOMO ELECTRIC

A Submission in Response to

Australian Energy Market Commission

Integration of Energy Storage Regulatory Implications

Discussion Paper 9 October 2015

Preamble

We commend the Australian Energy Market Commission on publishing the *Integration of Energy Storage: Regulatory Implications* Discussion Paper in the interest of determining whether changes to our robust regulatory frameworks are required for the integration of energy storage into our electricity supply chain.

We acknowledge the technical analyses undertaken by CSIRO on behalf of the AEMC and the contribution these analyses are making to the Commission's considerations and findings. We agree that no technology will be best suited to all potential applications and that the choice of storage technology for a particular application will depend on careful technical design to match its required operational characteristics with the main goals of its deployment.

However, we are concerned that some of the critical assessments made about large capacity flow battery technology are misleading or factually incorrect, and that these assessments could lead the AEMC to reach unsubstantiated findings. We are conscious that by doing so the AEMC could negatively impact the NEM in the context of the regulations.

We note that large capacity flow battery technology has been in development for decades and is mature in terms of its technology readiness and manufacturing readiness (Appendix 1). This technology has been successfully deployed in various jurisdictions including Japan, USA, China and Indonesia.

We are of the view that as the technology evolves further and its costs decrease further it could make a real impact in Australia and contribute to multiple value streams across the NEM.

We appreciate the AEMC's preference for concise submissions. Accordingly, in the section below we simply draw the Commission's attention to some examples of the ways in which large capacity flow battery technology could contribute to the NEM in the context of the regulations. We follow up with illustrations in the context of the *ElectraNet, AGL and WorleyParsons, Energy Storage for Commercial Renewable Integration in South Australia* case study presented in the discussion paper (Box 4.1). We then conclude with Appendices in which we provide supporting information.

Thursday, 5 November 2015

Regulatory Implications

1.3
We agree with the Commission that the broader uptake of electrical energy storage across Australia requires careful consideration of the effect of the Australian climate on storage technologies.

We note that large capacity flow batteries are not explosive; they are designed with fire-safety firmly in mind and are manufactured from non-flammable materials. This is of particular relevance in fire-prone areas of the NEM. Furthermore, the level of toxicity of these batteries is very low and is comparable to that of batteries used within general automotive vehicles.

3.2.2
We acknowledge that network operators need to consider efficient non-network alternatives and the possibility of substitution between capex and opex, and appreciate that the AER could challenge a network business's proposed expenditure if it was simply continuing to propose traditional investment programs, without consideration of efficient alternatives.

While the design life of a large capacity flow battery is typically 20 years, it is important to note that the system's cell stack and associated components could be readily replaced or refurbished at intervals and, accordingly, the useful life of a system could be extended considerably. This would dramatically impact a system's built-in replacement cost and the investment decisions of network operators within the context of the regulations.

At the end of system life the electrolyte can be re-used for other large capacity flow battery applications and, accordingly, the electrolyte retains a commercial value.

The operating cost of a large capacity flow battery is low. The battery's maintenance is uncomplicated, and simply involves the routine inspection and planned replacement of readily available mechanical components. The replacement of cells or complete batteries is not required and, again, this could influence the investment decisions of network operators within the context of the regulations.

The electrolyte within a large capacity flow battery bathes all the battery's single cells. Because of this fundamental design feature the state-of-charge (SoC) of a single monitoring cell accurately reflects the SoC of the whole system. Simple and efficient system control is key to preventing overcharging and preserving the useful life of the battery.

A large capacity flow battery system is able to consistently and indefinitely operate within the range of depth-of-discharge (DOD) from 0% (fully discharged) to 100% (fully charged). This is of particular relevance to network operators and other players in the NEM that depend on deep cycling of their storage assets.

Furthermore, this technology has no imposing limitations with respect to the number and depth of charge-discharge cycles. The unlimited cycling of large capacity flow battery includes full DOD which would provide maximum benefit to a network. The effects of DOD and number of cycles on system efficiency and system integrity are negligible, and have significant implications for the lifetime system cost and return on investment.

Data collected from the Tomamae Wind Farm in Japan over a three-year period demonstrates that a large capacity flow battery provided in excess of 270,000 cycles over the period. The data included shallow-cycling for grid firming as well as deep-cycling for load shifting.

3.2.5

We acknowledge that the option value element of the investment test should lead network businesses to value the potentially incremental nature of a storage solution as opposed to a "lumpy" network investment.

Large capacity flow batteries are exceptionally well-suited to grid applications where intermittent generation is progressively commissioned and additional storage capacity is required. Given the independence of cell stacks and electrolyte tanks, progressive expansion is relatively simple and the cost of expansion relatively low. By planning incremental growth and considering scalability during the design stage, network businesses that deploy large capacity flow batteries can expect to better control and predict the capex associated with future capacity requirements.

While the cell stacks of a large capacity flow battery system provide power (MW) the electrolyte stored in its tanks provide energy (MWh). Because the cell stacks are independent of the electrolyte tanks, extra power can be achieved through the addition of cell stacks and additional energy reserves through additional electrolyte. Additional electrolyte can be added to the existing tanks up to their capacity rating or additional tanks can be added to the system.

In this context we are of the view that the lead times in the planning process are sufficiently long to capture the value of an incremental storage solution as a substitute for traditional network investment.

5.4

We acknowledge that energy storage could be used for providing system restart services and that a very fast response frequency control service could act as a substitute for inertia in a power system with a predominance of non-synchronous generation.

A large capacity flow battery coupled with a finely-tuned power control system (PCS) can respond to system events in milliseconds and, in our view, could support large-scale intermittent power generation developments and high quality grid management across the NEM.

We note that on Sunday, 1 November 2015, an incident at ElectraNet's South East substation impacted electricity supply from Victoria to South Australia via the Heywood Interconnector, and as a result around 160-170 megawatts (MW) of load was lost. We are of the view that large capacity flow batteries attached to key parts of the grid could rapidly address major supply disruptions and provide additional energy security to the NEM.

Box 4.1

We acknowledge that the *ElectraNet, AGL and WorleyParsons, Energy Storage for Commercial Renewable Integration in South Australia* project is designed to specifically examine the value that can be obtained from the energy market and through both ancillary and network services.

We recognise that a key objective of the project is to demonstrate that storage assets can add value to renewable energy.

We are of the view that large capacity flow batteries are worthy of serious consideration in the context of the regulations and the objective of the ESCRI project and similar projects that could be contemplated by other state and territory governments.

Because the framework recommended by ESCRI includes part of the storage device cost being included in the TNSP RAB and the regulated component being limited to the value of the benefit identified in the required RIT-T we re-iterate that:

- The useful life of a large capacity flow battery could be cost-effectively extended considerably beyond 20 years,
- The battery's ability to consistently and indefinitely operate within the range from 0% (fully discharged) to 100% (fully charged) facilitates the deep cycling typically contemplated by a TNSP,
- The battery's control system prevents overcharging and preserves the battery's useful life,
- The effects of number of cycles on system efficiency and system integrity are negligible,
- The battery's relatively simple design and its uncomplicated maintenance regime confer low operating costs, and
- The re-use of the battery's electrolyte has significant commercial and environmental implications.

We acknowledge that the minimum capacity of the storage device would be determined by the TNSP network support requirements and the capacity would then be amended to maximise other intended revenue streams. We note that large capacity flow batteries are flexible and exceptionally well-suited to grid applications where intermittent generation is progressively commissioned and additional storage capacity is required at relatively low cost.

It is timely that *ElectraNet* and its project partners are considering the ways in which storage assets could play a valuable role within the NEM given the incident that occurred in the TNSP's network on Sunday, 1 November 2015.

4.2.1

We agree with the Commission that storage is a contestable service, participation of network businesses in this market must be done on a level playing field and the market-led installation of storage is most likely to lead to efficient outcomes.

We also agree that it is important to monitor the impact of ring-fencing requirements to ensure the vertical disaggregation of the electricity supply chain between regulated monopoly and competitive activities is maintained. We agree that network businesses should use energy storage where it substitutes efficiently for traditional network investments, provided that it does not significantly displace competitive energy services. We agree that it is appropriate for storage to be financed from regulated expenditure to the extent that it is providing network services. We agree that if a network business provides network services via storage then its use for competitive energy services (including energy trading) should be separated from its regulated network business.

Appendix 1: The technology readiness and manufacturing readiness of large capacity flow batteries as demonstrated by Sumitomo Electric installations.

Customer	Application	Capacity	Installation
Office Building	Load Levelling	100kWx8h	2000
Electric Utility	R&D	200kWx8h	2000
NEDO	Wind Tower	170kWx6h	2000
Contractor	Solar Panel	30kWx8h	2001
Factory	UPS/Peak Shaving	3MWx1.5s, 1.5MWx1h	2001
Developer	UPS/Peak Shaving	250kWx2h	2001
University	Load Levelling	500kWx10h	2001
Laboratory	R&D	42kWx2h	2001
Electric Utility	R&D	100kWx1h	2003
Office Building	Load Levelling	120kWx8h	2003
Railroad Company	R&D	30kWx3h	2003
Office Building	R&D	100kWx2h	2003
Data Centre	UPS	300kWx4h	2003
JST	Load Levelling	170kWx8h	2004
Office Building	LL, Emergency Power Supply	100kWx8h	2004
University	UPS/LL	125kWx8h	2004
Museum	UPS/LL	120kWx8h	2005
Electric Utility	R&D	100kWx4h	2005
Power Plant	Wind Farm	4MW(max 6MW)x1.5h	2005
Sumitomo Electric	Demonstration (with PV)	1MWx5h	2012
Construction Company	Smart Grid (with PV and CGS)	500kWx6h	2014
Hokkaido	Wind Farm	15MWx4h	2015

Note: Hokkaido currently in commissioning phase and scheduled for completion late-2015