AUSTRALIAN POWER QUALITY AND RELIABILITY CENTRE

UNIVERSITY OF WOLLONGONG

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Dear Jashan,

The Australian Power Quality and Reliability Centre at the University of Wollongong welcomes the opportunity to provide a submission to the Australian Energy Market Commission's (AEMC) consultation paper Distributed Energy Resources Integration – Updating Regulatory Arrangements.

Operating since 1996, The Australian Power Quality & Reliability Centre (APQRC) is a centre of excellence for research, education and consulting in distribution and transmission system power quality, reliability and renewable energy systems. The APQRC has worked closely with Australian Distribution Network Service Providers (DNSPs) and Transmission Network Service Providers (TNSPs) over the past two decades assisting them in managing electricity network quality of supply and reliability. Through these activities, the APQRC has developed an understanding and appreciation of a range of the technical and regulatory challenges faced by network operators due to the rapid uptake of relatively small scale dispersed generation, primarily rooftop solar photovoltaics (PV).

The APQRC recognises the inherent inequity, specifically identified by The St Vincent de Paul Society Victoria (SVDP), that exists at present whereby costs associated with network augmentation and other activities to support energy export are shared by all consumers regardless of benefit. As such, the APQRC supports the view of SVDP and SA Power Networks (SAPN) that changes should be made to the appropriate rules to remove impediments in the NER to DNSPs recovering their costs associated with supporting export of electrical energy. However, the APQRC is not in a position to determine whether the best option for recovery of costs is a direct charge to consumers or some other incentive scheme or regulatory adjustment. Regardless, the APQRC does agree that export services should be recognised as part of the network services provided by DNSPs to customers.

The APQRC notes with interest proposals for incentive schemes related to export services, particularly extension of the STPIS framework as a mechanism to incentivise DNSPs to optimise networks to allow energy export. If STPIS is to be extended on export services, the APQRC proposes that magnitude of the supply voltage be strongly considered as a key performance metric. As specified by AS 61000.3.100, the nominal allowable voltage range at the consumer point of supply is 230 V +10%/-6% (216 V – 253 V). The nature of the majority of DER is that it will lead to some increase in voltage magnitude when exporting energy. There are a number of studies that have identified that voltage magnitudes within distribution networks are generally at the upper end of the allowable range during light load (close to or slightly above 253 V). This leaves little headroom for connection of DER into distribution networks.

At the present time, magnitude of the supply voltage is generally the determining factor in constraint of energy export and is also the primary source of customer complaints to DNSPs relating to solar PV generation. These complaints are generally due to inverters disconnecting from the network due to overvoltage protection tripping. The primary objective of any extension of STPIS to voltage magnitude should be to ensure that voltage magnitudes are within the allowable range for the majority of sites for the majority of the time. Further, consideration should be given to a preferred voltage range somewhat below the upper boundary to allow headroom for energy export.

There are a range of technical and regulatory factors that support use of supply voltage magnitude as a metric within any incentive scheme these include:

- The CEPA report, *Feasibility of export capacity obligations and incentives* (hereafter referred to as the CEPA report), notes that "there is a range of metrics available these currently lack accuracy and robustness". Use of voltage magnitude as a metric overcomes this issue. Voltage magnitude can be measured accurately by relatively low cost devices and there are power quality monitoring and/or revenue meter measurement standards in place that define measurement requirements and accuracy.
- Chapter 4 of the STPIS already allows for provision of management of Quality of Supply Component within the incentive mechanism. Voltage magnitude is a quality of supply parameter and as such scope exists within the existing STPIS to include voltage magnitude as a performance metric with minimal changes to the overall STPIS framework.
- The APQRC has been collaborating to collect voltage data from DNSPs through the auspices of of the Long Term National Power Quality Survey and it successor the Power Quality Compliance Audit since 2002. As such, there exists a significant quantum of data that could be used to establish a performance baseline for supply voltage magnitude performance.
- Section 4.1.1 of the CEPA report identifies that beyond Guaranteed Service Level (GSL) provisions applicable in some jurisdictions, voltage magnitude obligations in the national electricity rules (NER) are not supported or complemented by incentive mechanisms. The proposal presented here may assist in incentivising enhanced management of supply voltage levels.

As noted above, supply voltage magnitudes in distribution networks have been identified as being higher than desirable for many years. There is currently little incentive (or penalty) for DNSPs to invest in programs designed to reduce voltage magnitudes to bring voltage levels within the allowable range let alone reduce operating voltage levels to magnitudes that allow headroom for energy export. In addition to allowance for energy export, incentive schemes that will allow mechanisms for improvement of management of voltage magnitude will manifest in a range of consumer benefits including:

- Increased lifespan of consumer equipment – preliminary studies have shown that operation of consumer appliances supplied by electronic converters at voltage levels toward the upper end and/or above the allowable range has a significant deleterious impact on the lifespan of that equipment. The impact of extended overvoltage on network equipment is yet to be determined.

- The concept of Conservation Voltage Reduction (CVR) indicates that reduction of supply voltage will reduce energy consumption and in turn provide reductions in consumer bills. In a high carbon electricity generation paradigm, reduction in energy consumption will also reduce carbon emissions.
- Consumer equipment will operate more efficiently when supplied at voltage levels close to the rated voltage (generally 220 V or 230 V)

If voltage magnitude were to become a metric for STPIS it is recommended that the full value of voltage management be considered. A value of customer voltage (VCV) parameter could be developed to fully recognise the various value streams that would manifest to consumers through management of supply voltage magnitude.

While supply voltage magnitude would provide a robust metric a component of an extension of STPIS to energy export, there are a range of factors that require additional work before a robust algorithm for calculation of VCV could be developed. These include:

- What are the appropriate metrics against which performance should be measured?
- What devices are appropriate for measurement of voltage? At present large quantities of voltage magnitude data is being sourced from smart revenue meter devices and it is likely that this will continue into the future and form the basis for data input into any supply voltage magnitude assessment scheme. However, the measurement methods used in smart revenue meters do not align with the requirements of power quality monitoring standards (e.g. AS/NZS 61000.4.30). It is not proposed that this is necessarily an impediment to implementation of an extension to STPIS some level of due diligence on the accuracy of typical meters used across jurisdictions may be required.
- Where measurement instrumentation be placed? Some work would be required to determine the optimum number and placement for measurement devices. While in some jurisdictions smart revenue meter deployment is pervasive this is not the case across the board. Statistical methods to determine whole of network performance based on a subset of measurement data (e.g. a random sampling approach) could be used to enable the scheme to run for those networks which do not have 100% data visibility.
- Further studies are required to determine a robust relationship between magnitude of supply voltage and loss of consumer appliance lifespan. Such studies could be extended to provide indication of the impact of supply voltage magnitude on electricity supply equipment such as electronic relays and electronic energy meters.
- While there is a significant volume of work which describes CVR, consensus is yet to be reached on applicable values. Different CVR factors may be required for different network types or different geographic locations.

Notwithstanding the above limitations, using existing information, it may be possible to undertake either a paper based evaluation or a shadow implementation of an incentive scheme using supply voltage magnitude as the metric.

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If required, the APQC would welcome the opportunity to discuss this submission with you in further detail. Should you have any questions I can be contacted by phone on 0242214737 or via email sean_elphick@uow.edu.au.

Yours Sincerely

S. Elphick

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