S&C ELECTRIC COMPANY
Excellence Through Innovation

12-14 Claremont Street
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Australia

Mr. George Huang
Director
Value of Customer Reliability
Australian Energy Regulator
GPO Box 520
Melbourne
Victoria 3001

Our Ref: JC 2018-087

20 December 2018

Dear George,

S&C Electric Company submission to the Value of Customer Reliability consultation (PRJ1003080)

S&C Electric Company welcomes the opportunity to provide additional input into the Consultation Paper covering the Value of Customer Reliability.

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 the "wires and poles" activities of the networks, but has delivered over 8 GW wind, over 1 GW of solar and over 45 MW of electricity storage globally, including batteries in Australia and New Zealand. We have also deployed over 30 microgrids combining renewable generation, storage and conventional generation to deliver improved reliability to customers.

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

Yours Sincerely

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Responses to Additional Questions

1. Whether we should determine a HILP VCR, and if so, how?

Building resilient networks is increasingly critical, given the impact of climate change on natural hazards, such as cyclones, storms, flooding, heat and fire. Without appropriate signals and incentives, a network could be reliable and meeting STPIS requirements, but as a result of HILP events, customers may be experiencing worse performance.

Developing resilient networks by reducing the risk of adverse impacts (e.g. engineering, automation, diversity), through being prepared, delivers improved restoration times following a major event. Experience in other locations has shown that a focus on investing for resilience, not only improves withstand to major events, but also improves reliability (by over 30%).

The Electricity North-West Limited (ENWL) innovation study in the UK did look at HILP and VCR. The study explored the impact of the scale (how many people affected, particularly a "community") and duration of outages, with a maximum length of 2-3 days. Pages 21-24 of the final report details the work on long duration outages. There are some very useful figures such as figure 2.11 on page 21 showing the VOLL for a range of outage durations on the basis of the number of times per year they occur.

VOLL does not increase linearly with unplanned outage length, but exhibits a relationship that is more logarithmic, with a flattening off in VOLL as duration increases. Interestingly VOLL for planned outages is more linear in nature and the values for VOLL are lower than for unplanned outages.

Final Report: https://www.enwl.co.uk/globalassets/innovation/enwl010-voll/voll-general-docs/voll-phase-3-report.pdf.

2. Whether we should develop VCR values for customers with DER, and if so, how?

As well as the comments below on the impact of momentary outages for DER (disconnection and the inability to deliver system support services), owners of DER anticipate an income from mechanisms such as Feed-in-Tariffs. The loss of the network, may mean the loss of income via export.

Having DER does not protect the owner from outages (of any length), unless the DER has been specifically designed to operate in islanded mode with the provision of isolation and a synchronous source to allow the operation of the islanded inverter-connected generation/batteries. Both an isolating switch and a synchronising source are likely to be too expensive for a residential-scale approach. This means that the generation that may have been facilitating self-consumption (minimising of import costs) is not available to the customer, resulting in increased costs.

The ENWL innovation project explored the needs of DER owners (Low Carbon Technologies, LTCs, in the report) and found that their VCR (VOLL) was at least 9 % higher than for customers without DER. For those with heat pumps (air conditioners) and EVs, the VCR was 14 % and 23 % higher, respectively.

The Final Report (link above) details some of the work on DERs on page 19, including a useful table comparing a range of DER options and associated VCRs (VOLL).

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Figure 2.10: VoLL in £/MWh based on current LCT usage

Domestic segment	VoLL £/MWh	Damage function *(multiple of average domestic VoLL)*
All domestic customers	£17,500	x 1.00
Current domestic LCT[31] users	£19,000	x 1.10
Current domestic customers with PV	£18,000	X 1.05
Current HP users	£20,000	x 1.15
Current domestic EV users	£21,500	x 1.25

Taken from ENWL VOLL project (voll-phase-3-report, page 19)

3. Whether we should develop VCR values for momentary outages, and if so, how?

Momentary outages, while short and much less than one minute (let alone the new 3 minute definition to be applied in the STPIS going forward), may have significant impacts, some of which are not seen by the network.

Anti-islanding requirements for all inverter-connected devices mean that a momentary outage will see certain DER disconnect. This will impact on solar PV, batteries, some heat pumps (air conditioners) and potentially EVs. Critically, it is the loss of solar PV that will have a major impact on DNSPs and network operation. Anti-islanding ensures that any exporting DER is unable to export, preventing the flow of electricity onto a potentially damaged network to protect line crews and customers. Load or demand is not subject to a delayed reconnection following an outage.

So, where the solar PV was locally meeting load, that load will reconnect before the local generation has connected, resulting in a short-fall in generation, which has to be managed.

Additionally, in a future where we hope to rely on DERs to provide system services, a momentary outage will disconnect these assets, meaning they will be unavailable to support the local or wider system. This may mean that an asset is unable to provide a service through the loss of the connecting network, that would have resulted in a payment and the inability to provide the service is not the fault of the asset owner (the provider) but due to a failure of the network.

A momentary outage also impacts load, since while the outage may be minimal in network terms, the loss of electricity may have resulted in some devices restarting or the interruption of processes. For instance, streaming entertainment will be interrupted, and a variety of devices will need to restart and reconnect, before resuming the entertainment. This will be annoying and is likely to become an increasing issue for technologically savvy customers. For commercial and industrial users, momentary outage has financial implications, rather than annoyance value

A paper from Lawrence Berkeley National Laboratory (dated 2004, updated in 2006: https://emp.lbl.gov/sites/all/files/lbnl-55718.pdf) indicates that momentary outages, lasting 5 minutes or less, account for two-thirds of the overall cost to the USA, versus sustained interruptions (see page 27):

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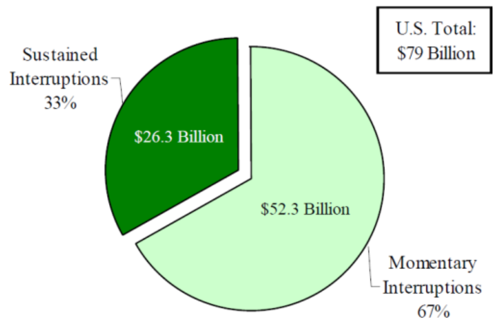

Taken from the Lawrence Berkeley National Laboratory paper.

Current Approaches

Norway operates a scheme where the cost of energy not supplied is deducted from the distribution companies' revenue under their Cost of Energy Not Supplied (CENS) scheme. Initially this only covered longer duration interruptions but from 2009 was extended to include momentary interruptions (<= 3 minutes and voltage sags), because momentary outages can have significant economic impacts (e.g. Lawrence Berkeley National Laboratory work). MAIFI is the metric used in Norway for this scheme and momentary outages are those less than 3 minutes (in common with the new definition for Australia). These incentives use damage functions for VOLL and were based on research, a copy of which will be provided separately.

Now, consider the short interruptions (≤ 3 min). Cost rates for short interruptions and voltage dips were estimated from the Norwegian survey 2001 – 2003 given in the table below.

Table 21: Normalized cost rates from Norwegian survey 2001 – 2003. Short interruptions and voltage dips. (Source: Samdal et al. 2006)

	Short interruptions	Voltage dips
Customer sector	[NOK/kW]	[NOK/kW]
Industry	17	13
Commercial	19	12
Large industry	6	4
Public sector	1	1
Agriculture	4	4
Residential	2	-

Taken from page 125 of the Research Report (Study on Estimation of Costs due to Electricity Interruptions and Voltage Disturbances, SINTEF, 2010)

4. Appropriate business and industry segmentation

No Comment