

ESCRI-SA Meeting Minutes

Meeting Name: Knowledge Sharing Reference Group, Meeting 2**Date:** 8 May 2018**Start Time:** 10:00 am**Finish Time:** 2:00 pm**Location:** Pullman Adelaide, 16 Hindmarsh Square, Adelaide (Level 15, Room name: Hindmarsh 3)

Attendees:	Name	Affiliation
	Hugo Klingenberg	ElectraNet
	Rainer Korte (for part of meeting)	ElectraNet
	Dorin Costan	ElectraNet
	Wai-Kin Wong (for part of meeting)	ElectraNet
	Laurence Antal (for part of meeting)	ElectraNet
	Ren Gentilcore (for part of meeting)	ElectraNet
	Paul Ebert	Advisian (KSRG Chair)
	Paul Knispel	Advisian
	Matthew Rowe	Advisian
	Bruce Bennett	AGL
	Claire Richards	AEMC
	Jess Hunt	AEMO
	Dee Butler	AER
	Dan Sturrock	Australian Renewable Energy Agency
	Niva Lima	CSIRO
	Grant Cushion	Government of Victoria
	Amy Kean (via Skype)	Government of New South Wales
	Andrew Burnett (via Skype)	Government of Queensland
	Brendon Hampton	SA Power Networks (SAPN)
	Alex Lloyd	University of Adelaide
	Duncan MacKinnen	Australian Energy Council
	Stuart Johnston	Australian Energy Networks
	Mark Derry	Consolidated Power Projects (CPP)
	Crina Costan	Consolidated Power Projects (CPP)
	Michael Wood	ABB Australia
	Bernard Norton	ABB Australia
	Peter Murphy	University of South Australia

Apologies:	Name	Affiliation
	Karl Rodrigues	CSIRO
	Eamonn McCabe	Government of Western Australia
	Richard Webster	Government of South Australia
	Barry Millar	AGL
	Stuart Richardson	Federal Government
	Matthew Peake	ElectraNet
	Andrew Fraser	TasNetworks, representing Govt. of Tasmania

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No	Description	Presented by	Time
1	<p>Welcome by Chair & Introductions</p> <ul style="list-style-type: none"> The Chair introduced himself and the context and purpose of the KSRG. Each KSRG member introduced themselves and their interest in batteries. It was noted that the KSRG is a good forum for cross-pollination of ideas given the vast knowledge held by the members of the group. The Chair reminded people of the KSRG Terms of Reference which are available on the Project Portal (www.escri-sa.com.au) – particularly in regards to being careful with commercial or other confidential information not in the public domain, and in relation to the media and communication protocols. Brief welcome from ElectraNet was also made by Hugo Klingenberg who noted that: <ul style="list-style-type: none"> The BESS was energised 30th April, with delays due to modelling and Generator Performance Standards. Licensing in next few weeks, followed by registration. Handover to AGL expected by middle of June. 	Paul Ebert	10:00 – 10:05
2	<p>Confirmation of Minutes from Previous (Meeting 1 & Site Visit)</p> <ul style="list-style-type: none"> Minutes accepted from KSRG Meeting #1 – no edits requested 	Paul Ebert	10:05 – 10:10
3	<p>Discussion on Outcomes from Meeting 1 & Day’s Agenda</p>	Paul Ebert	10:10 – 10:20
4	<p>Project Status and Project Management Learnings</p> <ul style="list-style-type: none"> An overview of the status of the Project was given by Dorin Costan, the ElectraNet Project Manager for the project (presentation is available on the Project Portal). <p>General</p> <ul style="list-style-type: none"> Regulated and non-regulated services will be available from the BESS. Non-regulated services to be operated by AGL. Regulated services used as part of ElectraNet’s requirement. Wattle Point wind farm comprises type 1 induction generators, meaning integration is more difficult than newer wind farms. <p>Design</p> <ul style="list-style-type: none"> Staged design was required due to faster delivery timeframe. 	Dorin Costan	10:20 – 11:00

- The team had to define a minimum set of requirements to be able to purchase equipment, and any level of error was borne by the project.
- Earthing was a large consideration for the design.
- Two Safety-In-Design workshops were held – first relating to development of housing, and second for equipment installation.
- Fire considerations – project team had to demonstrate to the Country Fire Service that no ember attacks could enter the premises and start a fire with the batteries. Fire prevention was a significant issue in the design process.

Delays

- Not enough incentive to ensure high priority for suppliers. (Needed to fast-track delivery of equipment, but because it wasn't a large enough order there was little leverage).
- Because of the tight timeframe, any errors in early stage procurement couldn't be rectified and the project design had to adapt.

Construction

- Dalrymple substation – works were coordinated between SAPN and CPP. Concurrently, works had to be performed at the Dalrymple North site.
- Normally ElectraNet has standalone control room with its facilities, but it was deemed more efficient for the BESS have this as part of and at the end of the main BESS shed.

Network Studies

- Lesson learnt - all required models should ideally be made available before project starting.
- Given that the battery had multiple operation modes (islanding and grid connection) it added difficulty to network studies and model development, as it was hard to optimise battery performance that benefitted both modes.
- *Comment from AEMO* – If AEMO is to see similar inverter make in the future, it will be easier for them endorse.
- The battery first needs grid-connected aspects cleared in order to be able to test islanding functionality.
- *Comment from ABB* – The regulatory and technical requirements of the SA connection point make it one of the most difficult places on earth to satisfy. This should make ongoing projects easier using the same equipment.
- Experience of BESS connecting to HV environment is very new, all teams are learning and it takes time.

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- *Comment from AEMO* – Each local network condition is unique, but if you have dealt with similar equipment before then it makes progress faster/easier.
- Fault current that can be provided by this BESS is much larger than typical inverters. A protection study on the local network was required. It resulted in small updates to local DNSP hardware (SAPN).

Islanding

- Islanding was one of the most complicated areas and brought up unforeseen issues – for example, if the battery loses two or more (of six) transformers, it will not be able to supply sufficient fault current to support protection mechanisms during an islanding event. As such, anti-islanding procedures will be implemented for this and some other scenarios.
- *Comment from Wai-Kin (ElectraNet)*: Key overcurrent protection threshold is 800A. PSCAD studies of grid-connected operation have been completed, and the grid-connection to islanding mode transition has been completed. However, studies regarding fault current under islanding conditions are ongoing. Modelling the network has been difficult. It took an estimated 4 weeks for preliminary islanding studies.
- If fault current is not adequately implemented, then the system will not be able to identify between high load current and fault current. As such, this becomes a safety concern. If infrastructure changes within the SAPN network were to be large, this would have required large cost. However, the team was fortunate in that only minor changes were required – mainly of settings changes, not mass installation of new hardware.
- Vector-shift islanding protection studies were conducted, and it was found that this type of protection may lead to inadvertent tripping in some situations. As such, the team has used a topology-based methodology to identify when islanding is occurring. This is reliable, but computationally expensive regarding the number of switchgear configurations.
- *Comment by SAPN*: SAPN are conducting a number of studies like this but nothing this technical. So far SAPN have been able to rely on existing current protection settings and small-scale batteries can integrate much easier (as long as they can support fault current.)
- *Comment by ARENA*: In 10-15 years, ARENA is presuming microgrids will be very common. Discussion such as this is very useful in understanding the complexities of microgrids.

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- *Comment from Chair:* The more bespoke the engineering of a project, the worse the commercial case. So it is very important to have proven field work to base future projects around to avoid re-engineering every project.
- *Comment by SAPN:* Getting battery to detect and see localized islanding situation (complying with AS4777) has been difficult. The batteries were often acting like a virtual generator. As such, there has been concern about how microgrids will impact the network when it is behind the meter, responding to price signals and DNSPs having to match thermal ratings on lines.
- Battery performance testing and islanding testing are to be performed after AEMO's acceptance of models.

5 Lessons Learnt from Electranet

Hugo Klingenberg 11:00 – 11:30

- Hugo Klingenberg assisted by Wai-Kin Wong and Laurie Antal gave a presentation on lessons learnt from the perspective of ElectraNet (this presentation is available on the Project Portal).

(Wai-Kin Wong

Laurie Antal)

Modelling & Generator Performance Standards

- Challenge was getting control system to work on-grid and off-grid.
- *Question posed by ElectraNet:* How do we harness synthetic inertia for the benefit of the wider NEM? Some discussion on this then took place amongst the group.

Registration and Generator Licensing

- Aggressive timelines have brought about the majority of Project problems.
- There was also changes to physical plant that needed to be replicated in models.
- *Note from Victorian Government:* In Victoria a pre-requisite of the contract signing (for battery projects) was to have the GPS approved by suppliers. Models took between 3-5 months to get AEMO signoff at the risk of the suppliers.

Cycle Count And FFR

- Availability has been guaranteed at 96% per annum. However, information was made available by Samsung that a rest time is required after a fast charge which was not previously known. As such, this could impact battery availability.
- Better capturing of non-linear degradation (e.g. limited degradation between 60-90%) is required for future cycle definition. It is not adequate to assume that each discharge will

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be for a set amount or pass a certain capacity line (which is how the current definition of "cycle" is defined in the contract).

- *Comment by AGL:* The Tesla battery has been bidding into the 6-second FCAS market quite heavily, which has made the price drop. However, if AGL was to operate heavily in the 6-second FCAS then the operation of the battery would commonly be used for short-term discharges, with it rarely registering a "cycle".
- *Question from AGL:* Since the ESCRI project has started, there is now an emergency control action which can *prevent* a frequency event (this is not technically FFR as it happens *before* a frequency event). How can we value this service for future projects?

6 Lessons Learnt From AGL

Bruce Bennett **11:30 – 12:00**

- Bruce Bennet from AGL presented on lessons learnt from AGL's perspective. This presentation is available on the Project Portal.
- ABB very experienced in remote areas where voltage regulation is required. Voltage Source Inverters (VSI) are required by islanding characteristic of the BESS.
- Requirement for PSCAD modelling coming about because renewable generation tends to be inverter/converter interfaced with Current Source Inverters (CSI). Can VSI technology (such as that used on ESCRI) be applied more generally to grid-connected solar farms to minimize this concern to AEMO?
- *Comments By ABB and SAPN:*
 - ESCRI inverters have a higher auxiliary load than most on the market.
 - VSI have higher switching losses.
 - VSI can implement own frequency, but CSI follows grid frequency.
 - CSI's are cheaper.
 - You require DC voltage in a tight range for VSIs or the asset with trip.
 - VSI introduce very little harmonics.
- Normally FFR is for frequency change, not RATE of change of frequency which this device is. (It is noted also, that the inertia of synchronous machines slow the rate of frequency change, but they also therefore slow the recovery of frequency back to 50Hz).
- Fast charge is at a C rate of 4, normal is at a C rate of 1. Rest time is related to cell temperature. It takes approximately one hour to extract heat from the asset after a full charge.

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- Fast charge likely if high pool price is expected to be coming, or if the pool price is at the floor.
- *Comment by SAPN:* It will be interesting to see what happens to the operation of the battery when we go to a 5-min market window.
- ElectraNet underwrites round-trip energy efficiency. Since FFR is a service being met by the BESS, the inverters must be on continually, which could make energy draw comparatively larger than other BESS projects which could pose a risk to ElectraNet.
- It was expected that an element of real power over-capacity could be achieved. It turns out that the inverters can achieve an overload power of 200%, however the real power output is limited due to battery cells not having this overload capability. (Fault current is normally reactive current.)
- During a fault, you will see the reactive power rise highly, whilst the real power drops. In this event, a physical control signal is sent to the Wattle Point wind farm so 4 of 5 breakers to be tripped instantly.

7 Lunch

**12:00 –
12:30**

8 Lessons Learnt From The Field

**Mark Derry /
Crina Costan**

**12:30 –
12:50**

- A presentation was provided by Consolidated Power Project (CPP) (EPC Contractor for the Project) and ABB staff on lessons they have learnt from the Project (this presentation is available on the Project Portal).

Consolidated Power Projects (CPP)

- Bus ducts required significant customization for use in this project due to the dog-leg. (5000A - enclosed in a faraday cage).
- Had to manage large and varying teams on site - 65 people on site one day.
- There were a number of language barrier issues noted with suppliers. E.g. vocabulary usage didn't indicate same object/item.

ABB

- First voltage source inverter that ABB have installed that required NEM-level modelling and performance analysis.
- Off-grid/islanding functionality was not a key reason for model delays.

**Michael Wood
/ Bernard
Norton**

**12:50 –
13:20**

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- Control system to PSS/E automation could be faster, PSCAD can be converted directly from Power Factory (or perhaps Matlab). 3MW/Hz/s is the ramp rate that triggers a FFR.
- Project timeline wouldn't allow for overseas assembly, requiring a more logistically difficult program.
- On-site data storage functionality was made for the Project Portal (long-term storage made available due to knowledge sharing requirements).

9 Portal Demonstration and Update

Matthew Rowe / Ren Gentilcore 13:20 – 13:35

- Portal was demonstrated to the KSRG.
- Portal development is aligning with major milestones and schedule.
- Expecting to be finalised before June.

10 Questions and Comments on Knowledge Sharing

All 13:35 – 13:50

- *Comment from CPP:* For wind projects, we currently follow a given process. The same will come in battery projects once learnings have been transferred across the industry.
- *Comment from CPP:* There will be times when a building will be beneficial, as opposed to the Tesla-style containers and vice versa. Each container must have its own fire suppression system, duplicated air conditioning and other elements. However, for a building you can have redundancy built into the design as a whole, not on a per-container basis. The equivalent of the ESCRI building solution was 24x container design.
- *Comment from CPP:* Would make the shed slightly wider if they were to do it again.
- *Comment from CPP:* Batteries degrade beneath 21 degrees, so they need to be kept between 23-28 degrees. CPP did not previously know this.
- *Comment from ElectraNet:* The guarantee of 8MWh after 12 years was something difficult to guarantee and has caused concern.
- *Comment from ARENA:* The aggressive timeline was proposed such that learnings could be accelerated, and they didn't want to get to the commissioning only at the end of 2018.

11 Other Business

Paul Ebert 13:50 – 14:00

- Reminder of next KSRG meeting (1-4pm 14 August) and site visit (all day 15 August).
 - It was noted that KSRG members were encouraged to put forward other colleagues who may be interested in the site visit.
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- All material from this KSRG can be found on the Project Portal.
 - The Chair thanked the ElectraNet, AGL, CPP and ABB representatives for their presentations, and ElectraNet staff for organisation for the event.
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12 Close

Paul Ebert

14:00

-----end of minutes

Certified as a correct record of the ESCRI-SA Knowledge Sharing Reference Group Meeting of 8 May 2018.



26 July 2018

Paul Ebert

Date

KSRG Chair

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