Low-Voltage Grid Battery Energy Storage Systems Trial – Lessons Learnt Report No 1

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1. Summary

This document is the first Lessons Learnt Report for the United Energy (UE) Low-Voltage (LV) Grid Battery Energy Storage Systems (BESS) Trial (the project). The project investigates the technical and commercial feasibility of using pole-mounted batteries connecting to the LV network to manage constraints on the distribution network and increase the hosting capacity of distributed photovoltaics (PV) systems. The project is funded under ARENA's Advancing Renewables Programme (2020/ARP024). It fulfils an obligation under the Knowledge Sharing Plan to provide an update on the status of delivery of the project including sharing of results and lessons learnt.

This report provides a summary of the lessons learnt during the delivery, installation and commissioning of the BESS Pilot project, which was completed by UE prior to conducting the ARENA project. These lessons learnt include:-

1) Project Management
2) Commercial
3) Technical
4) Social
5) Regulatory

This lessons learnt report is available on United Energy's website.

2. Key Lessons Learnt

Table 1 lists the project management related lessons learnt on this project.

Table 1: Project Management Lesson Learnt

No	Situation	Action
1	At the start of the project, there was some uncertainty regarding roles/responsibilities between various teams involved in the project.	A formal Project Management Plan (PMP) was developed to identify how the project will be delivered along with details about resourcing, budgeting, milestones, roles and responsibilities and delivery methodology. UE also established a program level working group that meets on a weekly basis to track project progress and fast track issue resolution. This working group includes a number of stream leads who were briefed on their responsibilities at the beginning of the project.
2	The use of emails to share information and key documents between internal teams and external parties was a key risk which might cause some cyber security issues. This resulted in lack of visibility and confusion between teams.	A project folder for the internal teams was established to share documents and key information about the project. The stream leads also took the initiative to ensure the project team is using the folder to share information. An external OneDrive folder was also established to share information with external stakeholders.
3	The project had multiple streams (BESS design, control system, communications, IT and stakeholder engagement) that had to work together in delivering the project. At the start, it was challenging to understand all the key activities and critical paths due to lack of visibility/plan from each stream. This was also impacting UE's ability to track critical activities on the program master plan.	Each project stream lead was requested to develop a project plan in MS Project to track their key activities and timelines. This was regularly updated during the weekly program management meeting and was feeding into the program master plan. This assisted UE to identify and resolve upcoming risks and issues early.
4	There was a lack of clarity about UE expectations of a preliminary design against BESS supplier's understanding.	UE worked closely with the BESS supplier to better manage expectations. Weekly design meetings were held to review the project with the BESS supplier. The BESS supplier then reviewed the drawings with the project leads to ensure expectations were met prior to formal submission. For future projects, it is recommended to define preliminary design in the contract and also ensure both the BESS supplier and UE expectations are aligned during the project kick-off meeting.

No	Situation	Action
5	Trial projects involving development of new innovative technologies are complex and have many unforeseen challenges/issues which can impact the delivery timeline and cost. Trial projects should consider having additional contingencies, over and above a business-as-usual (BAU) project.	UE worked actively with internal and external stakeholders to manage unexpected issues as well as conducted comprehensive risk assessments. The issue resolution process was streamlined to ensure quick decisions are achieved to mitigate project delays and cost overruns.

As Table 1 summarises, it is critical to clarify roles and responsibilities for each party and working group at the beginning of the project as well as expectations and business requirements to expedite the delivery of the project. Risk assessment also plays an important role on development of new technologies and innovative projects.

Table 2 details the lessons learnt on commercial of this project.

Table 2: Commercial lessons learnt

No	Situation	Action
1	The project commencement was slightly delayed due to extended time for contract negotiation. Delays in commencement date needs to be reflected in the final delivery timeline.	UE worked with the BESS supplier to gain efficiency by completing parallel activities in the plan.
2	Being an innovative new design it was challenging for UE to award the installation contract early in the project to firm up the project cost. A detailed design had to be developed prior to engaging the service provider(s) for the installation cost.	UE developed a delivery strategy that was acceptable for managing project risks and costs. The proposed delivery strategy considers staged awards of the installation and commissioning contract to minimise the potential risks.

As highlighted above, for future projects it is recommended to account more time during project planning for contract negotiation and execution and that can be conducted in parallel with other independent activities. Also, as a learning for future projects it is recommended to develop a clear delivery strategy prior to project initiation to ensure all parties are aligned.

Table 3 details the technical lessons learnt of this project.

Table 3: Technical lessons learnt

No	Situation	Action
1	UE identified through a gap analysis that there is a business need to implement IEEE 2030.5 protocol[1] for the control system and had to go through a learning journey.	UE enrolled key internal resources to complete a training course to fasten the learning curve for the new protocol. UE also reached out to other utilities and other industry partners to increase its understanding and expedite the implementation. This is highlights how the project is at the fore-front of integrating LV-connected storage into distribution networks.
2	UE technical specifications had limited information to complete a full structural review of the mechanical design.	UE worked collaboratively with the BESS supplier to ensure business requirements were refined and addressed during the design phase of the project.
3	The initial drawings submitted by the BESS supplier needed refinement to meet UE drafting standards.	UE worked with the BESS supplier to finalise the drawings for final submission. It was agreed that the BESS supplier draft team should work with UE drafting team directly to ensure drawing quality standards were met for the project. UE drafting team then reviewed drawing quality prior to final submission.
4	Cyber security considerations were raised regarding using the IEEE 2030.5 protocol.	UE worked with the technology supplier to ensure the feedback from the internal IT security teams were addressed in the design. The UE BESS system will be using a dedicated Telstra virtual private network (VPN). All auxiliary protection equipment will also be hardwired and will not be allowed to be configured remotely. The main circuit breaker is designed to act independent to the BESS unit to mitigate any potential cyber security risks.
5	Working with ARENA and related first-responder agencies to address fire risks for grid-connected LV BESS solutions and further develop industry best-practice.	UE engaged an independent fire engineer to review best practise standards for the proposed application. UE has also commenced the consultation with industry stakeholders about best practises and engaged the service providers at early stages of the BESS development.

[1] For more information on IEEE 2030.5-2018 – IEEE Standard for Smart Energy Profile Application Protocol, refer to https://standards.ieee.org/standard/2030_5-2018.html.

No	Situation	Action
		UE and the BESS supplier worked with the fire engineering in accommodating all of the recommendations to improve the fire safety. These recommendations include battery compliance to IEC 62619[2] or equivalent, deployment of double skinned cabinet with three point locking system and installing fire rated panels at rear of the BESS unit to reduce risk of pole catching fire. Furthermore, UE proactively engaged with Fire Rescue Victoria[3] (FRV) to develop industry best practices in relation to LV-connected batteries and is specifically using the "Country Fire Authority (CFA) Guideline for Renewable Energy Installation[4]" as part of the safety-in-design (SiD) process for the trial.
6	Determining the ideal height at which the BESS should be mounted.	UE decided to use the same height standard applicable for the installation of pole-mount distribution transformers for the BESS units. It was agreed to install the BESS units at a height of 3.6m. This approach was endorsed by the internal Work Practices team.
7	From prior experience, it was observed that significant time and cost was associated with onsite testing of protection and communications equipment on the pole during installation. This was based on zone substation commissioning and was deemed not practical for LV BESS installation.	In the design of the BESS units, UE engineered out this requirement by using a compliant LV moulded case circuit breaker with protection capability rather than a dedicated zone substation standard relay. This would considerably reduce the requirement for on-site testing. Protection and communications testing was proposed to be completed as part of the factory acceptance testing (FAT) rather than during site acceptance testing (SAT). This approach was endorsed by UE Secondary Protection team.
8	Optimum engagement with installation service providers during the design phase.	UE established a mini project to engage service providers during the design phase of this project to optimise the installation effort and ensure suitable access for maintenance. An ergonomics review of the design was then completed to understand ease of access for maintenance. UE also engaged service providers' representatives in the SiD process to capture learnings from other projects early in the design.

[2] IEC 62619:2017: Secondary cells and batteries containing alkaline or other non-acid electrolytes - Safety requirements for secondary lithium cells and batteries, for use in industrial applications.
For more information, refer to: https://www.standards.org.au/standards-catalogue/international/iec-slash-tc--21-slash-sc--21a/iec--62619-colon-2017.
[3] https://www.frv.vic.gov.au.
[4] https://www.cfa.vic.gov.au/about-us/publications/guides-for-businesses-and-councils.

No	Situation	Action
9	Identified the need to develop an emergency management and operational plan for the network control centre (NCC) and FRV in managing new assets introduced to the network.	As referred to earlier, UE reviewed the CFA Guidelines for Renewable Energy Installation and started engaging FRV and other key stakeholders early in design process. An emergency management plan will be developed before the project is completed to ensure internal and external stakeholders (including FRV) are aware of the operational procedures during any emergency event. UE will also organise training with the BESS supplier and key stakeholders to familiarise processes related to these new assets.

Since this project is technically complex, a comprehensive design (end-end) needs to be developed and reviewed by key stakeholders. This is to ensure all aspects of the final solution are thoroughly taken into consideration prior to installation.

The general lesson learned is that the more comprehensive and detailed the original specifications are, the less issues arise during the project execution.

Table 4 details the social related lessons learnt of this project.

Table 4: Social lessons learnt

No	Situation	Action
1	Social risks were identified with siting the BESS units in the most appropriate locations to ensure residents and other stakeholders do not express concern with the BESS installation.	A social risk assessment was completed by the Stakeholder Engagement team and a comprehensive stakeholder engagement plan was developed to address any social risks. A list of criteria was developed to address the potential risks during site survey and the Stakeholder Engagement team was engaged in selecting the locations of BESS installations.
2	It was highlighted that potential concerns which could be raised by the community regarding noise and electromagnetic field (EMF) needed to be addressed at early stages of the project.	UE confirmed with the BESS supplier that the new units are required to comply with the Environment Protection Authority[5] (EPA) SEPP (Control of Noise from Commerce, Industry and Trade) No. N-1[6] (SEPP N-1). Noise and EMF tests will also be performed at the factory prior to installation and will be available for the Stakeholder engagement team.

[5] https://www.epa.vic.gov.au.
[6] https://www.epa.vic.gov.au/about-epa/laws/legislation-regulations-and-policies/noise-legislation.

No	Situation	Action
3	The colour of the new units had to blend with surroundings to minimise visual amenity concerns from local residents.	The colour of the BESS units was selected in consultation with the Stakeholder Engagement team. It was decided to use the River Gum colour for the BESS units.

Since this project is considered as a community energy project, a comprehensive stakeholder engagement plan needs to be developed including a risk assessment for the final BESS solution.

Table 5 details the regulatory lessons learnt of this project.

Table 5: Regulatory lessons learnt

No	Situation	Action
1	The energy market is evolving as we transition to renewable energy. The market ancillary service specifications are constantly being reviewed and updated. Participation in consultations are important to understand latest guidelines and specifications	UE was successful in receiving a ring-fencing waiver from the Australian Energy Regulator[7] (AER) for this project As part of the AER's current review of ring-fencing guidelines, UE referenced projects such as this to highlight that distributors should not be excluded from providing battery systems as this will unnecessarily increase the cost of these innovative new network services or stifle there development altogether. It should be noted that this is due to distributors having: • established teams, systems and processes for equipment installation and commissioning; • access to land and network infrastructure from existing sites and existing relationships with local councils and community groups, providing flexibility for locating near constraints; • economies of scale as they already operate and maintain and high volume of distributed assets; • a single network control system to maintain; and • expertise in managing the risk of outages and reliability events on a daily basis across their entire network. To further offset the cost to provide network services through innovative storage projects,

[7] https://www.aer.gov.au.

No	Situation	Action
		and lower costs to consumers, distributors can competitively bid and lease battery capacity for provision of market services and offset overall costs based on the value of the expected market services. UE has also actively participated in the Australian Energy Market Operator[8] (AEMO) market ancillary services specification (MASS) consultations[9] to review and understand the proposed changes to specifications. To be compliant to AEMO frequency control ancillary services (FCAS) specifications, a dedicated fit-for-purpose meter was required.

In this project, UE is demonstrating that distributors can deliver broad benefits for customers through investment in innovative technology such as energy storage.

This project is specifically:

- supporting reliability of electricity supply in the community, particularly during peak demand times;
- increasing the network capacity to allow more homes to connect and export from rooftop solar PV systems;
- improving the quality of electricity supplied by our distribution network; and
- helping reduce network charges for customers by avoiding traditional network upgrades that might otherwise be required.

[8] https://aemo.com.au/en.
[9] https://aemo.com.au/en/consultations/current-and-closed-consultations/mass-consultation.

3. Conclusion

This report summarises the key lessons learnt at the early stages of the project which covers the project management, commercial, technical, social and regulatory aspects.

It should be noted that as the project progresses, further lessons learnt will be made and such learnings will be captured and reported in subsequent public reports.

4. Glossary of Terms

The following terms are referenced within this document:

Term	Description
AEMO	Australian Energy Market Operator
AER	Australian Energy Regulator
ARENA	Australian Renewable Energy Agency
BAU	Business As Usual
BESS	Battery Energy Storage System
CFA	Country Fire Authority
SEPP	State Environment Protection Policy
EMF	Electromagnetic Field
EPA	Environment Protection Authority
FAT	Factory Acceptance Testing
FCAS	Frequency Control Ancillary Services
FRV	Fire Rescue Victoria
LV	Low Voltage
MASS	Market Ancillary Services Specification
NCC	Network Control Centre
PMP	Project Management Plan
PV	Photovoltaic
SiD	Safety-in-Design
UE	United Energy
VPN	Virtual Private Network