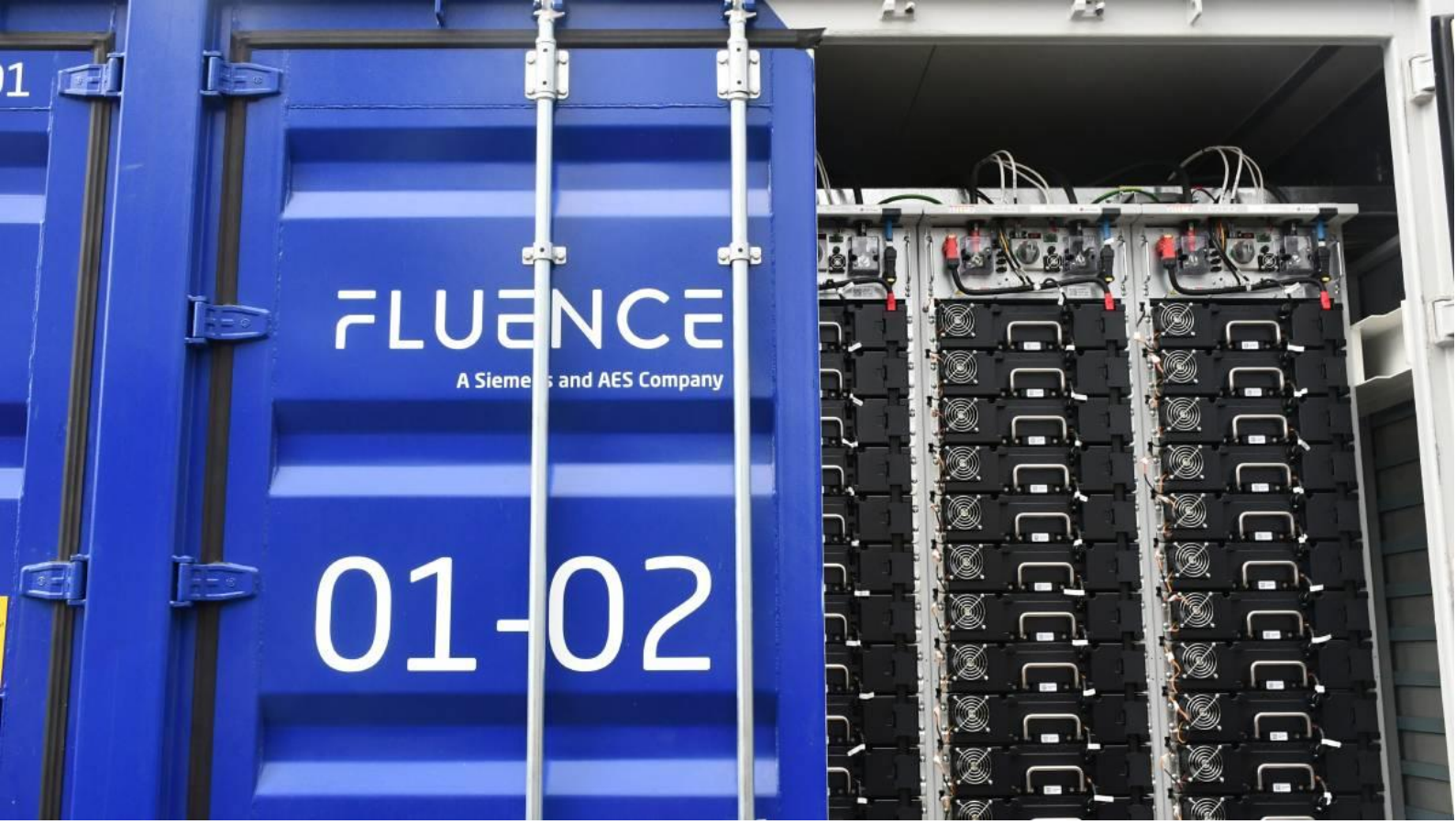

Ballarat BESS: Knowledge Sharing Report

Ballarat Terminal Station (BATS)

Prepared for the Victorian Government and ARENA

Revision	Date
Final	07/08/19

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Glossary of Terms

Term	Description
AC	Alternating Current
AEMO	Australian Energy Market Operator
AER	Australian Energy Regulator
ARENA	Australian Renewable Energy Agency
BATS	Ballarat Transmission Station
BAU	Business as Usual
BESS	Battery Energy Storage System
BOP	Balance of Plant
CB	Circuit Breaker
CEMP	Construction Environmental Management Plan
CPI	Cost Performance Index
D&C	Design & Construct
DC	Direct Current
DOC	Distribution Operations Centre
Dvar	Dynamic Voltage Amp Reactive
EEO	Equal Employee Opportunity
EMP	Engineering Management Plan
EOI	Expression of Interest
EPC	Engineering, Procurement, and Construction
EPMP	Emergency Preparedness Management Plan
EV	Earned Value
FCAS	Frequency Control Ancillary Services
FFR	Fast Frequency Response
GPS	Generator Performance Standards
HVAC	High Voltage air Conditioning
Hz	Hertz
IMS	Integrated Management System
ITP	Inspection and Test Plans
ITR	Inspection Test Report
KPI's	Key Performance Indicators
kV	Kilovolts
LTIFR	Lost Time Injury Frequency Rate
LV	Low Voltage
MASSVT	Market Ancillary Service Specification Verification Tool
MW	Megawatt

MWh	Megawatt hour
NCC	Network Capability Component
NCIPAP	Network Capability Incentive Parameter Action Plan
NCRs	Non-Conformance Reports
NEM	National Electricity Market
NER	National Electricity Rules
NPV	Net Present Value
O&M	Operation and Maintenance
PACSIS	Relay Settings Data Base
PC	Practical Completion
PCMP	Project Controls Management Plan
PMO	Project Management Office
PMP	Project Management Plan
PSCAD	Power System Computer Aided Design
PSMP	Procurement & Supply Management Plan
PSS/E	Power System Simulator for Engineering
QMP	Quality Management Plan
R&D	Research and Development
RFI	Requests for Information
RFP	Request for Price
RMP	Risk and Opportunity Management Plan
RoCoF	Rate-of-change-of-frequency
SCADA	Supervisory Control and Data Acquisition
SCIMS	Station Control & Information Management Systems)
SCMP	Stakeholder & Communications Management Plan
SMP	Safety Management Plan
SOC	State of Charge
SPI	Scheduled Performance Index
TMP	Transition Management Plan
TNSP	Transmission Network Service Provider
TOC	Transmission Operations Centre
TRIFR	Total Recordable Injury Frequency Rate
TUOS	Transmission Use of System
Tx	Transformer
WBS	Work Breakdown Structure
WRMP	Workplace Relations Management Plan

1. Executive Summary

This report has been prepared to provide information with regards to the installation and commissioning of a utility scale, transmission asset connected, Battery Energy Storage System. It details the steps undertaken during the planning, design, installation, commissioning, and performance testing phases, including R2 and FCAS.

Key results and lessons learnt:

- Delays were experienced due to the unique consortium arrangement and the necessity for multiple funding partners created a challenging contractual and commercial environment. The interdependence of all the associated agreements and the technical assessments delayed financial close.
- The Ballarat Transmission Station was previously operated by the State Electricity Commission (SEC) and the location of obsolete in ground assets was not clearly defined. This delayed the preparation of the site placing the construction phase into a non-optimal weather window.
- The BESS System is connected directly to the transmission network through a single point of coupling and a complexity is that the system could not be connected to the network prior to registration and the system could not be registered until it had been tested to the satisfaction of AEMO.
- The development of the R2 Test Plan and the subsequent R2 testing was extensive and the requirement for full testing of the system as both a Generator and a Load was additional to expectations.
- The application of Battery Energy Storage System for Frequency Control Ancillary Services (FCAS) was not defined in the AEMO FCAS Verification Tool User Guide and as such use of the Market Ancillary Service Specification Verification Tool (MASSVT) was not ideal suited for BESS FCAS testing. This resulted in AEMO producing a guide to registering BESS for FCAS informed by the experience with BATS BESS.
- The strong response time by BATS BESS – both in terms of FCAS provision and peak power dispatch displays better performance than the market pays for.
- BATS BESS is capable of monetising additional services if the market would reimburse FFR, synthetic inertia and Volt/VAR for example.
- The BATS BESS project has demonstrated for the development of future transmission connected projects to be cohabited with transmission and distribution assets.

2. Introduction

The Ballarat Transmission Station (BATS) Battery Energy Storage System (BESS) is a consortium project undertaken by the Spotless / Downer Group, Fluence, Ausnet Services, and Energy Australia. The project was identified during the Victorian Government Energy Storage Initiative tender process and is one of two projects under that program. The Victorian Government and the Australian Renewable Energy Agency (ARENA) through the Advancing Renewables Program contributed $25 million in grant funding for this project.

The project is a first of its kind in Australia, being installed in front of the meter and directly connected to transmission assets.

The BESS is 30MW / 30MWh and utilises Lithium Ion battery technology and is directly connected to BATS No2 transformer via a 22kV 40MVA tertiary winding.

The BESS is designed to operate at 250 full cycle charge and discharges per annum and is registered to operate as a 30MW generator, 30MW load, regulation Frequency Control Ancillary Services (FCAS) raise and lower, and all six contingency FACS markets.

2.1 Background

On 23 February 2018, Spotless entered into a contract with AusNet for the design, supply, construction and commissioning of a 30MW/30MWhr battery energy storage system as part of the Victorian Government's energy storage initiative.

Spotless also entered into supply agreements with the Australian Energy Market Operator (AEMO) and Energy Australia who will operate/trade the plant once operational. Spotless also signed Agreements with the Independent Certifier and a Funding Agreement.

The value of the project is $33.2 million, that achieved a Date for Substantial Completion on 5 October 2018.

Essentially Spotless took the balance of plant responsibility for the delivery of the project with the main battery technology coming from Fluence Energy out of USA.

In March 2018 project-management of the project was transitioned to Downer Utilities Pty Ltd.

2.2 Project Location

124 Coulsons Road, Warenheip VIC 3352

2.3 Project Description

The Victorian Government Energy Storage Initiative encompasses the design, construction, operations and maintenance of (BESS) at the Ballarat Terminal Station (BATS). BATS is owned and operated by AusNet.

The purpose of the BESS is to strengthen the Victorian electricity network and to enable further renewable electricity generation investment.

Given the nature of the project and the strength of existing relationships with AusNet, it was agreed to engage key Downer personnel from its Utilities Business to lead the management of the project.

2.4 Scope of Work

The scope of work is a mandatory requirement of Downer that all projects must develop to provide:

- a complete, clear and unambiguous statement of the project deliverables in measurable terms; and
- a detailed description of the work required to be performed to achieve the deliverables.

The approved scope of work for the project, including battery limits and exclusions, is detailed in AusNet D&C Agreement, Energy Storage Initiative Funding Agreement, Equipment Supply and Services Agreement.

2.4.1 Scope of Work Summary

The following are a summary of the key physical components of the Scope of Work for the project:

- Design – Civils, structural, electrical & SCADA
- Locate existing services and relocate or remove as required
- Cut Bench, prepare site, install new storm water & road
- Core drill, cast & cap enclosure pilling
- Construct equipment footings, inverters, HVAC, transformers
- Install HV conduits, LV culverts, AC, DC & fibre cables
- Procure & Install e-house
- Install enclosures, batteries, inverters, HVAC and transformers
- Load batteries
- Procure & install 415 AC LV distribution board
- Commissioning & testing

2.5 BESS Limits

The following are a summary of the battery limits for the project:

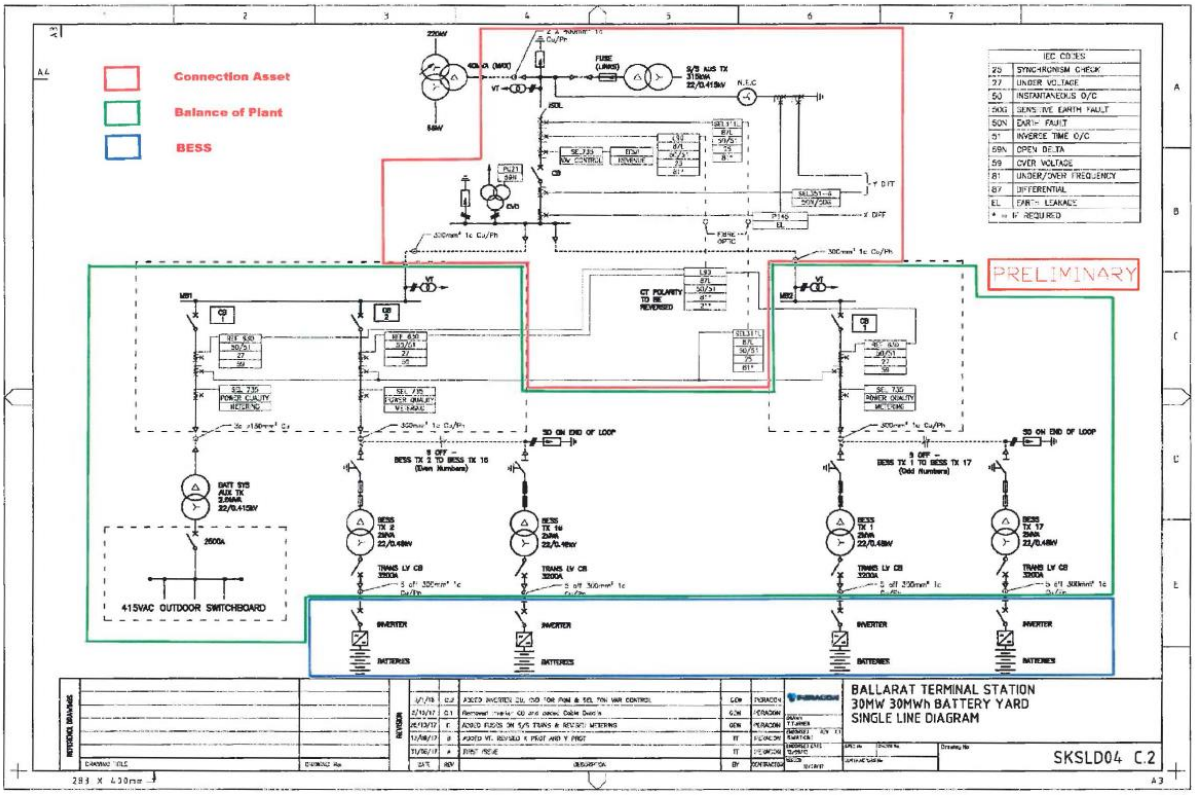


Figure 11 Battery Limits

	Design	Bulk Earthworks	Civils	Structural Installation	Electrical Installation	Battery Installation	AEMO Registration	Commissioning
Fluence	X					X		X
Downer	X	X	X	X	X		X	X

Table 1 Downer-Fluence Scope Overview

2.6 Exclusions

The following are a summary of the exclusions from the Scope of Work:

- Connection Asset – AusNet Services will provide engineering, procurement, construction and commissioning of a suitable 22kv feeder from the 22kv tertiary winding of the BATS B1 220kv / 66kv / 22kv Tx to the 22kv terminals of the MV switchgear at the PCC. A revenue meter will be installed on the feeder Refer to the Red Box in the figure under 2.5 BESS Limits.

Summary of further exclusions from the Scope of Work:

- Connection Asset – Electrical and fibre optic infrastructure between 22kv feeder from the 22kv tertiary winding of the BATS B1 220kv / 66kv / 22kv Tx to the 22kv terminals of the MV switchgear located in the BESS switch room.

- BOP – Electrical and communications infrastructure between the incoming 22kv cable terminations to the 22kv MV switchgear located in the BESS switch room and the BESS inverter terminals.
- Civil works, security systems, fenced area (if required), access road, communications to BATS fence line.
- BESS – BESS inverter blocks with AC cabinets.
- Battery enclosures with Batteries, HVAC and Fire suppression system.
- Software and remote servers.

2.7 Scope of Services

The scope of services for the Project Team includes the following activities within the defined BESS limits:

A. Project management, including the management and control of budget (costs), schedule, design, procurement, quality, risk, resources, stakeholders, safety and the environment
B. Procurement and logistics of equipment, bulk materials and consumables
C. Construction equipment transport, cranage and logistics for the project
D. Provision of all labor, plant, equipment, supervision and all other items necessary to perform the work as detailed under the contract, typically for:
    - surveys
    - earthworks
    - piling/ piers and detailed civil works
    - structural steel installation
    - supply and installation of high voltage (HV) and low voltage (LV) electrical works
    - Engineering services
    - GPS approval and AEMO Registration
    - Commissioning

Figure 1 BATS BESS

3. Document Purpose and Distribution

3.1 Purpose of Document

This document is a public Report issued as part of the Knowledge Sharing commitments of the BATS BESS, in accordance with the Funding Agreement. Knowledge Sharing is an integral component of the Project and a requirement of ARENA, who as contributed funding support through its Advancing Renewables Programme.

The Knowledge Sharing Report focusses specifically on core components of the Project delivery, and lessons learnt on the journey from financial close to commissioning, including:

- Pathway to Financial Close
- Downers Project Management Organisation
- Risk Management
- Environmental Management
- Quality Management
- Safety Management
- Project Controls
- Design & Engineering Management
- AEMO Registration
- Procurement
- Commissioning
- Testing
- Operation
- Lessons Learnt & Challenges

3.2 Intended Distribution

This document is intended for the public domain and has no distribution restrictions.

4. Pathway to Financial Close

4.1 Government Policy

The $25 million Energy Storage Initiative was announced by the Premier, and the Minister for Energy, Environment and Climate Change in 2017.

Supporting the integration of energy storage is one of the actions outlined in the Victorian Government's Renewable Energy Action Plan, released in July 2017.

The Energy Storage Initiative supported and assisted energy storage technologies and projects to improve the reliability of the Victorian electrical system, drive the development of clean technologies, and boost the local economy. It has enhanced system security, resilience and reliability, especially in peak demand periods.

4.2 Expression of Interest

The Victorian Government issued an Expression of Interest (EOI) for the supply of Battery Energy Storage project for the Western region of Victorian that was responded to by the Spotless Group.

Spotless Group was committed to developing a consortium approach to provide the best outcome for the initiative. The Expression of Interest was submitted April 2017.

4.3 Request for Proposal

The Spotless Group was successful during the EOI phase and began to work with Fluence, Energy Australia and Ausnet Services to develop the consortium model. A unique opportunity was formed with a transmission connected, in front of the meter proposal. The RFP was submitted in June 2017 and the consortium was successful in proceeding through to provide further details to the Government appointed expert assessment panel.

4.4 Expert Panel Presentations

An expert panel was convened by the Victorian Government to assess the proposal submissions. The panel consisted of representatives from Government, Industry, and Network Planning.

A series of presentation were delivered to the panel, providing financial, commercial, and technical details and the overall electrical network benefits. The panel provided a pathway for the consortium to provide greater surety of the project's success and pre-financial close works commenced.

4.5 Pre-engineering

Early works pre-engineering commenced in August 2017. During this phase the design was further developed to 80 percent completion and drawings and schedule prepared for the implementation phase to commence as soon as financial close was reached.

4.6 Network Studies

The Generator Performance Study was a prerequisite to obtaining financial close and was undertaken with the assistance of AEMO. Early engagement with AEMO provided valuable information regarding the connection and approval process and the GPS studies commenced in October 2017. AEMO provided timely feedback throughout the process and assessed the information as it was provided. This enabled the team to update the studies accordingly. With AEMO's assistance and using experience modelling teams the 5.3.4a letter was issued by AEMO on the 25th of January 2018.

5. ASSOCIATED PROJECT PARTIES

Spotless is a leading provider of integrated facilities services with clients across Australia and New Zealand. They depend on us to provide services that are essential to the everyday running of their businesses.

Spotless has a revenue close to $3B in the period ending 30 June 2018. Spotless is publicly listed on the Australian Securities Exchange (ASX: SPO) and headquartered in Melbourne.

Spotless is 88 per cent owned by Downer EDI Limited (DOW), and together we are the leading provider of integrated services in Australia and New Zealand.

Downer is one of Australia's largest and most experienced providers in the renewable energy market and power systems sectors, delivering services to customers requiring both utility and commercial scale sustainable energy solutions.

More than 2.3 GW of renewable energy is generated by plants Downer has built or is currently delivering.

We offer trusted services and integrated solutions required for the entire asset lifecycle including procurement, assembly, design, construction, commissioning and maintenance for a range of renewable assets specifically in the wind, solar and power systems storage sectors including transmission and substations.

Solar farms include Sunshine Coast, Numurkah, Limondale, Clare, Ross River and Beryl. 14 wind farms since 2003 including Ararat, Mt Mercer and Taralga.

For more than 100 years, AusNet Services has been supplying energy to and from homes and businesses across Victoria 24 hours a day, seven days a week.

Today we are a diversified Australian energy infrastructure business, owning and operating almost A$13 billion of electricity and gas network assets.

We have more than 1,900 employees working across our three regulated networks – electricity transmission, electricity distribution, and gas distribution - and Mondo, our commercial energy services business.

We are committed to maintaining a safe and trouble-free energy supply for our customers at all times. At the same time, we are harnessing the opportunities being created by new technology and Australia's transition to renewable energy to build a truly customer-focused modern energy business.

Energy Australia is one of the country's leading energy retailers with around 1.7 million electricity and gas customers across eastern Australia. Our heritage in the Australian energy industry dates back almost a century. Today, we supply our retail, business, commercial and industrial customers from a modern energy portfolio underpinned by coal and gas power plants as well as newer energy sources like wind, solar and batteries. Energy Australia is owned by CLP Group, one of the oldest and largest integrated power businesses in the Asia Pacific. We employ around 2,500 people across Victoria, New South Wales and South Australia.

Fluence is the result of two industry powerhouses and pioneers in energy storage joining together to form a new company dedicated to innovating modern electric infrastructure. In January 2018, Siemens and AES launched Fluence, uniting the scale, experience, breadth, and financial backing of the two most experienced icons in energy storage.

The Fluence team encompasses more than 10 years of experience deploying and operating energy storage. Fluence is driving change by opening new markets to storage around the world and has the largest deployed fleet of energy storage projects of any company.

For more information on the Project, please visit the Ballarat Energy Storage System Project website located at the following we-addresses:

https://www.ausnetservices.com.au/Projects/Battery-Storage

6. Timeline Overview

Appendix A provides the final as-built construction schedule through to commissioning which shows more detail on the actual timeline performance.

Milestone	Date completed
EOI	13 June 2017
RFP	07 June 2017
Project Financial Close	05 March 2018
Project mobilisation date	02 April 2018
First Container shipment received	06 June 2018
Final Battery shipment received	29 June 2018
Battery install completed	27 September 2018
Hot commissioning complete	05 October 2018
AEMO registration	06 November 2018
Hold Point 1 release by AEMO and site back energisation	07 November 2018
Hold Point 2 release by AEMO	19 November 2018
Hold Point 3 release by AEMO	30 November 2018
Commissioning / PC / FCAS	30 November 2018

7. Downers Project Management Plan

7.1 Purpose

The Downer Project Management Plan (PMP), and related subordinate functional management plans, defines the project specific management structure and resources as well as the principles, processes, procedures, systems, tools, and templates implemented for use throughout the duration of the Ballarat Battery Energy Storage System Project, hereafter referred to as the project.

This PMP has been developed with an understanding of and compliance with specific requirements defined by AusNet, and the requirements of other relevant stakeholders.

The PMP:

- satisfies the requirements of the contract.
- supports the Project Team in completing the requirements of the project; and
- ensures the delivery of the project to the agreed budget, schedule and quality.

7.2 Project Management Plan Scope

The scope of this Project Management Plan (PMP) applies to Infrastructure Services and Engineering, Construction and Maintenance; and New Zealand, hereafter referred to as Downer.

This PMP applies to all aspects of the project.

The target audience for this PMP is the Project Team (irrespective of location and employment status, e.g. on or off site, and part or full time), subcontractors, visitors and any other relevant stakeholders.

7.3 Project Management Framework

The Downer project management framework aligns and integrates the project functions which define the project's delivery methodologies and processes. The Project Management Plan (PMP), as a key element of the project management framework, is the integration document which identifies and details both the standard Downer project management practices, structure, and execution methods and any project specific requirements for the project.

The PMP incorporates a number of subordinate management plans which provide the specific functional detail required to successfully delivery the project, as illustrated in the following figure:

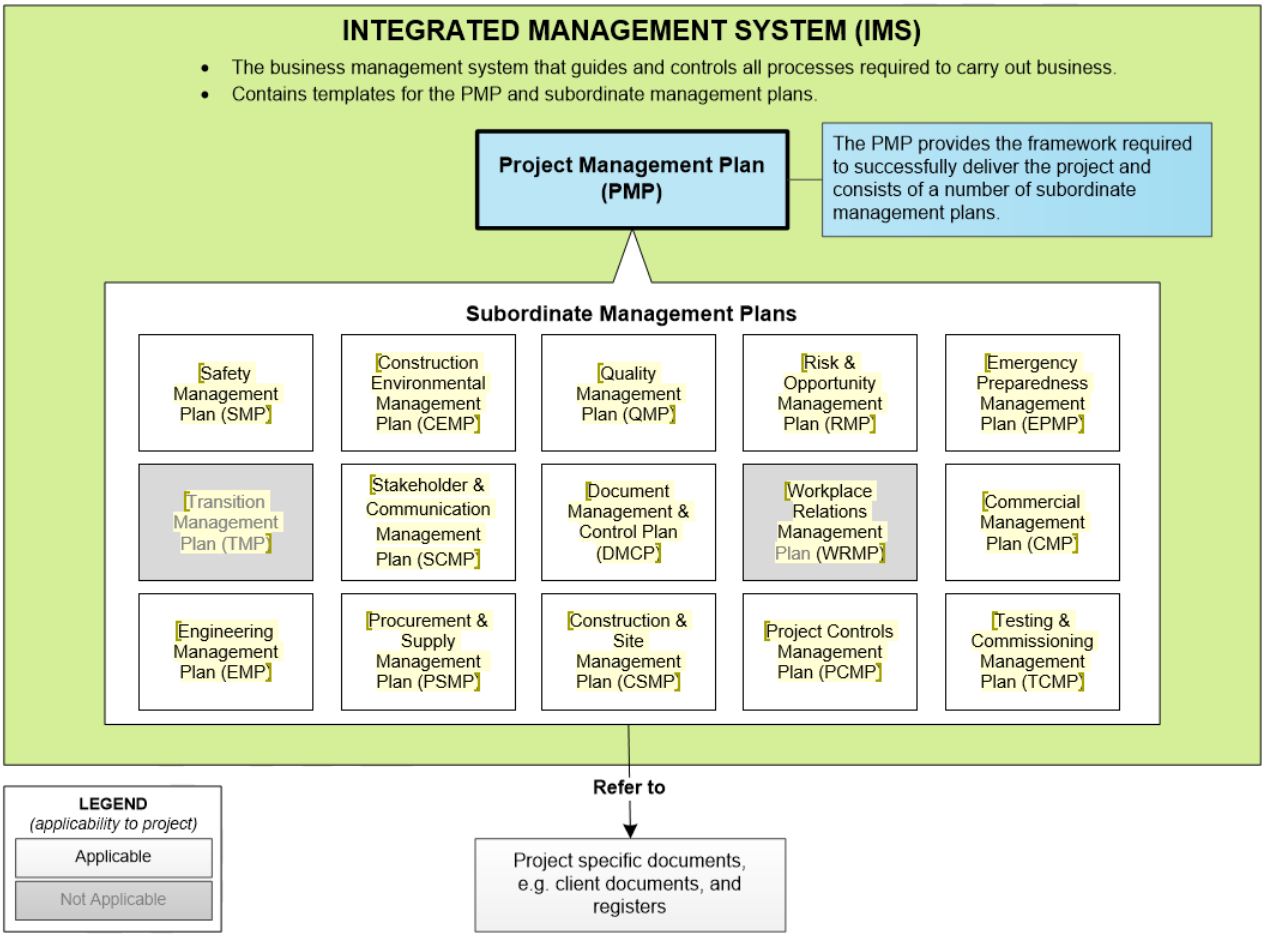


Figure 11 Project Management Plan Structure

The plans reference any IMS documents (including but not limited to, procedures, work instructions, and forms), AusNet specific requirements, and project specific documents required to execute the project.

The PMP provides project specific details including, but not limited to, the following:

- Project information, i.e. background, project location, and project description
- Scope of work i.e. scope of work narrative, basis of design, battery limits, and scope of services; and
- Project objectives and values, i.e. objectives, overarching principles, values, and key performance indicators (KPIs) for the project.

The PMP and subordinate management plans were audited throughout the duration of the BATS BESS project to maintain compliance and was updated as required. Updates to the PMP and subordinate management plans are subject to the document review and approval process detailed in the project's Document Management & Control Plan.

7.4 Standards & Legislation

The following standards and/ or legislation apply to all project functions:

- All Australian and Manufacturing Standards specified in the AusNet D&C Agreement
- AusNet Service Standard
- AEMO GPS (Generator Performance Standards)

The standards and/ or legislation applicable to specific project functions (e.g. Safety, Environment and Risk) are detailed in the relevant subordinate management plans.

7.5 Project Information

The information in the following sections on project background, location and description have been taken from document(s):

- AusNet D&C Agreement
- Energy Storage Initiative Funding Agreement
- Equipment Supply and Services Agreement

8. PROJECT MANAGEMENT IMPLEMENTATION

8.1 BATS BESS Project Management Overview

Project management is the application of knowledge, skills, tools and techniques to the broad range of activities in a project to meet or exceed stakeholder requirements and expectations.

The leadership of the project's management team and the execution of this Project Management Plan (PMP) and associated subordinate management plans ensures that capable and available resources are used in the most effective and efficient manner, i.e. right way first time. This PMP integrates and harmonises all project functions in the delivery of common project objectives.

All AusNet, stakeholder and project specific requirements were captured by each functional discipline to clearly differentiate between Downer "business as usual" processes and procedures and those additionally required for the BATS BESS project.

Downer's project management methodology and framework ensured the effective management of the key project drivers of time, cost, scope and quality, and guaranteed the successful delivery of the BATS BESS project.

8.2 Objectives

The following key objectives have been established by the Project Team to meet Downer and AusNet goals and objectives for BATS BESS.

FOCUS AREA	OBJECTIVE	MEASURES
Health, Safety and Environment	▪ Deliver outstanding project safety and environmental performance ▪ Integrate health, safety and environment considerations into design, procurement, construction and commissioning ▪	▪ Improvement notices or penalties for safety/ environment breaches = 0 ▪ Cardinal Rule breaches = 0 ▪ LTIFR = 0 ▪ TRIFR = 0
Cost	▪ Project completed within approved budget	▪ Earned value (EV) ≥ 1 ▪ Cost Performance Index (CPI) ≥ 1
Schedule/ Time	▪ Complete project on or before scheduled target dates ▪ Achieve scheduled outage durations and minimise disruption to AusNet Services operations ▪ Additional objectives	▪ Earned value (EV) ≥ 1 ▪ Schedule Performance Index (SPI) ≥ 1

FOCUS AREA	OBJECTIVE	MEASURES
Quality Management	▪ All functional audits (e.g. safety, environment and quality) are undertaken to schedule ▪ Project deliverables are to requisite statutory requirements, specifications and standards ▪ Non-conforming products and services are identified and reported for immediate corrective action ▪ Additional objectives	▪ 100 % compliance with audit schedule ▪ Zero overdue non-conformance reports (NCRs) ▪ No repeat NCR's
Risk and Opportunity Management	▪ All project activities and tasks are undertaken with an understanding and control of related hazards, risks and opportunities ▪ Proactive identification of emerging risks and opportunities ▪ Residual risk exposure correlates to project contingency ▪ Additional objectives	▪ Zero overdue risk control plan actions ▪ Project Risk and Opportunity Register and treatment plan updated monthly ▪ Residual risk ratings updated monthly ▪ Additional objectives
People Management	▪ Ensure that all project personnel are regularly consulted on matters that affect safety, environment and quality. ▪ All employees, suppliers and subcontractors are free from discrimination, harassment and bullying in the workplace ▪ Additional objectives	▪ Pre-start meetings held daily ▪ Toolbox meetings held monthly (as a minimum) ▪ Zero Equal Employee Opportunity (EEO) complaints ▪ Additional objectives
Stakeholder Management	▪ Satisfied all reasonable and defined needs of the project stakeholders, including AusNet, community and statutory bodies ▪ Additional objectives	▪ Zero complaints ▪ Compliance with reporting and consultative communication schedule = 100% ▪ Additional objectives

8.3 Governance

Governance was provided internally to the BATS BESS project by the Project Board and externally to the project by Downer's Project Management Office (PMO). The Project Board, as defined by the Downer Project Board Guide, ensures the appropriate level of oversight, resources and support was provided to the project management and project team proportionate to the project's needs and specific risk and opportunity profile.

The Project Board details the key risks, project objectives and project stakeholders in the Project Mandate and executes its governance function primarily by way of regular, structured Project Board meetings, reviewing project metrics, and engaging with key project team members.

8.4 Values

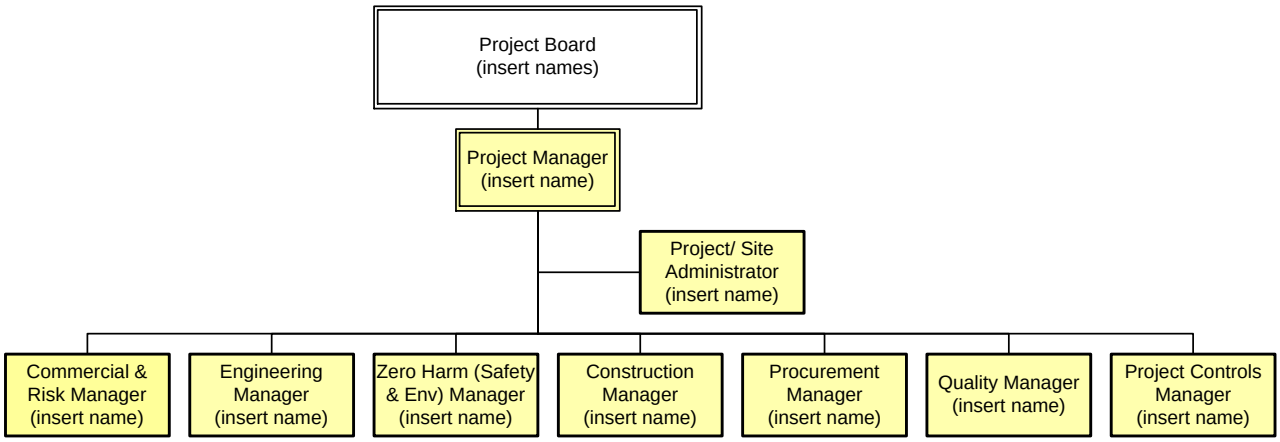
The project objectives in section *8.2 Objectives* are underpinned by the following set of project values that all project personnel work to:

- Continual focus on Zero Harm
- Be positive and team orientated
- Open and honest communication
- Personal accountability and responsibility
- Project and outcome focused
- Work with trust and integrity
- No surprises

9. Project Organisation & Responsibilities

9.1 Organisation Structure

The following figure outlines the key roles in the project's management team. The complete organisation structure for the project is detailed in project organisation chart number and name.



9.2 Responsibilities of Key Project Resources

All Downer workers and visitors have a responsibility to ensure all tasks and activities are undertaken efficiently, with consideration of the safety and environmental risks and quality requirements for the activity.

The Project Manager has overall accountability for the timely execution of the project and ensuring that contract requirements are satisfied in accordance with:

- AusNet specific requirements
- statutory obligations
- the Project Management Plan (PMP); and
- any related management principles, processes, procedures, systems, tools, and templates defined in the related subordinate management plans.

All roles in the Project Team have a clearly defined role with a set of responsibilities. All members of the Project Team are made aware of and understand their responsibilities prior to commencing work on the project.

The project's Workplace Relations Management Plan details the complete set of responsibilities for each project role.

10. Safety Management

Downer, the Project Manager and the Project Team ensured the BATS BESS project site was managed and operated in a safe manner, and Downer workers are trained in health and safety matters that affect their tasks and workplace. The Health and Safety principles, processes, procedures, systems, tools, and templates implemented for use throughout the duration of the project are detailed in the project's Safety Management Plan (SMP).

The SMP has been developed specifically for the BATS BESS project and is read in conjunction with this Project Management Plan (PMP) and other documents referenced within the SMP.

Downer's Cardinal Rules are specific rules that are pivotal to upholding the integrity of the Downer safety management system. The Project Team will use the Cardinal Rules, a risk-based hazard management approach and supporting processes in collaboration with AusNet safety management system to achieve the required project outcomes.

Health and Safety risks are addressed by the Zero Harm risk management process detailed in the SMP and reflected in the Project Risk and Opportunity Register. All project activities and tasks are risk assessed, with the outcome of risk assessments used to define control measures.

The project's Safety Management Plan addresses:

- Contract health and safety targets
- Downer's approach to Health and Safety
- Social and community interaction and engagement
- Downer's Cardinal Rules
- Legislation, standards and procedures
- Downer's safety management system
- Communication, consultation and training
- Incident management and reporting
- Project performance
- Subcontractor and supplier management
- Project safety documentation
- Operational control
- Construction safe work practices.

The project's Safety Management Plan has been developed to meet the contractual requirements of BATS BESS Project and project specific requirements defined by AusNet.

11. Environmental Management

The Project Team ensured that all environmental aspects for the BATS BESS project were identified, impacts assessed, and appropriate controls developed and implemented to manage the associated environmental risks.

Environmental management principles, processes, procedures, systems, tools, and templates implemented for use throughout the duration of the project are detailed in the project's Construction Environmental Management Plan (CEMP).

The CEMP has been developed specifically for the project and is read in conjunction with this Project Management Plan (PMP) and other documents referenced within the CEMP.

Environmental risks are addressed by the Zero Harm risk management process and reflected in the Project Risk and Opportunity Register. Compliance with the CEMP by the Project Team will ensure compliance to all statutory and AusNet specific environmental requirements is achieved throughout the duration of the project.

The project's Construction Environmental Management Plan addresses:

- Project statutory approvals
- Environmental management
- Training and awareness
- Communications
- Monitoring and corrective action
- Incident management.

Further to the above, a specific Construction Environmental Management Plan has been developed to meet the contractual requirements for the BATS BESS and project specific requirements defined by AusNet.

12. Quality Management

The project's Quality Management Plan (QMP) has been developed specifically for the BATS BESS project to satisfy the requirements of the contract, AusNet specific requirements and to support the Project Team in completing the requirements of the project.

The QMP defines the quality management principles, processes, procedures, systems, tools, and templates implemented for use throughout the duration of the project and is read in conjunction with this Project Management Plan (PMP).

The QMP ensures that quality management is embedded throughout all phases of the project, rather than relying on inspection and remedial work to achieve quality outcomes. The strategy of having the right person in the right place, with the right training, with the right material, and using the right system underpins completing the project and all associated tasks, i.e. right first time. Quality management involves the following:

- Quality Planning, i.e. identifying which quality standards are relevant to the project and how to implement them
- Quality Assurance, i.e. ensuring the planned quality activities and processes employed by the project meet the requirements of the contract and key stakeholders
- Quality Control, i.e. monitoring specific project deliverables' results to confirm they comply with requisite quality standards; and
- Right First Time, i.e. utilising lessons learned from previous projects and the results of non-conformance investigations to identify ways to eliminate causes of unsatisfactory performance and prevent re-occurrence.

Further to the above, a specific Quality Management Plan has been developed to meet the contractual requirements for the Ballarat BESS and project specific requirements defined by AusNet.

13. Risk & Opportunity Management

Throughout the duration of the BATS BESS project, day to day small issues arose that required a deeper understanding of the risk and opportunity elements associated with the activity to establish the most effective course of control and treatment.

Analysis methodology for a topic-specific risk and opportunity assessment will depend on the issue requiring analysis. Safe Design, construction, environment, safety, scheduling or commissioning processes will be covered by this type of assessment with the timing of these reviews defined in the relevant subordinate management plans.

The Project Manager and the Project Team ensured that all project activities and deliverables were executed in line with recognised risk and opportunity management guidance and principles and control and treatment plans were developed that relate to the key risks and opportunities faced.

The project's Risk and Opportunity Management Plan (RMP) defines the risk management principles, processes, procedures, systems, tools, and templates implemented for use throughout the duration of the project. The RMP has been developed specifically for the project and allows the Project Team to understand the risks and opportunities associated with the delivery of the project, comply with all statutory and AusNet requirements, and prioritise resources to activities that will best achieve the project's objectives.

The RMP is read in conjunction with this Project Management Plan (PMP) and other associated documents referenced within the project's Safety Management Plan (SMP). The RMP is underpinned by the Project Risk and Opportunity Register which captures project risks and opportunities across all project areas/ functions, including but not limited to:

- Safety
- Environmental
- Quality
- Engineering and design
- Procurement and supply
- Time and schedule
- Cost and budget
- Plant and equipment
- Contractual and commercial
- Labour resourcing; and
- Commissioning.

Further to the above, a specific Risk and Opportunity Management Plan has been developed to meet the contractual requirements for the BATS BESS and project specific requirements defined by AusNet.

The Project Risk and Opportunity Register has been developed based on input from all key project stakeholders.

14. Emergency Preparedness Management

Adequate preparation and response to all foreseeable emergency situations at BATS BESS was key to the successful delivery of the project with zero harm to people, the environment and property.

The principles, processes, procedures, systems, tools, templates and information required to adequately prepare and successfully respond to emergency situations that may arise throughout the duration of the project are detailed in the project's Emergency Preparedness Management Plan (EPMP).

The EPMP has been developed specifically for the BATS BESS project and was read in conjunction with this Project Management Plan (PMP), the project's Safety Management Plan (SMP) and Construction Environmental Management Plan (CEMP), and other associated documents referenced within the EPMP.

The EPMP details all project stakeholders relating to emergency preparedness management (e.g. project emergency management personnel, AusNet emergency response team, external emergency responders, Downer senior management, statutory organisations and the community) and the respective involvement associated these project stakeholders.

The EPMP addresses:

- contact details of key project response personnel and external emergency responders
- the roles and responsibilities of emergency response personnel
- location and type of emergency response equipment and facilities
- location of access, egress and muster points
- communication and training on the EPMP and specific emergency situation scenarios
- recovery and restoration of project operations; and
- evaluation and recording of emergency response drills using a Hot Wash Lessons Learned to share lessons learned with all key stakeholders.

Emergency response risks are addressed using the Zero Harm risk management process detailed in the project's EPMP and are reflected in the Project Risk and Opportunity Register.

Further to the above, a specific Emergency Preparedness Management Plan has been developed to meet the contractual requirements for the Ballarat BESS and project specific requirements defined by AusNet.

15. Transition Management

Transition management is the process of planning, organising, directing, controlling and coordinating all requisite activities to establish Business-As-Usual (BAU) operations at the completion of an asset upgrade project or the change in operating ownership of a facility in preparation for capital or maintenance works.

Transition management for the project was detailed in the Transition Management Plan (TMP). The TMP defines the mobilisation, handover and service design principles, processes, procedures, systems, tools, and resources required throughout the duration of the mobilisation and operational readiness activities at BATS BESS.

Transition management ensures:

- The operational services are designed from the outset to deliver the agreed outcomes with detailed planning to minimises the risk of delays or loss of service during the initial Go Live, ensuring a smooth transition of service. Where new facilities or equipment are required, detailed planning ensures these facilities are available in accordance with the master schedule.
- Change management and value engineering requests are adequately assessed with all risk and opportunities clearly defined and documented for approval.
- All resources are optimised to minimise cost whilst also ensuring adequate and timely availability.

- Where existing staff may be offered new contracts, expectations are carefully managed with the key goal to minimise any impact to the existing operation prior to the Go Live date.
- Adequate handover between phases, e.g. from capital works phase to operations phase.

Further to the above, a specific Transition Management Plan has been developed to meet the contractual requirements for the Ballarat BESS and project specific requirements defined by AusNet and the reasonable needs of other key stakeholders.

16. Stakeholder & Communications Management

Stakeholder engagement, communication and strong community relationships are essential to the success of the project and the Project Team is responsible for providing effective communication and engagement with all stakeholders and supporting positive relationships with the community.

The stakeholder and communications management principles, processes, procedures, systems, tools, and templates implemented for use throughout the duration of the project are detailed in the project's Stakeholder & Communications Management Plan (SCMP).

The SCMP has been developed specifically for the BATS BESS project and is read in conjunction with this Project Management Plan (PMP) and other associated documents referenced within the SCMP.

The SCMP identifies all project stakeholders, (e.g. AusNet, statutory bodies and the community) and the respective needs associated with each stakeholder. Understanding stakeholder needs underpins the establishment of effective communication. The frequency and medium of communication are based on the results of the stakeholder assessment and power interest analysis that is completed during the Handover/ Initiation Phase of the project.

The execution and administration of sound and effective project communications was fundamental to effective decision making and the success of the BATS BESS project.

The SCMP defines the type and frequency of project communications, including but not limited to:

- Requests for Information (RFI)
- using a record of conversation or decision memo to capture verbal conversations
- using site instructions to communicate any task related/ subcontract requests
- distributing incoming correspondence to the Project Team using the project's correspondence distribution matrix
- ensuring meetings include agendas and minutes
- using an action tracking register to track all actions resulting from project correspondence and meetings; and
- using a project calendar to capture recurring meetings, due dates for reports and any other specific requirements for the project.
- The SCMP identifies the risks and control plans for key stakeholders, which are included in the Project Risk and Opportunity Register. Typical control measures include but are not limited to:
- codes of conduct and behaviour standards; and
- grievance and complaints procedures.

Further to the above, a specific Stakeholder & Communication Management Plan has been developed to meet the contractual requirements for the Ballarat BESS and project specific requirements defined by AusNet and the reasonable needs of other key stakeholders.

The Downer/Spotless Project and Site Managers often engaged with neighbours and surrounding community members to update on project specific subjects and align stakeholder expectations.

17. Document Management & Control

Document management for the BATS BESS project is detailed in the project's Document Management & Control Plan (DMCP). The DMCP defines the document management and control principles, processes, procedures, systems, tools, and templates implemented for use throughout the duration of the project.

Document management and control ensured that all:

- project documents were reviewed, approved, distributed and filed in accordance with the correct processes and protocols
- information created by project stakeholders was managed within the BATS BESS project's Document Management System, including the management and distribution of all controlled documents and all formal correspondence ensuring consistency and traceability
- documents were created, formatted and numbered in accordance with correct processes and include any AusNet document numbering and formatting requirements; and
- supplier and subcontractor data were adequately managed, reviewed and distributed.
- The scope of the DMCP covers all engineering, procurement, construction, commissioning and project management activities on the BATS BESS project.

Specific topics addressed by the DMCP include:

- the project's Document Management System and tools
- creating and numbering of project documents
- document filing, review and distribution
- management of supplier and subcontractor data
- project meetings and RFIs
- the project calendar; and
- roles, responsibilities and authorities relating to document management and control.

Further to the above, a specific Document Management & Control Plan has been developed to meet the contractual requirements for the Ballarat BESS and project specific requirements defined by AusNet.

18. Workplace Relations Management

The project's Workplace Relations Management Plan (WRMP) has been developed specifically for the BATS BESS project to satisfy the requirements of the contract, project and location specific requirements and to support the Project Team to effectively manage human resources for the project.

The WRMP defines the employee relations and human resources management principles, processes, procedures, systems, tools and templates implemented for use throughout the duration of the project and is read in conjunction with this Project Management Plan (PMP).

The following core workplace relations principles were maintained throughout the duration of the BATS BESS project:

- Downer workers are the project's greatest asset as they collectively deliver results for the Client.
- People impacts from the execution of the project are considered throughout the duration of the BATS BESS project.
- Workplace relations is managed on an integrated and coordinated project basis.
- All employees, and employees of AusNet, suppliers and subcontractors, are free from discrimination, harassment, and bullying in the workplace.

- Workplace relations risks are identified and captured in the Project Risk and Opportunity Register in accordance with the project's Risk and Opportunity Management Plan.
-

In addition, to manage workplace relations risks throughout the duration of the project the WRMP defines the following fundamentals:

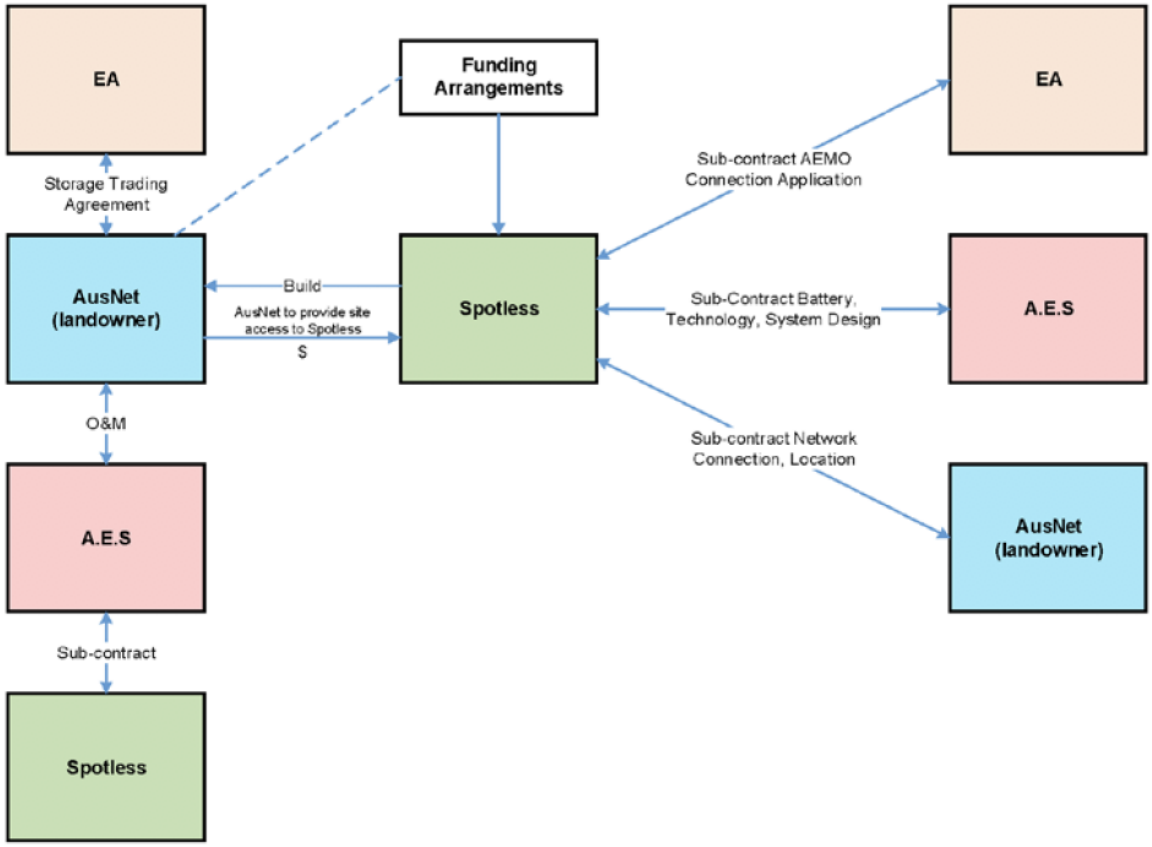
- Human Resources management, e.g. inductions, fitness for work, and performance management
- Employee Relations management, e.g. industrial instruments and codes compliance, and Right of Entry
- Subcontractor employee relations requirements, e.g. pre-qualification, selection, induction, and management
- Workforce capability and development, verification of competency, and maintaining training records
- Community and indigenous relations
- Project resource demobilisation.

19. Contract Structure

The BATS BESS project started within Spotless's Sustainability Team, which has been integrated into Downer's Utility Pty Ltd – Renewables & Power Systems Group during the construction of the BATS BESS within Downer's 89% acquisition of the Spotless Group.

The Spotless Sustainability Team, Ausnet Services, Energy Australia and Fluence (AES & Siemens) formulated a consortium where Spotless was responsible for all consortium partners. Spotless wrapped the complete BESS Solution in the Victorian Energy Storage Initiative so that funding from DELWP (Victorian Government) & ARENA (Federal Government) had one single contractual entity.

- In addition to the above, Spotless wrapped the entire BESS Solution, to subcontract all equipment and services for the delivery of the project, to sign a D&C contract with Ausnet and BESS supply agreement with AES (Fluence)
- Ausnet became the asset owner and funding partner
- Energy Australia is the offtake and funding partner
- AES (Fluence) is the technology provider with BESS performance guarantee that was back to back with Spotless contractual responsibilities
- Separately Ausnet signed an offtake agreement with Energy Australia



19.1 Contract Management

Effective head contract management was essential to the successful delivery of the BATS BESS project's obligations to AusNet and maintaining Downer's commercial position with clear definition of Downer's rights under the head contract.

The principles, processes, procedures, systems, tools, and templates implemented for effective understanding and management of the head contract's rights and obligations are detailed in the project's Commercial Management Plan (CMP).

The Project Manager and Project Commercial Manager were responsible for ensuring that the BATS BESS project executed all of its head contract obligations and provides all head contract deliverables, both cyclical and singular, when required.

The CMP has been developed specifically for the project and is read in conjunction with this Project Management Plan (PMP) and other associated documents referenced within the CMP.

19.2 Contracting Challenges

As Battery Energy Storage Projects require end-to-end continuity by all parties to set expectations and to ensure availability, reliability and performance, the BATS BESS contract nature required the necessity to accommodate multiple funding partners as well as asset owner (AusNet Services) and market intermediary (Energy Australia). This meant that a novel contracting model had to be developed and pioneered for the BATS BESS. A deregulated market, BESS performance guarantees (that would be otherwise standard practice for Fluence but are relatively new for Australian Utilities) added significant time pressure which

required not only innovative procurement and construction methodologies, but also non-standard contract models.

20. Project Controls

Effective project control was essential to the success of the BATS BESS project. The Project Team depended on accurate and timely data to ensure the correct decisions were made and mitigating strategies employed across all project phases and functions.

The project controls principles, processes, procedures, systems, tools, and templates implemented for use throughout the duration of the BATS BESS project are detailed in the project's Project Controls Management Plan (PCMP).

The PCMP has been developed specifically for the BATS BESS project and is read in conjunction with this Project Management Plan (PMP) and other associated documents referenced within the PCMP.

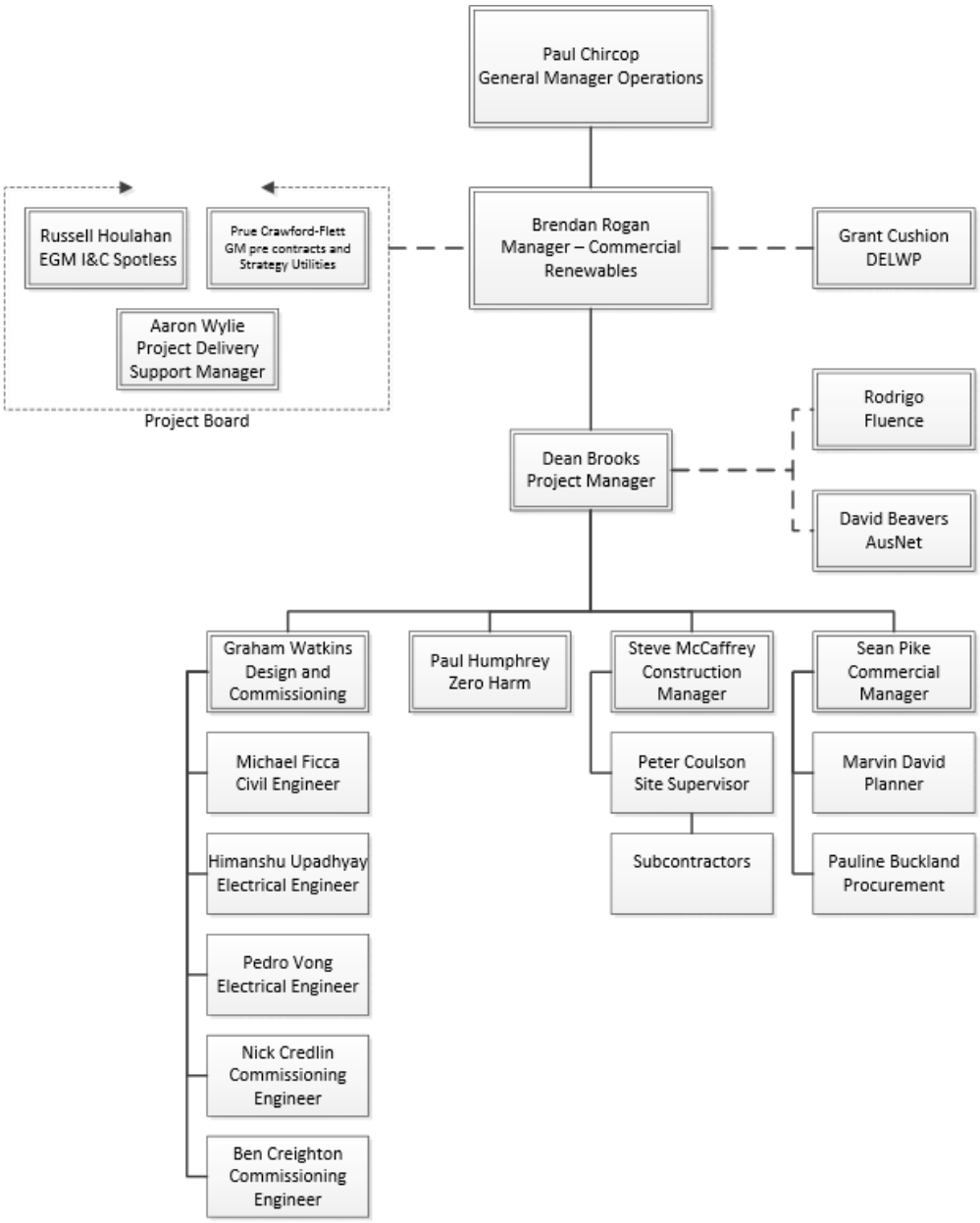
The PCMP provides:

- guidance on the development and management of the key baseline documents, scope of work, budget and schedule, and the various performance measures for the production deliverables throughout the project lifecycle; and
- a detailed description of the project controls system for the project and the interaction of various components.
- The Work Breakdown Structure (WBS) is the common language by which all elements of the project controls system communicate and forms the basis of the hierarchical structure for all reporting.
- The PCMP defines the following key project controls fundamentals:
    - The project baseline scope, budget and schedule were established and documented.
    - Progress and performance were planned, monitored and reported.
    - Costs were analysed, monitored, controlled and reported.
    - Changes that may have impacted on scope, schedule, cost and quality were identified and managed
    - Requisite project controls deliverables were prepared, reviewed, approved and issued that supported effective decision-making.

Further to the above, a specific Project Controls Management Plan has been developed to meet the contractual requirements for the Ballarat BESS and project specific requirements defined by AusNet.

21. Project Delivery Team

The diagram below shows the core Project delivery team from Downer & Spotless in terms of roles, including the basic interactions with stakeholders and contractors.



22. Planning

The Victorian Government Energy Storage Initiative provided a unique opportunity to develop a project, that would lead the way in Australia, with regards to the utilisation of battery energy storage to provide constraint relief, grid stabilization, and peak demand management. ARENA's Advancing Renewable Programme (ARP) supports a broad range of development, demonstration and pre-commercial deployment projects that can deliver affordable and reliable renewable energy for Australian families and businesses.

The Spotless Sustainability team identified that the Ballarat Transmission Station was ideally suited. Incorporating and existing point of connection and available construction zone. BATS is the electrical network transmission hub of Western Victoria connecting to Moorabool near Geelong, Terang to the southwest, and a looping connection through Bendigo, Kerang, Wemen, Red Cliffs, down to Horsham and back to Ballarat.

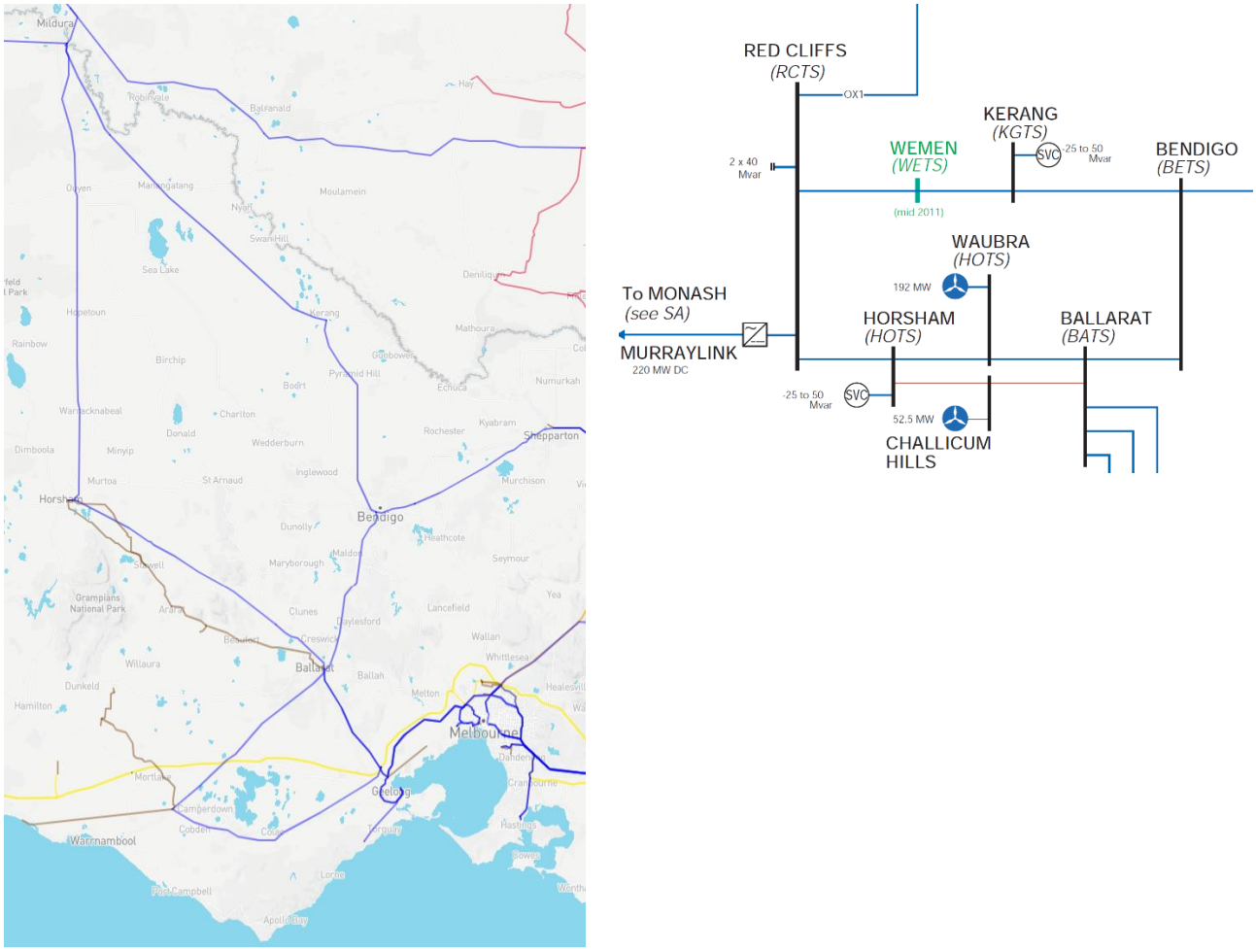


Figure 2 Electrical Network, Source – AEMO

The location places BATS BESS firmly in the centre of the regional wind farms.

The planning phase was extensive and not only included the consortium members but also the City of Ballarat, the State Planning Minister, AEMO network planners, and local community groups and residents.

A community engagement program was developed with the assistance of the Victorian Government and included an open day at the Warrenheip town hall where the details and the importance of the project were

presented to the community by the consortium members. The purpose of the program was not only to provide details of the project's logistics and construction phase but also to provide information regarding the future direction of renewable generation, and network reliability and security. Residents were also visited by the team with specific project information and a monthly newsletter distributed. A community hot line was set up and any concerns addressed. The electrical network studies were also undertaken during the planning phase.

23. Design

The design of the BESS system needed to be adaptive and collaborative. The commercial constraints within the consortium, the funding arrangements with the Victorian Government and the Australian Renewable Energy Agency (ARENA), and the technical requirements of Ausnet Services, Fluence, and Australian Energy Market Operator (AEMO), meant that continued design changes were required.

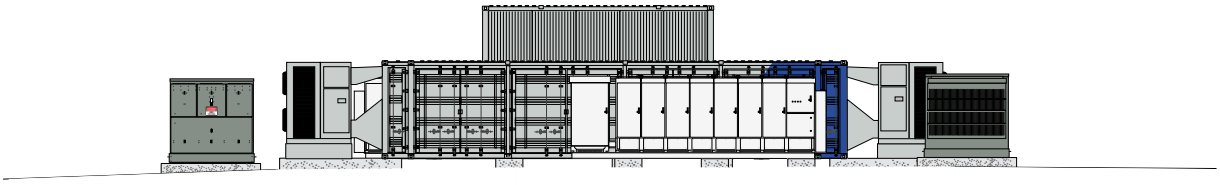


Figure 3 Early Sketch of BATS BESS

A single design team was used to ensure that the connection of the BESS to the BATS point of coupling was integrated, including all the protection systems. These were in turn reviewed by both Ausnet Services and AEMO.

The design team was also used during both the construction and commissioning phases. This ensured that the design not only meet the technical and commercial requirements but the construction, commissioning and maintenance requirements. The team also developed the R2 and FCAS testing plans.

The result is a purpose-built integrated design that, although unique for this application, is adaptive and replicable at other Australian sites and facilities.

23.1 Engineering Management

Engineering management is the process of planning, organising, directing, controlling and coordinating the production of engineering deliverables required for the project scope of work and the contract. To produce the engineering deliverables in accordance with both AusNet and statutory requirements, and the timing defined by the Project Schedule, the Engineering Team undertakes design, specification, calculation, modelling, inspection, measurement and drafting activities.

Engineering management for the BATS BESS project is detailed in the project's Engineering Management Plan (EMP). The EMP defines the engineering and design principles, processes, procedures, systems, tools, and templates implemented for use throughout the duration of the project.

Engineering management ensures:

- the project is designed and able to be constructed, maintained and operated to the appropriate safety standards, by integrating hazard identification and risk assessment methods in the design process to remove or minimise the risks of harm throughout the duration of the project.

- sustainability is included as part of the design process and the entire project lifecycle is reviewed for appropriateness of materials and potential impacts on the environment
- change management of all internal and external changes applies across all aspects of engineering and design against a comprehensive unambiguous baseline covering scope of work, quality, hours, material quantities, labour effort, cost and timing; and
- progress on the production of deliverables is based on earned value and not hours expended and is measured objectively against planned expectations and a predefined deliverable gating structure.

24. Procurement

24.1 Transformers

To ensure we had on-time delivery and support, the 22kV/048kV core transformers were sourced from the Wilsons Transformers Wodonga factory which is located only approximately 380-400km away from the site.

Wilsons were proactive in developing the delivery schedule and providing the transformers to site as required to meet the construction programme.

24.2 Battery Energy Storage System

The Battery Energy Storage System (BESS) was supplied by Fluence. The system included the enclosures, batteries, control systems, and inverters. A comprehensive delivery schedule was developed between Fluence and Spotless / Downer and all equipment was delivered as required to site. The local, Ballarat based Hendersons transport company were used to store equipment prior to site deployment. The integrated BESS approach provided surety of delivery.

24.3 Switchgear

The medium voltage switchgear was supplied by ABB and was required to be expedited during factory production in order to meet the construction program. The switchgear was factory integrated into the containerised e-house. Although delays were experienced during the equipment supply, the overall schedule was maintained.

24.4 Cabling

The cable manufactures quoted extended delivery schedules for all Medium Voltage, low voltage AC, and DC cables of up to 16 weeks. The medium Voltage cables were combined with the Ausnet Services connection asset works and early orders were placed to ensure delivery. The low voltage and DC cables were sourced from Triangular Cables and were manufactured in Port Melbourne on a 6-week delivery programme.

24.5 Supply Management

Procurement and supply were a critical function of the BATS BESS project. Project procurement is risk based and utilises a project procurement schedule detailing each procurement package to ensure all products and services are delivered to plan.

The Project Team understands the importance of managing the entire process and by using planned elapsed durations and working backwards to the completion of the detailed engineering requirements to allow for the timely management of each milestone and expediting, as required.

The following core procurement principles were maintained throughout the duration of the BATS BESS project:

- Procurement activities were only conducted by delegated and authorised project personnel.
- An open and honest procurement environment for all stakeholders was maintained.
- All risks associated with all sourcing options are documented and considered.

- All suppliers and subcontractors are pre-qualified prior to awarding any subcontracts.
- A competitive process was maintained with the aim of utilising a minimum of three quotes for all procurement requirements.

The procurement and subcontracts process are the coordination and management of the following four core processes:

- Planning
- Contract tendering and formation
- Contract administration; and
- Material management.

The project's Procurement & Supply Management Plan (PSMP) has been developed specifically for the BATS BESS project to satisfy the requirements of the contract, AusNet specific requirements, and to support the Project Team in completing the requirements of the project.

25. Installation

The installation of a BESS project within an operational transmission station comes with challenges that are not evident when constructing in a Brown Field / Green Field environment. When executing construction woks on a Brown Field site the constructor relies on previous older information on in-ground services which may be unavailable, inaccurate or hidden and difficult to locate.

BATS have both transmission and distribution assets and the continued operation and security of the network was always to remain paramount during construction.

A temporary fence was installed on site separating the BATS station from the BESS construction work area, a Vicinity Access permit issued, and an Authorised Recipient on site for the entire construction and commissioning periods. The site remained secure at all times and the Authorised Recipient was required to control access.

Earthing systems and step touch potential requirements also needed to be taken into consideration.

To ensure compliance with the Construction Environmental Management Plan, onsite parking and equipment laydown areas were established within the designated work area and the hours of work limited under the EPA Noise Control Guidelines, Publication 1254.

Community engagement continued throughout the construction phase and monthly progress newsletters delivered to all nearby residents.

Figure 4 Installation

25.1 Installation Challenge

The construction program of the project was challenging. The global demand for batteries, cable, switchgear and transformers etc are high, with the lead time of some items in excess of 24 weeks. To ensure that the project remained on schedule some items were expedited while the cable and transformers were procured locally. The switchgear was pre-installed, and factory tested prior to shipping.

The risks associated with administrating a concurrent construction and commissioning works program are high, and with up to eighty workers on a 100 x 50-metre work site, the risks are compounded, when excavating, piling, lifting, and concreting plants are also in operation. Strict adherence to the Downer Project Management Plan and subordinate management systems enabled the project to be completed with zero lost time injuries.

25.2 Installation Success

The successful integration of the project into BATS and the acceptance of the Warrenheip and broader Ballarat community was imperative and as much local labour and services were engaged throughout the project as possible. Local contractors, labour teams, logistic and transport businesses were employed during construction, Ballarat Regional Industries provided recycling services, and what was developed as a unique and specialised infrastructure project also became a community project.

25.3 Construction & Site Management

Construction and site management for the BATS BESS project is detailed in the project's Construction & Site Management Plan (CSMP). The CSMP defines the principles, processes, procedures, systems, tools, and templates implemented for use throughout the duration of the project.

The CSMP has been developed specifically for the BATS BESS project and is read in conjunction with this Project Management Plan (PMP) and other associated documents referenced within the CSMP.

The CSMP addressed the following:

- the construction execution methodology
- the systematic and structured review of constructability, with construction personnel and field engineers providing input into the constructability reviews to ensure Safe Design, safety in construction and cost-effective installation practices were considered
- the planned establishment and ongoing maintenance of both temporary and permanent site construction facilities
- management of site communications, including interfacing with the design team with site instructions, records of conversation, Requests for Information (RFI), daily diaries and progress reports
- implementation of construction quality control by Inspection and Test Plans (ITP) and Inspection and Test reports as per the project's Quality Management Plan (QMP)
- defect management and preparation for completion and handover; and
- site demobilisation of facilities.

In addition to defining the management of all site and construction activities the CSMP details the processes for progress measurement based on installed quantities, and the inputs into project controls for accurate progress performance measurement, forecasting and claims management.

26. Commissioning

The installation of the BESS within the confines of the Ballarat Transmission Station presents additional requirements. Prior to energisation and with the work area segregated from the live network, works could proceed with an Authorised Recipient under a Vicinity Access Permit. Once energised, Electrical Access Permits, and Sanction for Tests are required and a transmission authorised operator and the Transmission Operations Centre (TOC) engaged. The requirement for commissioning power and the changes to the permit conditions means that an extensive pre-commissioning under temporary generation supply was required. This had been understood during design and early commissioning was able to commence.

Control systems commissioning was 85% completed prior to full system power up. This enabled construction and commissioning schedule concurrency to occur, maintaining the overall works program and helped to facilitate on time construction delivery.

One of the constraints during the commissioning and testing phase is the need for the system to be bid into the market for any generation or load dispatching. This requires 30-minute generation and load dispatch targets to be scheduled and submitted to the Energy Australia Physical Markets team and AEMO for market participation. All testing is then undertaken within the limits of the trade.

To assist during this phase, a *dispensation to operate in the NEM for the purpose of commissioning and test* was required. This would enable the commissioning team to operate as closely as practical to the daily commissioning and testing schedule but would allow for variances in testing time, allocated capacity, and test sequencing without incurring non-compliance.

26.1 Testing & Commissioning Management

Commissioning management, including the testing of manufactured items, is the process of planning, organising, directing, controlling and coordinating all of the required steps and tasks to take the facility, or piece of equipment, from confirmed built as designed stage to operational readiness and handover.

Testing and commissioning management for the BATS BESS project was detailed in the project's Testing & Commissioning Management Plan (TCMP). The TCMP defines the commissioning principles, processes, procedures, systems, tools, and templates implemented for use throughout the duration of the project to ensure that:

- all equipment has been installed in accordance with the design, statutory and contractual requirements
- all equipment is finished to the extent required to allow power to be applied for each stage of direction testing, no load testing, load testing and equipment operation
- all defects identified are risk assessed to confirm the impact on the operation of the asset or facility, and the priorities and extent of rectification work is understood and completed to enable final project completion in a timely manner; and
- testing and commissioning activities and the sequence of activities minimises, and where practicable eliminates, the risk to people, property and the environment.
- The rigorous and detailed approach to commissioning as defined in the TCMP ensures all commissioning activities, all checks and adjustments, and all settings and plant conditions, are documented and recorded for training and handover, which forms part of the commissioning records and manual.

26.2 Commissioning Challenges

- Prior to the BATS BESS deployment, the AEMO - GPS standards did not consider the possibility of standalone energy storage assets.
- Due to tight timeframe, elements of registration had to be completed in parallel with financing and construction. AEMO provided support and let Spotless/Downer to submit individual clauses instead of 1 submission.
- Due to the nature of BESS (-i.e. static inverter vs rotary machines-) there was a confusion regarding who sets the BESS system ramp rate. The AEMO rules did not consider that ramp rate as a variable for BESS's.
- It was the first instance of R2 testing for a standalone battery, which required testing operation as both generator and load. Spotless/Downer had to develop the R2 test plan in conjunction with AEMO
- See further detail below in "30. Delays Experienced and Lessons Learned"

26.3 Commissioning Plan

26.3.1 PURPOSE

This plan details the methodology to complete commissioning of 415VAC switchboard and 22kV MV switchgear, which provides interface between BESS and BATS supply transformer (B1).

26.3.2 STAGES

This Commissioning Plan will cover Stage 3 to 5 in the energisation sequence of the BESS Commissioning Programme with reference to Stage 2. Refer Ausnet/Powercor Commissioning Plan for Stages 1 and 2, which captures energisation of 22kV cables to B1 22kV CB, and E-House 22kV bus MB1 and MB2.

Commencement day for energisation of BESS 22kV MV switchgear was planned for 26/09/2018.

Stage 2 – Energise 22kV cables and MV bus MB1 / MB2 *(in conjunction with Ausnet/Powercor)*

Stage 3A – Energise BESS AUX TRANS

Stage 3B – Energise BESS 415V Switchboard

Stage 4A – Energise BESS 22KV/480V TRANS 2 to 16 (Even)

Stage 4B – Energise BESS 22KV/480V TRANS 1 to 17 (Odd)

Stage 5 – Energise BESS TRANS 1 to 17 480V CB, Inverter Banks and Batteries

26.3.3 TIMETABLE – WITH APPLICATION NUMBERS

26/09/2018 **NWA-AKL-100**	07:00	**Issue NWA** covering general commissioning activities and completion of Stages 2 – 3A.
26/09/2018 **NWA-AKL-100**	07:30 to 12:00	**MB1 / MB2 -** Energise 22kV bus MB1 and MB2 *(in conjunction with Ausnet/Powercor)*
26/09/2018 **NWA-AKL-100**	12:00 to 17:00	**BESS AUX TRANS –** Energise, test and commission auxiliary transformer
27/09/2018 **NWA-AKL-101**	07:00 to 17:00	**BESS 415V SWITCHBOARD –** Energise, test and commission 415V AC switchboard
1/10/2018 **NWA-AKL-102**	07:00 to 17:00	**BESS 22kV/480V TRANS 2 – 16** (Even) **-** Energise, test and commission 8 off transformers
2/10/2018 **NWA-AKL-102**	07:00 to 17:00	**BESS 22kV/480V TRANS 1 – 17** (Odd) **-** Energise, test and commission 9 off transformers
1/10/2018 to 31/10/2018 **NWA-AKL-102**	07:00 to 17:00	**BESS TRANS 1 to 17 480V CB –** Energise BESS TRANS 1 – 17 LV CBs, Inverter Banks and Batteries.

26.3.4 Diagrams

SLD Diagrams :

SLD Attached in Appendix 'G' (22kV BOP Energisation Sequence)

26.3.5 EQUIPMENT TO BE COMMISSIONED

Primary Equipment:

Name	Standard	Non-standard
BESS MB1 22kV EARTHING SW	X	
BESS AUX TRANS 22kV CB (MB1 CB1)	X	
BESS INVERTER BANK 1 22kV CB (MB1 CB2)	X	
BESS MB1 22kV BUS VT	X	
BESS MB2 22kV EARTHING SW	X	
BESS INVERTER BANK 2 22kV CB (MB2 CB1)	X	
BESS MB2 22kV BUS VT	X	
BESS AUX TRANS	X	
BESS 415V SWITCHBOARD	X	
BESS 22kV/480V TRANS 2 - 16 (Even), and associated HV ISO/ESW & TR LV CBs		X
BESS 22kV/480V TRANS 2 - 16 (Even) End of Loop Surge Diverter	X	
BESS 22kV/480V TRANS 1 - 17 (Odd), and associated HV ISO/ESW & TR LV CBs		X
BESS 22kV/480V TRANS 1 - 17 (Odd) End of Loop Surge Diverter	X	

Secondary Equipment :

Name	PACSIS relay settings data base	Applied
22kV MB1 CB1 Feeder Protection (ABB REF630)	X	X

22kV MB1 CB2 Feeder Protection (ABB REF630)	X	X
22kV MB2 CB1 Feeder Protection (ABB REF630)	X	X
22kV Cable & MB1/MB2 Bus Protection (GE L90)	X	X
22kV Cable & MB1/MB2 Bus Protection (SEL 311L)	X	X
SEL 735 PQ Metering – 3 off	X	X
Nexus 1500+ VAr Control	X	X
SCIMS	X	X

Proven SCIMS Points: (station control & information management systems)

Department	Initials
TOC/DOC (transmission & distribution operation centres)	NA
HMI	Yes
3rd Party Distribution Business	NA

Remotely Controlled Equipment :

Name	Standard	Non standard
BESS AUX TRANS 22KV CB	X	
BESS INVERTER BANK 1 22KV CB	X	
BESS INVERTER BANK 2 22KV CB	X	
BESS AUX TRANS 415V CB	X	
BESS TRANS 1 480V CB	X	
BESS TRANS 2 480V CB	X	
BESS TRANS 3 480V CB	X	
BESS TRANS 4 480V CB	X	
BESS TRANS 5 480V CB	X	

BESS TRANS 6 480V CB	X	
BESS TRANS 7 480V CB	X	
BESS TRANS 8 480V CB	X	
BESS TRANS 9 480V CB	X	
BESS TRANS 10 480V CB	X	
BESS TRANS 11 480V CB	X	
BESS TRANS 12 480V CB	X	
BESS TRANS 13 480V CB	X	
BESS TRANS 14 480V CB	X	
BESS TRANS 15 480V CB	X	
BESS TRANS 16 480V CB	X	
BESS TRANS 17 480V CB	X	

26.4 Commissioning Risk Assessment

Refer to Appendix 'G' for SLD's indicating energised electrical equipment at each stage.

26.4.1 Identified Commissioning Risk

Stage 2 **Energise 22kV MB1 and MB2 (in conjunction with *Ausnet/Powercor*)**

- New primary equipment at risk of failing under first energisation.
- New line protection in service for first time.

Stage 3A **Energise BESS AUX TRANS**

- New primary equipment at risk of failing under first energisation
- New feeder protection in service for first time

Stage 3B **Energise BESS 415V Switchboard**

- New equipment at risk of failing under first energisation
- Contact with electricity as auxiliary services are energised

Stage 4A **Energise BESS 22kV/480V TRANS 2 – 16 (Even) Loop**

- New primary equipment at risk of failing under first energisation
- New feeder protection in service for first time

Stage 4B **Energise BESS 22kV/480V TRANS 1 – 17 (Odd) Loop**

- New primary equipment at risk of failing under first energisation
- New feeder protection in service for first time

Stage 5 **Energise BESS TRANS 1 – 17 480V CB, Inverters and Batteries**

- New equipment at risk of failing under first energisation
- Contact with electricity as Battery Cores are energised and commissioned.

26.4.2 Control Measures

Refer to Appendix 'G' for SLD's.

Stage 2 **Energise 22kV MB1 and MB2 (*Ausnet/Powercor*)**

- All ITP's and supplemental documentation completed prior to first energisation
- End to End protection checks completed between MB1 / MB2 and BATS 22kV bus. ITP's completed and test results available
- Protection equipment tested and confirmed by all parties
- All SCIMS points confirmed, tested and available for service
- Clearance certificate signed off by relevant parties prior to initial energisation

Stage 3A **Energise BESS AUX TRANS**

- All ITP's and supplemental documentation completed prior to first energisation
- Feeder protection tested, confirmed and placed in service
- All SCIMS points confirmed, tested and available for service
- Clearance certificate signed off by relevant parties prior to initial energisation

Stage 3B **Energise BESS 415V Switchboard**

- All ITP's and supplemental documentation completed prior to first energisation

Stage 4A **Energise BESS 22kV/480V TRANS 2 – 16 (Even) Loop**

- All ITP's and supplemental documentation completed prior to first energisation
- Cable testing performed and recorded for BESS TX 2 to BESS TX 16 cable loop
- Feeder protection tested, confirmed and placed in service
- All SCIMS points confirmed, tested and available for service
- Clearance certificate to signed off by relevant parties prior to initial energisation

Stage 4B **Energise BESS 22kV/480V TRANS 1 – 17 (Odd) Loop**

- All ITP's and supplemental documentation was completed prior to first energisation
- Cable testing performed and recorded for BESS TX 1 to BESS TX 17 cable loop
- Feeder protection was tested, confirmed and placed in service
- All SCIMS points confirmed, tested and available for service
- Clearance certificate signed off by relevant parties prior to initial energisation

Stage 5 **Energise BESS TRANS 1 – 17 480V CB, Inverters and Batteries**

- All ITP's and supplemental documentation was completed prior to first energisation
- CB protection tested and confirmed
- All SCIMS points confirmed, tested and available for service
- Clearance certificate signed off by relevant parties prior to initial energisation

27. Performance Testing

A rigorous set of tests were undertaken prior to commercial operation of the BESS system. In addition to the standard tests required for medium voltage switchgear, cables and cable terminations, transformers, and earthing systems. The protection systems were tested from the 220kV to the 66kV, 22kV, feeder protection, BESS MV relays, through to the transformer settings and LV circuit breakers.

The BATS BESS system is registered as both a market and scheduled generator and load. It is required to undertake Generator Performance and Customer Performance testing to ensure compliance with the National Electricity Rules (NER). The testing was carried out at three hold points at which point different aspects of the system performance are tested and the results reported to AEMO for review and comparison with the GPS / CPS system model.

Test Schedule				
Item	Scheduled Date	Activity	Test Reference	GPS Clause Validation
1		Background power quality measurements (HP1_BESSPQT)	HP1_BESSPQT	
2		Generating unit signal injection tests (HP1_BESSSI)	HP1_BESSSI	S5.2.5.8
3		Power quality test (HP2_BESSPQT)	HP2_BESSPQT	S5.5.5.2 S5.2.5.6
4		Generating system reactive power capability test (HP2_BESSRCT)	HP2_BESSRCT	S5.2.5.1 S5.2.6.1
5		Generating system active power dispatch test (HP2_BESSAPT)	HP2_BESSAPT	S5.2.5.14 S5.2.6.1
6		Generating system reactive power dispatch test (HP2_BESSRPT)	HP2_BESSRPT	S5.2.5.13 S5.2.6.1
7		Power quality test (HP3_BESSPQT)	HP3_BESSPQT	S5.5.5.2 S5.2.5.6
8		Generating system reactive power capability test (HP3_BESSRCT)	HP3_BESSRCT	S5.2.5.1 S5.2.6.1
9		Generating system active power dispatch test (HP3_BESSAPT)	HP3_BESSAPT	S5.2.5.14 S5.2.6.1
10		Generating system reactive power dispatch test (HP3_BESSRPT)	HP3_BESSRPT	S5.2.5.13 S5.2.6.1
11		Generating system voltage reference step test (HP3_BESSVCT)	HP3_BESSVCT	S5.2.5.13 S5.2.6.1
12		Generating system power factor reference step test (HP3_BESSPFT)	HP3_BESSPFT	S5.2.5.13 S5.2.6.1
13		Generating system frequency control test (HP3_BESSFCT)	HP3_BESSFCT	S5.2.5.11 S5.2.6.1
14		Partial generating system trip test (HP3_BESSFTT)	HP3_BESSFTT	S5.2.5.4 S5.2.5.8 S5.2.5.13
15		System event analysis		S5.2.5.3 S5.2.5.4 S5.2.5.5 S5.2.5.8 S5.2.5.9 S5.2.5.10 S5.2.5.11 S5.2.5.12

Table 1 Performance Test Schedule

The performance contracting model that was adopted for the project was vital to ensure that the outcomes that were detailed during the commercial modelling were achieved at practical completion.

The system exceeded the guarantee targets for available capacity, deliverable energy, and round-trip efficiency. These performance guarantees are essential in delivering commercial certainty.

	Performance Test Results 27/11/18
Capacity (MW)	30.13
Energy (MWh)	30.01
RTE %	89.51

Table 1 Performance Results

The BATS BESS is also registered for the eight Frequency Control Ancillary Services markets. These were separately modelled and tested and the results submitted to AEMO for review. The BATS BESS system successfully demonstrated its ability to automatically track shifting frequency and respond rapidly.

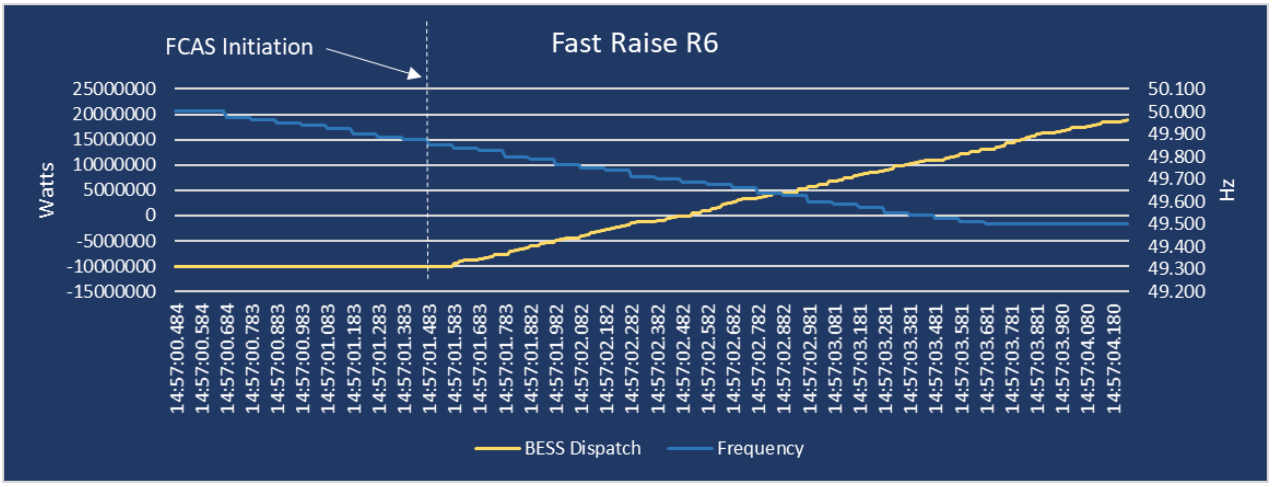


Figure 5 FCAS Results

The BESS system demonstrated its variable control full capacity availability for all contingency services A droop setting of 0.7% enables the system to provide 30MW of dispatch as required into the NEM.

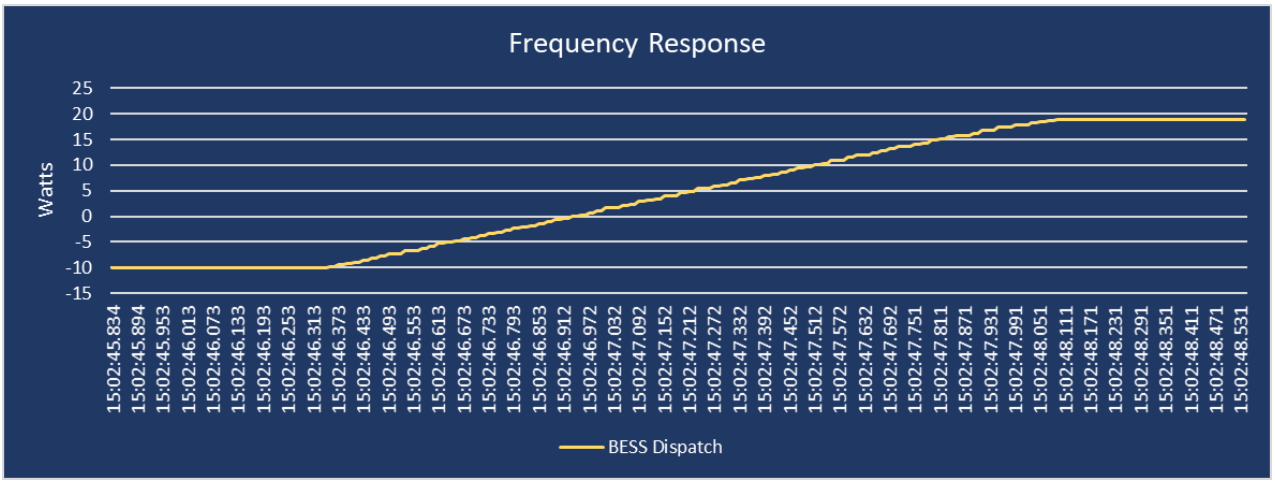


Figure 6 Fast Frequency Response

The BESS system responded to an instant change in frequency from 50Hz to 49.5Hz by shifting the dispatch from 10MW of load to 20MW of generation in under 1.75 seconds.

Additional learnings from the BATS BESS's operation will continue to be gained as the system transitions for the final testing into commercial operation. A high-speed data acquisition system used during the commissioning and testing phase remains installed as part of the final project. The data available from this system will provide further information on the BESS performance in the network.

This data has already been of great value and has demonstrate the BATS BESS response to events at Wemen, Red Cliffs, and a lightning strike and outage at South Ballarat distribution sub-station.

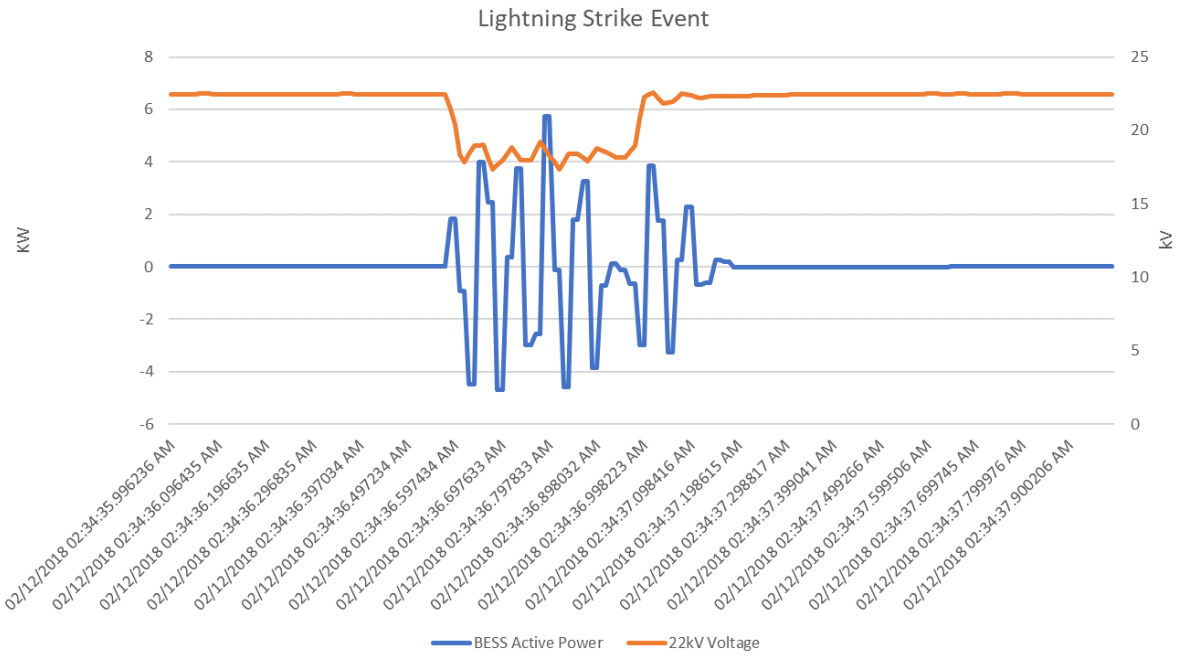


Figure 7 Low Network Voltage Response

Battery Energy Storage Systems are proving to be unique in the NEM when compared to traditional generation and loads. To assist with the modelling and testing, clauses in the National Electricity Rules may require further review. This could provide improved clarity regarding the generation and load and relevant clauses. This would ensure that the system modelling and associated test requirements for reactive power capability four quadrant, active power dispatch, reactive power dispatch, voltage control, power factor control, and frequency control, for both generation and load conditions, are fully understood and the required data and test results are consistently reported.

28. Performance Guarantee

The consortium members Energy Australia and Ausnet Services, and funding partners the Victorian Government and ARENA, provided the funding for the project. Certainty of outcome was required to ensure that the project would deliver the services, performance and value as detailed in the proposal. Energy Australia carried out detailed financial modelling based on historical market pricing, potential emerging ancillary services and the system performance and storage degradation. Ausnet Service as the owner of the asset and in turn Spotless and Fluence needed to provide performance guarantees to ensure that the system fully meets the immediate and long-term requirements.

A performance contracting model was adopted the design, construction and implementation. This model differs from the traditional specification and tender, and design and construct project delivery models. It requires the active participants to engage collectively throughout the entirety of the process. The team that commenced the conceptual development phase of the project have continued though the detail design phase, the GPS and registration phase, project planning and construction, community engagement, through to commissioning and performance testing.

This model has been proven to provide the most reliable delivery outcomes with each phase of the development, design, and specified work packages being verified during the construction, commissioning, testing, and ongoing operational and maintenance phases.

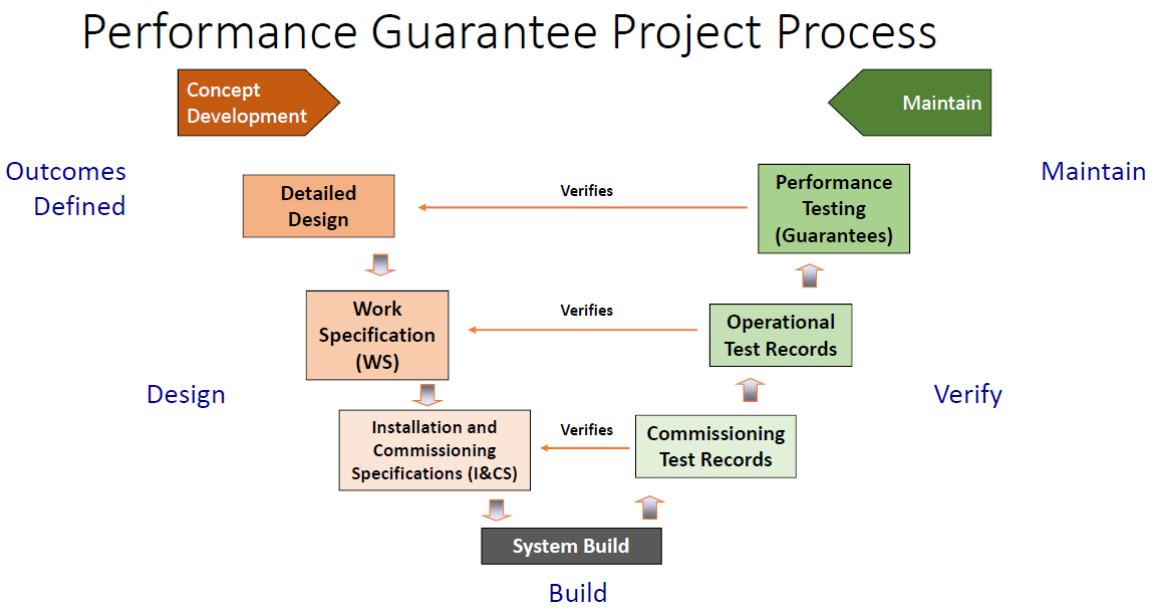


Figure 8 Performance Guarantee Process

29. Entering Operation

In first 3 months of operation, the Ballarat system has been dispatched to provide FCAS over 1,400 times – averaging 15 interventions per day – injecting or absorbing power to compensate for excessive drops or rises in frequency on the Victorian grid.

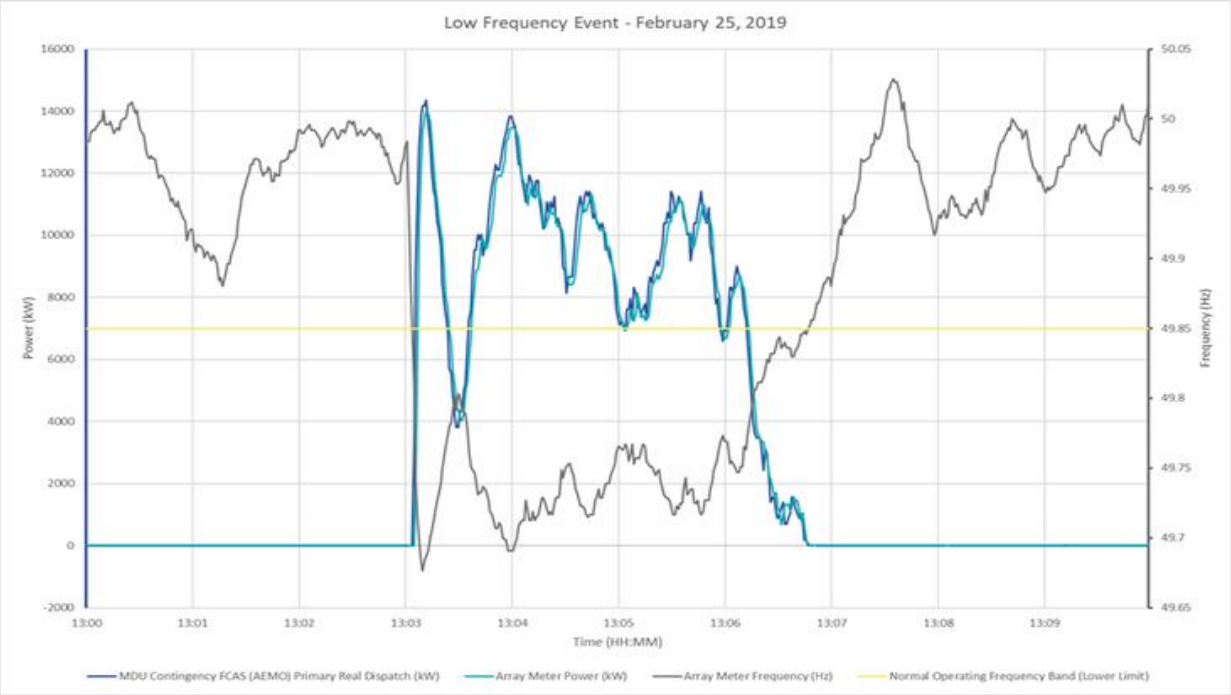


Figure 9 Low Frequency Event

The Ballarat BESS providing power injections daily into VIC/NEM based on EA dispatch, charging and providing load during low-demand periods.

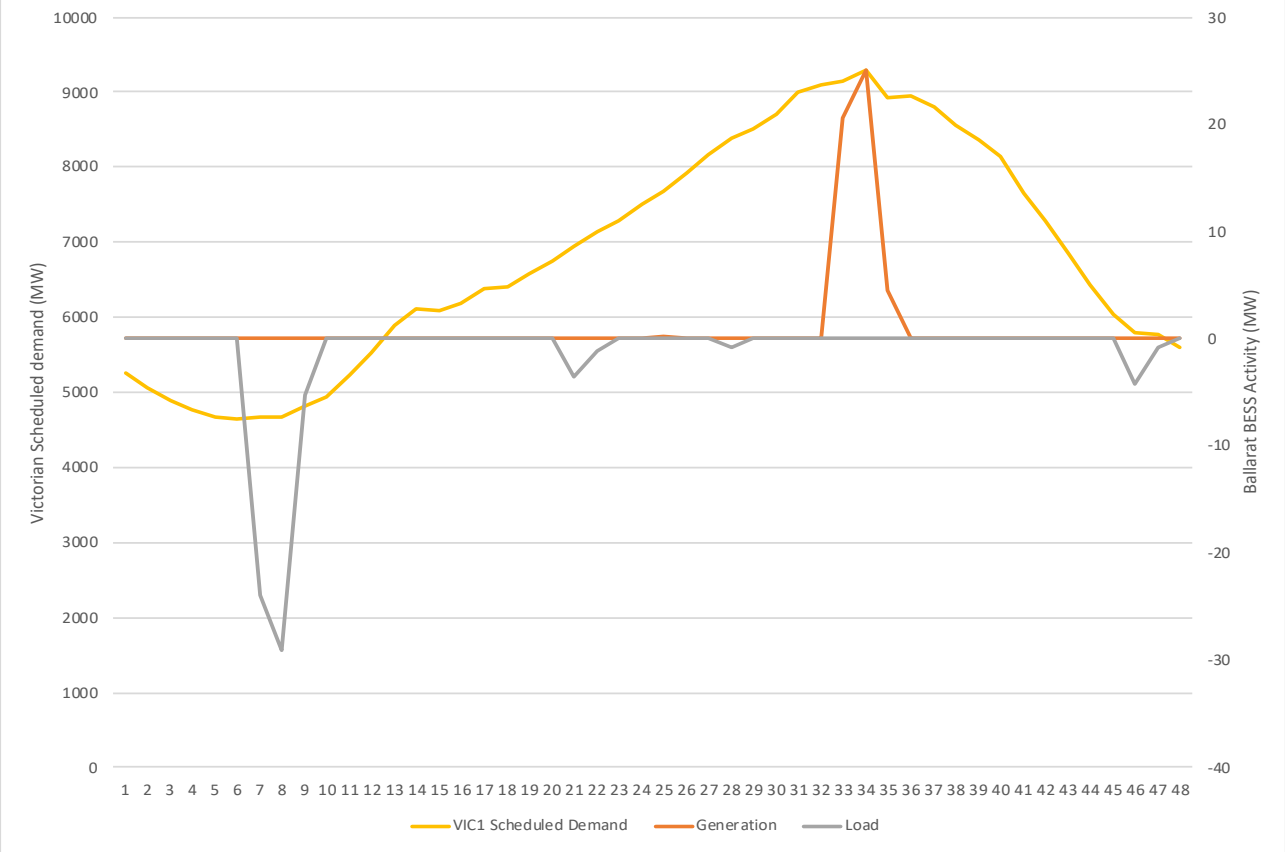


Figure 10 BATS BESS Power Injections

30. Delays Experienced and Lessons Learned

30.1 Final Investment Decision

The unique consortium arrangement and the necessity for multiple funding partners created a challenging contractual and commercial environment. An extended contracting period was experienced whilst contracts were formulated. The contracts and funding were contingent on the connection application and the AEMO acceptance of the Generator Performance Standard and the issuance of the Primary Function and Protection and Control Requirements. The interdependence of all the associated agreements and the technical assessments delayed financial close.

30.2 Construction

The Ballarat Transmission Station was previously operated by the State Electricity Commission (SEC) and the location of obsolete in ground assets was not clearly defined. A series of extensive ground penetrating radar surveys were commissioned prior to the commencement of the early works and earthworks packages. The discovery of control system cabling, operators house drainage, hydraulic and septic systems, as well as operational fibre optic cabling meant that extreme caution was required during excavation. This delayed the preparation of the site placing the construction phase into a non-optimal weather window.

30.3 Commissioning

The BESS System is connected directly to the transmission network through a single point of coupling and a complexity is that the system could not be connected to the network prior to registration and the system could not be registered until it had been tested to the satisfaction of AEMO. To carry out the testing required to achieve registration the system was granted a Notifiable Exemption by AEMO. However, the pre-commissioning testing, including the SCADA interface were tested utilising temporary power in preparation of the connection.

The development of the R2 Test Plan and the subsequent R2 testing was extensive and the requirement for full testing of the system as both a Generator and a Load was additional to expectations. The learnings from this project will enable AEMO to provide greater clarity and guidance for future projects.

30.4 Market/Operations

The application of Battery Energy Storage System for Frequency Control Ancillary Services (FCAS) was not defined in the AEMO FCAS Verification Tool User Guide and as such use of the Market Ancillary Service Specification Verification Tool (MASSVT) was not ideal suited for BESS FCAS testing. The team worked closely with AEMO during the project and a first Issue of the battery energy storage system requirements for Contingency FCAS registration has subsequently been released and is available via the link below.

https://www.aemo.com.au/-/media/Files/Electricity/NEM/Security_and_Reliability/Ancillary_Services/Battery-Energy-Storage-System-requirements-for-contingency-FCAS-registration.pdf

30.5 New Processes, New Guidelines

- Registering an unmanned, standalone energy storage system in the NEM required strong collaboration with AEMO during the grid connection process.
- Registering an asset owned by another entity
- R2 Test Plan for standalone asset (has informed subsequent releases of AEMO MASS tool)
- Strong collaboration with AEMO was required that resulted in an exemption to solve the “chicken and egg” type scenario for Registration/Connection as the BESS could not be connected to the network prior to registration and the system could not be registered until it had been tested to the satisfaction of AEMO.
- AEMO produced a guide to registering BESS for FCAS that is informed by experience with BATS BESS

30.6 Results & Technical Lessons Learned

- MASS Tool: AEMO’s MASS tool for FCAS was prior to BATS BESS a fixed ramp rates approach, but as BESS ramp rates can be set based on local requirements (down to millisecond-range), this had to be worked through.
- Chicken & Egg: connection required for Registration, but Registration required for connection
- Fast Response: Strong response time by BATS BESS – both in terms of FCAS provision and peak power dispatch which resulted in better performance than the market reimburses for.
- Monetizing Additional Services: BATS BESS is capable of further services such as FFR, synthetic inertia and Volt/VAR but no active markets are available which results in a lost revenue.

30.7 Learnings for other NEM-connected BESS assets

- Connections: Tremendous expertise was collected during the process of configuring, connecting BESS’s, as well as in co-located and complex connections configurations.

- GPS Compliance: Approval of a BESS in a new type of NEM asset architecture.
- Business Case & Correct BESS Sizing: Through BATS BESS a Techno-economic optimization improvment for multiple stakeholders will be possible.
- FCAS Registration: Specific body of knowledge and capability.
- Registration and R2 Testing: Specific body of knowledge and capability.

31. CONCLUSION

The Ballarat Transmission Station Battery Energy Storage project has demonstrated the capability of BESS technology in the network. It has provided a blue print for the development of future transmission connected projects to be cohabited with transmission and distribution assets. It has demonstrated the performance guarantee model as a highly successful approach to development and delivery and will continue to provide valuable data into the future.

The project has demonstrated its ability to meet and or exceed the guidelines, connection rules, and technical performance standards required to ensure network security and provides valuable services to the electrical network.

The continued analysis of the network performance, with regards to event disturbances and the renewable energy generation transition, will demonstrate further evidence of the value of Battery Energy Storage Systems to provide network robustness and reliability. BATS BESS will provide insight and a platform for future development and the integration of energy storage into the transmission, distribution and micro grid environments. New value streams will be identified to provide improved revenue stacks. This coupled with the reduction in technology cost will advance commercially viability and future investment.

32. PROJECT CLOSE-OUT

Project close-out for the BATS BESS involved collecting project records, analysing project success (or failure), gathering lessons learned and archiving project information for future use. Close-out activities included:

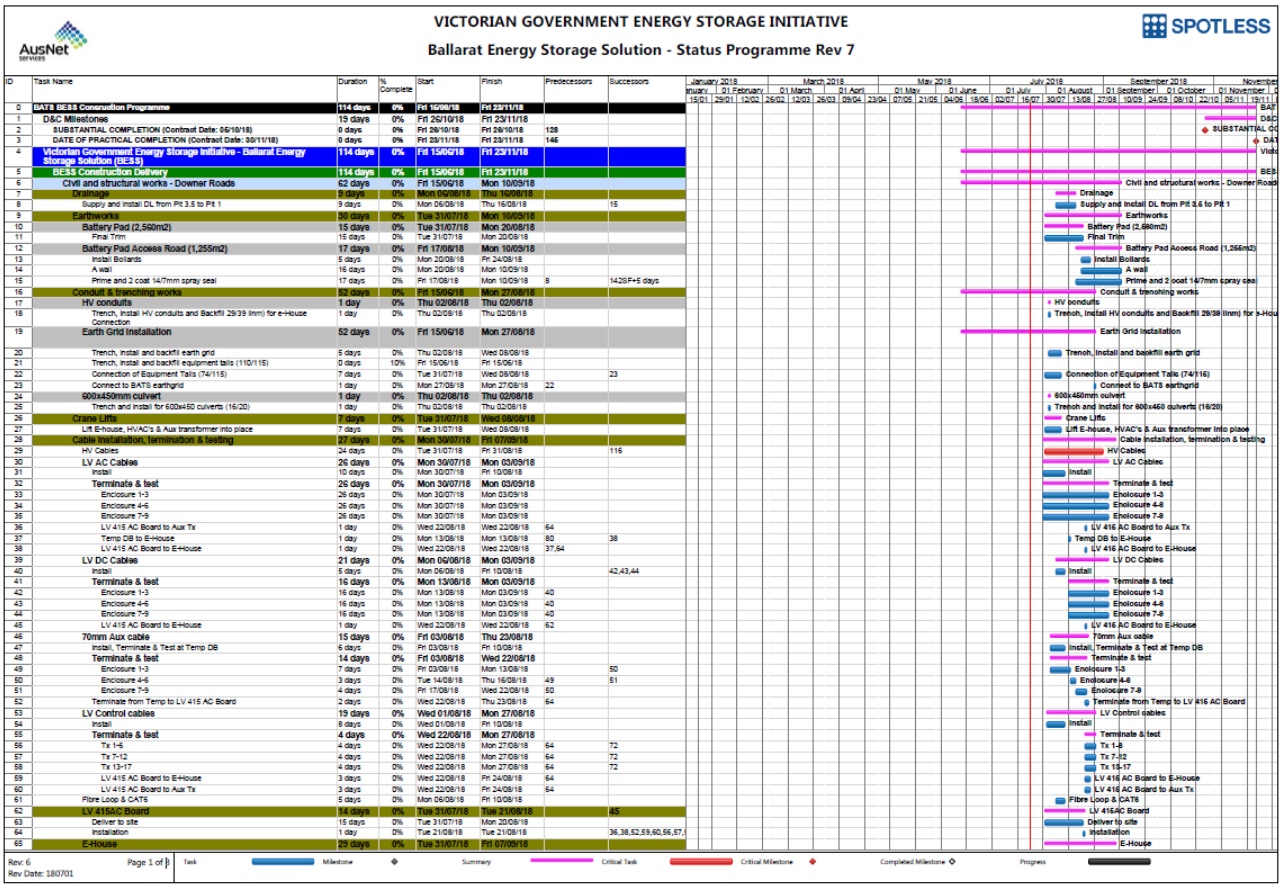
- confirming that the project has met all stakeholder requirements
- verifying that all deliverables have been delivered and accepted; and
- validating that all exit criteria have been met.

Project close-out is completed in accordance within the Downer ***DI-PM-PR024 Project Close-Out Plan***, and will take place when functional requirements for the project (e.g. engineering, procurement, construction, project controls and commissioning) are completed.

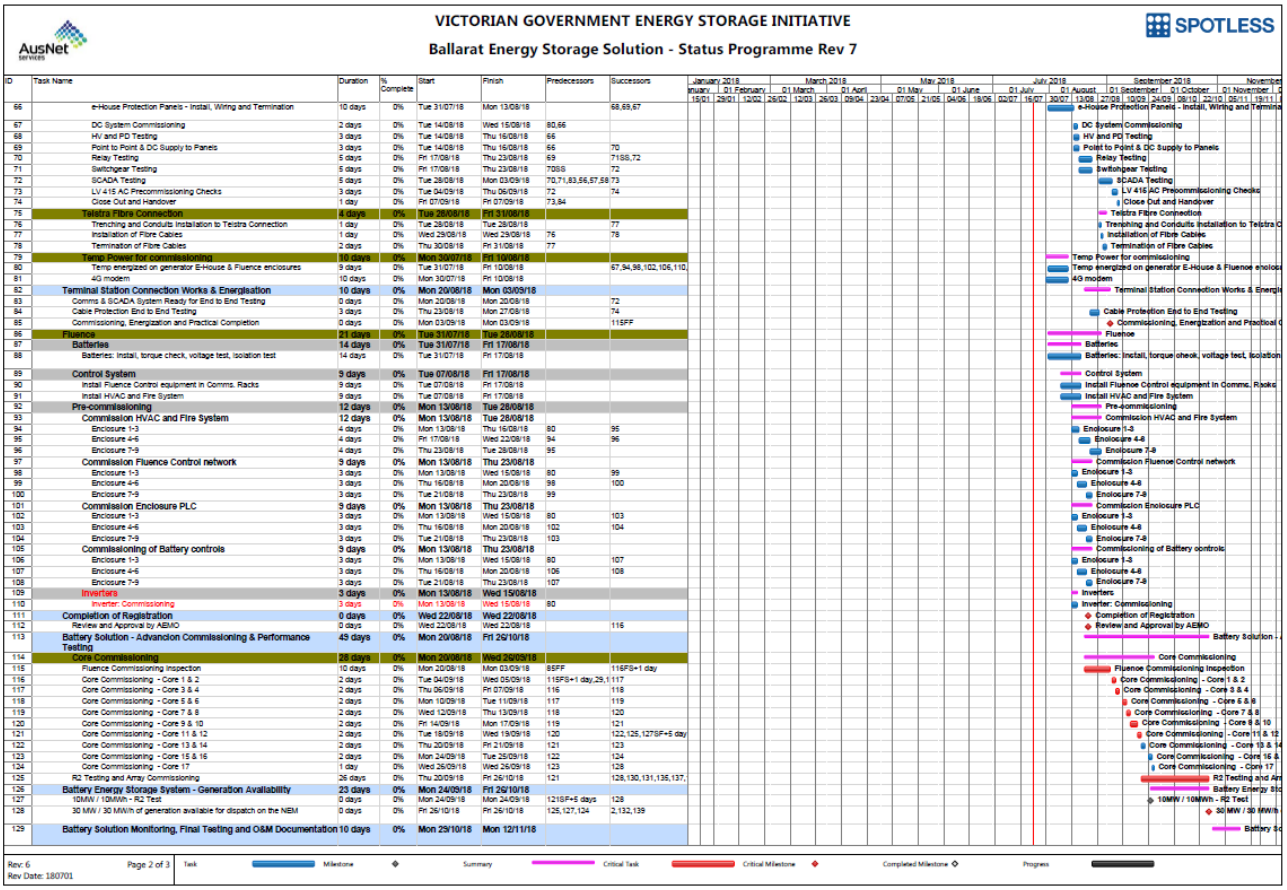
Project demobilisation and close-out included archiving all project documentation in accordance with the Downer ***DA-QA-PR009 Records Management Plan***. In addition to general archiving, the Project Team secured the following minimum set of project records:

- control budget and schedule (performance measurement baseline original and final)
- full set of detailed monthly project reports
- formal project close-out reports; and
- final detailed cost report and schedules.

Appendix A - As-built Construction Schedule



ID	Task Name	Duration	% Complete	Start	Finish	Predecessors	Successors
0	BAT1 BESS Consruction Programme	114 days	0%	Fri 16/06/18	Fri 23/11/18		
1	D&C Milestones	19 days	0%	Fri 26/10/18	Fri 23/11/18		
2	SUBSTANTIAL COMPLETION (Contract Date: 06/10/18)	0 days	0%	Fri 26/10/18	Fri 26/10/18	128	
3	DATE OF PRACTICAL COMPLETION (Contract Date: 30/11/18)	0 days	0%	Fri 23/11/18	Fri 23/11/18	146	
4	Victorian Government Energy Storage Initiative - Ballarat Energy Storage Solution (BESS)	114 days	0%	Fri 15/06/18	Fri 23/11/18		
5	BESS Construction Delivery	114 days	0%	Fri 15/06/18	Fri 23/11/18		
6	Civil and structural works - Downer Roads	62 days	0%	Fri 15/06/18	Mon 10/09/18		
7	Drainage	9 days	0%	Mon 06/08/18	Thu 16/08/18		
8	Supply and install DL from Pit 3.5 to Pit 1	9 days	0%	Mon 06/08/18	Thu 16/08/18		15
9	Earthworks	30 days	0%	Tue 31/07/18	Mon 10/09/18		
10	Battery Pad (2,560m2)	15 days	0%	Tue 31/07/18	Mon 20/08/18		
11	Final Trim	15 days	0%	Tue 31/07/18	Mon 20/08/18		
12	Battery Pad Access Road (1,255m2)	17 days	0%	Fri 17/08/18	Mon 10/09/18		
13	Install Bollards	5 days	0%	Mon 20/08/18	Fri 24/08/18		
14	A wall	16 days	0%	Mon 20/08/18	Mon 10/09/18		
15	Prime and 2 coat 14/7mm spray seal	17 days	0%	Fri 17/08/18	Mon 10/09/18	8	142SF+5 days
16	Conduit & trenching works	62 days	0%	Fri 15/06/18	Mon 27/08/18		
17	HV conduits	1 day	0%	Thu 02/08/18	Thu 02/08/18		
18	Trench, install HV conduits and Backfill 29/39 (mm) for e-House Connection	1 day	0%	Thu 02/08/18	Thu 02/08/18		
19	Earth Grid installation	52 days	0%	Fri 15/06/18	Mon 27/08/18		
20	Trench, install and backfill earth grid	5 days	0%	Thu 02/08/18	Wed 08/08/18		
21	Trench, install and backfill equipment tails (110/115)	0 days	10%	Fri 15/06/18	Fri 15/06/18		
22	Connection of Equipment Tails (74/115)	7 days	0%	Tue 31/07/18	Wed 08/08/18		23
23	Connect to BATS earthgrid	1 day	0%	Mon 27/08/18	Mon 27/08/18	22	
24	600x450mm culvert	1 day	0%	Thu 02/08/18	Thu 02/08/18		
25	Trench and install for 600x450 culverts (16/20)	1 day	0%	Thu 02/08/18	Thu 02/08/18		
26	Crane Lifts	7 days	0%	Tue 31/07/18	Wed 08/08/18		
27	Lift E-house, HVAC's & Aux transformer into place	7 days	0%	Tue 31/07/18	Wed 08/08/18		
28	Cable installation, termination & testing	27 days	0%	Mon 30/07/18	Fri 07/09/18		
29	HV Cables	24 days	0%	Tue 31/07/18	Fri 31/08/18		116
30	LV AC Cables	26 days	0%	Mon 30/07/18	Mon 03/09/18		
31	Install	10 days	0%	Mon 30/07/18	Fri 10/08/18		
32	Terminate & test	26 days	0%	Mon 30/07/18	Mon 03/09/18		
33	Enclosure 1-3	26 days	0%	Mon 30/07/18	Mon 03/09/18		
34	Enclosure 4-6	26 days	0%	Mon 30/07/18	Mon 03/09/18		
35	Enclosure 7-9	26 days	0%	Mon 30/07/18	Mon 03/09/18		
36	LV 415 AC Board to Aux Tx	1 day	0%	Wed 22/08/18	Wed 22/08/18	64	
37	Temp DB to E-House	1 day	0%	Mon 13/08/18	Mon 13/08/18	80	38
38	LV 415 AC Board to E-House	1 day	0%	Wed 22/08/18	Wed 22/08/18	37,64	
39	LV DC Cables	21 days	0%	Mon 06/08/18	Mon 03/09/18		
40	Install	5 days	0%	Mon 06/08/18	Fri 10/08/18		42,43,44
41	Terminate & test	16 days	0%	Mon 13/08/18	Mon 03/09/18		
42	Enclosure 1-3	16 days	0%	Mon 13/08/18	Mon 03/09/18	40	
43	Enclosure 4-6	16 days	0%	Mon 13/08/18	Mon 03/09/18	40	
44	Enclosure 7-9	16 days	0%	Mon 13/08/18	Mon 03/09/18	40	
45	LV 415 AC Board to E-House	1 day	0%	Wed 22/08/18	Wed 22/08/18	62	
46	70mm Aux cable	15 days	0%	Fri 03/08/18	Thu 23/08/18		
47	Install, Terminate & Test at Temp DB	5 days	0%	Fri 03/08/18	Fri 10/08/18		
48	Terminate & test	14 days	0%	Fri 03/08/18	Wed 22/08/18		
49	Enclosure 1-3	7 days	0%	Fri 03/08/18	Mon 13/08/18		50
50	Enclosure 4-6	3 days	0%	Tue 14/08/18	Thu 16/08/18	49	51
51	Enclosure 7-9	4 days	0%	Fri 17/08/18	Wed 22/08/18	50	
52	Terminate from Temp to LV 415 AC Board	2 days	0%	Wed 22/08/18	Thu 23/08/18	64	
53	LV Control cables	19 days	0%	Wed 01/08/18	Mon 27/08/18		
54	Install	8 days	0%	Wed 01/08/18	Fri 10/08/18		
55	Terminate & test	4 days	0%	Wed 22/08/18	Mon 27/08/18		
56	Tx 1-6	4 days	0%	Wed 22/08/18	Mon 27/08/18	64	72
57	Tx 7-12	4 days	0%	Wed 22/08/18	Mon 27/08/18	64	72
58	Tx 13-17	4 days	0%	Wed 22/08/18	Mon 27/08/18	64	72
59	LV 415 AC Board to E-House	3 days	0%	Wed 22/08/18	Fri 24/08/18	64	
60	LV 415 AC Board to Aux Tx	3 days	0%	Wed 22/08/18	Fri 24/08/18	64	
61	Fibre Loop & CAT6	5 days	0%	Mon 06/08/18	Fri 10/08/18		
62	LV 415AC Board	14 days	0%	Tue 21/08/18	Tue 21/08/18		45
63	Deliver to site	15 days	0%	Tue 31/07/18	Mon 20/08/18		
64	Installation	1 day	0%	Tue 21/08/18	Tue 21/08/18		36,38,52,59,60,56,57,
65	E-House	29 days	0%	Tue 31/07/18	Fri 07/09/18		


VICTORIAN GOVERNMENT ENERGY STORAGE INITIATIVE
Ballarat Energy Storage Solution - Status Programme Rev 7
AusNet services
SPOTLESS
Rev: 6
Rev Date: 180701
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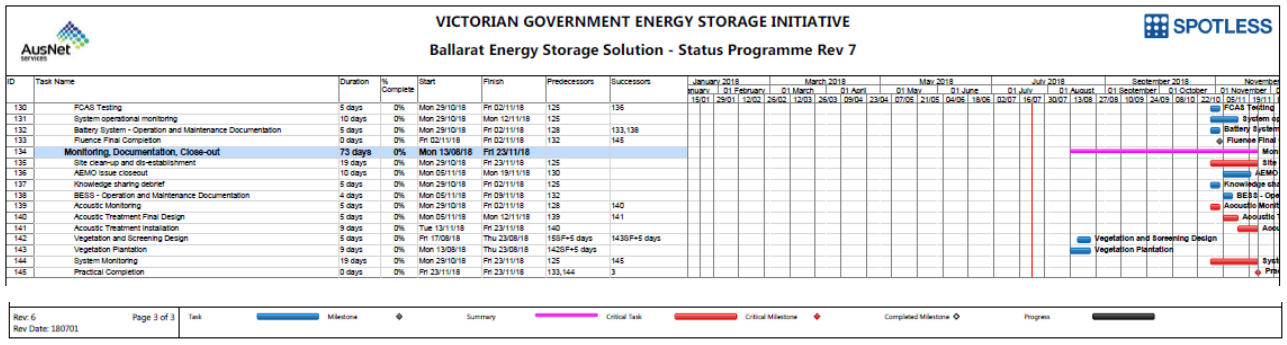
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Appendix B - Project Management Plan Table of Contents

Downer
Relationships creating success

AusNet services

Project Management Plan

Ballarat Battery Energy Storage System Project
Project Document Number & Version: Project Document Number & Version Number

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Appendix C - Zero Harm Management Plan Table of Contents

This plan defines the Health and Safety principles, processes, procedures, systems, tools, and templates implemented for use throughout the duration of the project.

This plan is subordinate to the Project Management Plan (PMP) which has been developed to:

- satisfy the requirements of the contract; and
- support the Project Team in completing the requirements of the project.

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SPOTLESS

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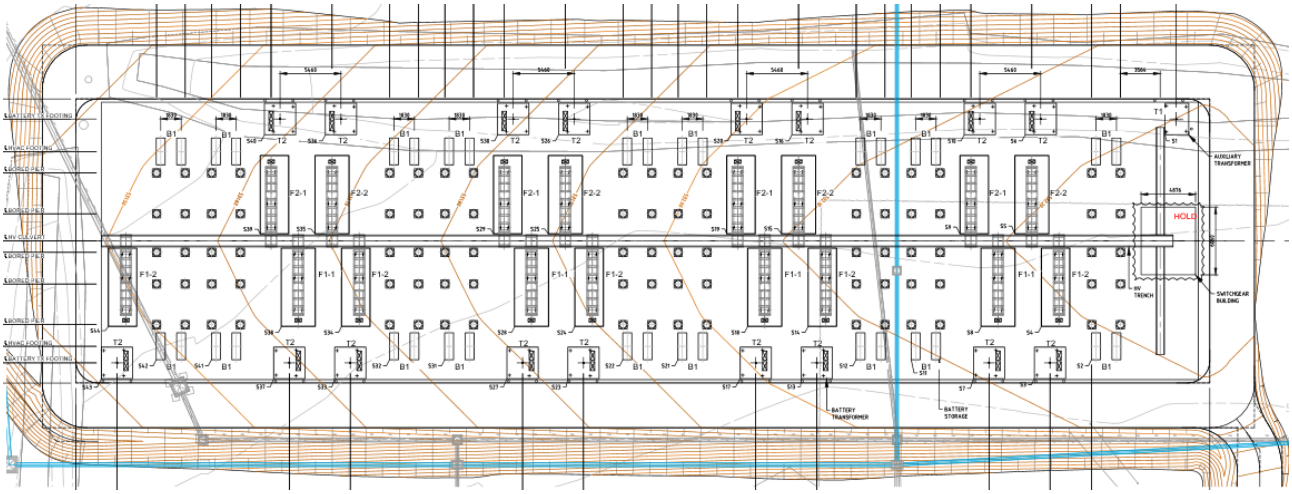
Attachments

Appendix E - Ballarat BESS Images

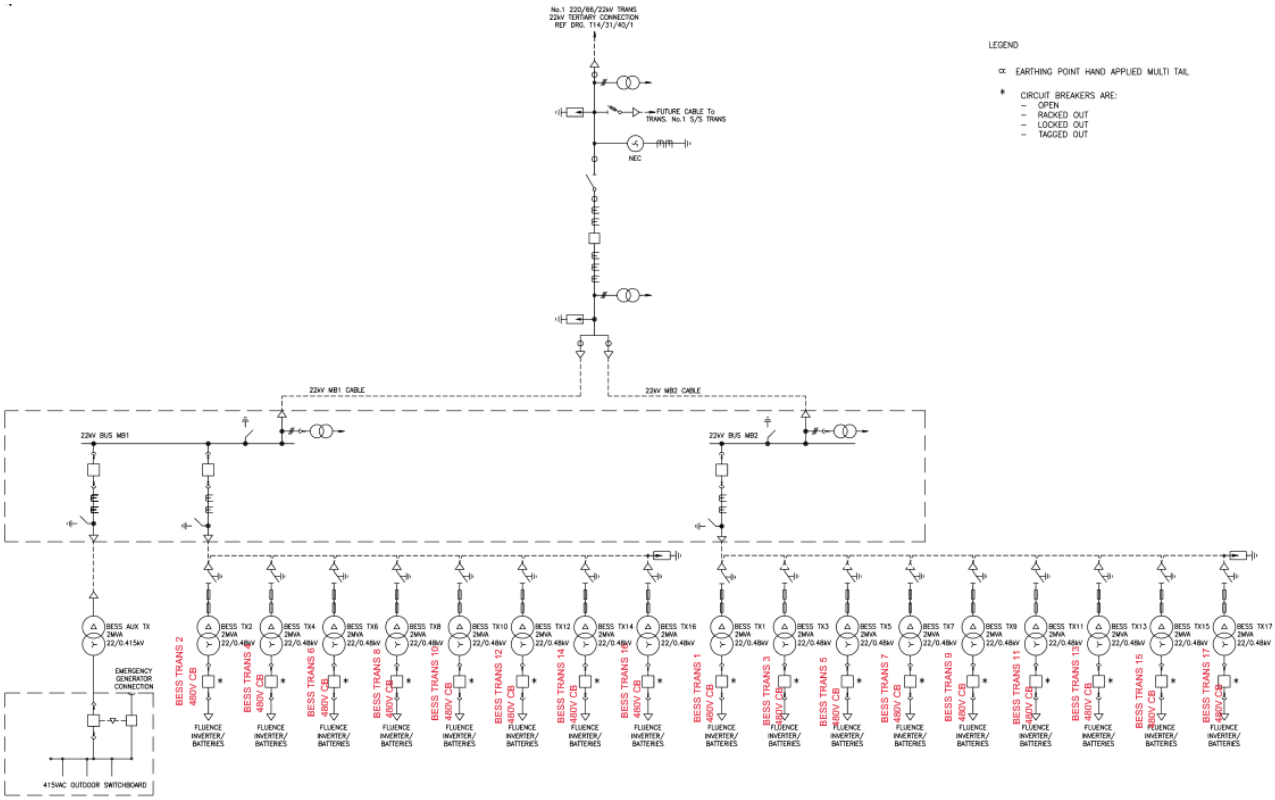

BESS MB2 22kV BUS VT
ALIVE
ALIVE
ALIVE
ALIVE


LG Chem

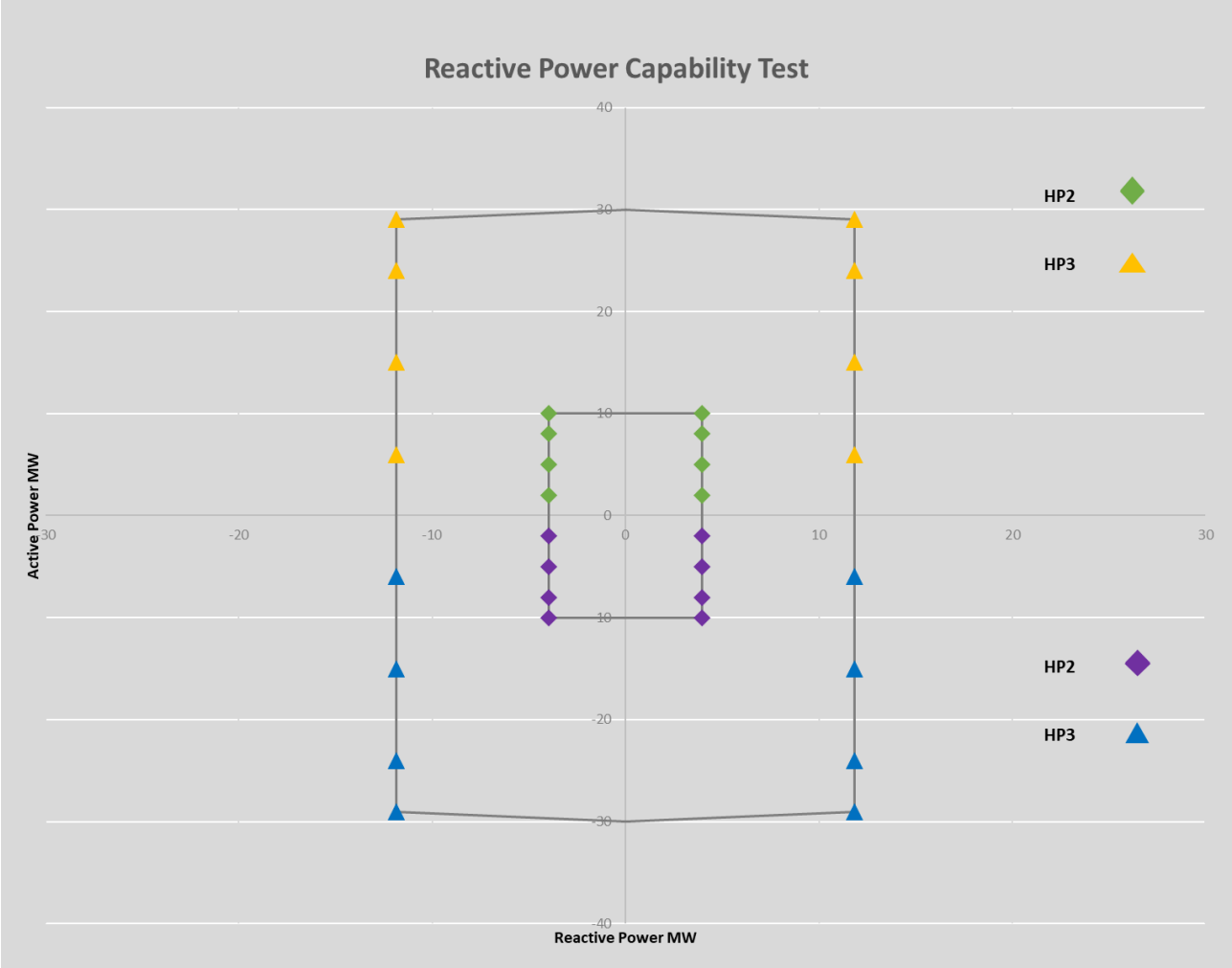
Appendix F - As-built Project Site Plan



Appendix G - As-built Electrical Single Line Diagram



Appendix H - Reactive Power Capability Test Points



Appendix I - GPS Compliance Assessment Tests

Hold Points and GPS Compliance					
Generator Performance Standard clauses	HP 1 (0 MW)	HP2 (10 MW)	HP3 (30 MW)	System Analysis	Notes
Reactive Power Capability (S5.2.5.1)		✓	✓		
Quality of electricity generated (S5.2.5.2)		✓	✓		
Response to frequency disturbances (S5.2.5.3)				✓	
Response to voltage disturbances (S5.2.5.4)			✓	✓	
Generating system response to disturbances following contingency events (S5.2.5.5)				✓	
Quality of electricity generated and continuous uninterrupted operation (S5.2.5.6)		✓	✓		
Partial load rejection (S5.2.5.7)					Not Applicable
Protection of generating systems from power system disturbances (S5.2.5.8)			✓	✓	
Protection systems that impact on power system security (S5.2.5.9)				✓	
Protection to trip plant for unstable operation (S5.2.5.10)				✓	
Frequency Control (S5.2.5.11)			✓	✓	
Impact on network capability (S5.2.5.12)				✓	
Voltage and reactive power control (S5.2.5.13)		✓ 1	✓		1. HP2 Includes only a PF Control Test. Voltage Control test performed at HP3 only
Active power control (S5.2.5.14)		✓	✓		
Monitoring and control requirements (S5.2.6)	✓	✓	✓		
Fault current (S5.2.8)			✓	✓	
Power station auxiliary supplies (S5.2.7)	✓				

Appendix J - CPS Compliance Assessment Tests

Hold Point and CPS Compliance Testing					
Generator Performance Standard clauses	HP 1 (0 MW)	HP2 (10 MW)	HP3 (30 MW)	System Analysis	Notes
Power Factor Requirements Test (S5.3.5)		✓	✓		
Balancing of Load Currents Test (S5.3.6)		✓	✓		
Voltage Fluctuations Test (S5.3.7)		✓	✓		
Harmonics and Voltage Notching Test (S5.3.8)		✓	✓		
Load Shedding Facilities Test (S5.3.10)		✓	✓		

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