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Springvale BESS Detailed Design

Risk Management Plan (RMP) and Fire Safety Study (FSS) Report

Report

AUS-SPR-EEA-ENG-FIR-REP-0001

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Executive Summary

The Springvale BESS Stage 1 involves the construction and installation of a 115 megawatt (MW) / 230 megawatt-hour (MWh) two-hour Battery Energy Storage System (BESS) at the project site.

The BESS will allow energy to be stored and released to the grid when it is most needed. Grid connections are readily available near the site, enabling a reliable energy supply during periods of high demand. The BESS will also help stabilise the grid during power supply fluctuations.

The site comprises approximately 47 hectares and is generally rectangular. It is approximately 350m wide and 1.3 km long with frontages to Westall Road Extension to the west, Spring Road to the north, Clarke Road to the east and Rowan Road to the south.

To assess the risk of fire in relation to the BESS project, this Risk Management Plan (RMP) has been developed to consider fire risk associated with bushfires and fire starting within the proposed infrastructure. The RMP follows the guidance provided by CFA in their *Design Guidelines and Model Requirements: Renewable Energy Facilities 2022* (CFA Guideline). It also includes assessing bushfire risk in accordance with Clause 13.02-1S of the Greater Dandenong Planning Scheme.

Although large bushfires have not impacted on the area of the proposed BESS facility, it is undeniable that bushfires can occur under elevated fire danger conditions in this landscape. The bushfire risk assessment in this report has led to recommendations for a range of mitigation treatments that align with the CFA Guidelines.

This report assesses the fire risk within the BESS facility and identifies the low risk associated with this type of development. This low risk, in addition to the mitigation treatments outlined within the CFA Guideline, ensures a high level of fire safety in the BESS facility.

The outcome of the risk assessment has recommended a range of mitigations to manage fire risk, including:

- Installation of a static water supply tank spread across the BESS area that complies with the CFA Guidelines and AS2419.1:2005 Fire Hydrant Installations (AS2419.1) based on a feed hydrant design.
- Provide fire breaks around the BESS, substation, and operations and maintenance areas.
- Installation of fire safety systems within the BESS enclosures based on the manufacturer's specifications and results of the UL9540A test.
- Provision of access tracks, including overtaking bays.
- Ongoing maintenance programs for the project's life, in accordance with relevant Standards or manufacturer specifications.

The risk assessment outcome indicates that the project can be conducted in this landscape without increasing the risk of fire to surrounding communities, farming assets, and other infrastructure.

A summary of the findings and recommendations of this FSS is:

Site Access:

- There is no off-site risk due to DGs being on-site. Therefore, further analysis of DG-related incidents was not required.
- All vegetation within 10 m of the BESS is cleared, and a material such as gravel is used to ensure clearance is maintained
- Vegetation in the area around the BESS is maintained at a level that will prevent any external fire from reaching an intensity which would adversely impact the BESS across the 10 m separation distance.
- A suitably qualified fire services engineer should review the gas detection system design.
- All equipment shall operate at the maximum anticipated ambient temperature.

- The row-to-row separation distance between battery enclosures is a minimum of 3 m. BESS Enclosures that are electrically connected to the same power ACC/DCC cabinet are separated by a distance of approximately 0.1 m.
- The BESS Integrator and Operator should have a commissioning plan that minimises downtime in monitoring and control of data transmission.
- Installation should be certified to all relevant Australian Standards (e.g. AS 3000 series) where possible.
- The installation of other infrastructure on the BESS site should be in accordance with the relevant Australian Standards. It should be separated from the BESS Enclosures by a distance of not less than 5 m or in accordance with the requirements of the aforementioned standards, whichever is greater.
- Fire extinguishers should be provided as first aid firefighting to ancillary areas within the BESS site, where first aid firefighting is appropriate. Locations and fire extinguisher types must comply with AS 2444:2001.
- The BESS Integrator should collaborate with the BESS Manufacturer to develop a site-specific Emergency Response Plan (ERP) for use by the Owner/Operator and the Fire Service, in accordance with HIPAP 1.
- Discussions should include the local fire service, a fire engineer familiar with the technology, the owner/operator, and BESS Integrator's subject matter expert during the ERP's development.
- An Emergency Information Book will be housed within an Emergency Information Container and located near the primary site access. The final location of the Emergency Information Container will be determined in conjunction with CFA.
- The project access roads shall achieve the following:
  - A four (4) metre perimeter road must be constructed within the ten (10) metre perimeter Fire Break.
  - Roads are to be of all-weather construction and capable of accommodating a vehicle of fifteen (15) tonnes.
  - Constructed roads must be a minimum of four (4) metres in trafficable width with a four (4) metre vertical clearance for the width of the formed road surface.
  - The average grade must be no more than 1 in 7 (14.4% or 8.1°) with a maximum of no more than 1 in 5 (20% or 11.3°) for no more than fifty (50) metres.
  - Dips in the road must have an entry and exit angle of no more than 1 in 8 (12.5% or 7.1°).
  - Passing bays must be incorporated at intervals of no more than 600 metres, and each bay must be at least 20 metres long, with a minimum trafficable width of 6 metres. Where roads are less than 600 metres long, at least one passing bay is to be incorporated.
  - Road networks must enable emergency services to access all areas of the facility.
  - Two access points must be available to the site to ensure safe and efficient access to and egress from areas that may be impacted or involved in a fire.

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Definitions

List of Definitions

Definitions	Definition
Project	Springvale BESS
Project Boundary	Lot or DPs that encompass the development footprint (i.e. the legal property description).
Development Footprint	Area within the project boundary on which the project infrastructure will be located.
Risk	The likelihood of a specified undesired event occurring within a specified period or circumstances. It may be either a frequency (the number of specified events occurring in unit time) or a probability (the probability of a specified event following a prior event), depending on the circumstances.

List of Abbreviations

Abbreviation	Definition
AS	Australian Standards
BMS	Battery Management System
BESS	Battery Energy Storage System
CFA	Country Fire Authority
DG	Dangerous Goods
EIS	Environmental Impact Statement
EMS	Energy Management System
ERP	Emergency Response Plan
ESIP	Emergency Services Information Package
FHA	Final Hazard Analysis
FRV	Fire Rescue Victoria
FIP	Fire Indicator Panel (sometimes referred to as Fire Detection Indicating and control Panel)
FSS	Fire Safety Study
HAZID	Hazard Identification
HAZOP	Hazard and Operability Study
HIPAP	Hazardous Industry Planning Advisory Paper
HV	High Voltage
HVAC	Heating, Ventilation and Air Conditioning
IEC	International Electrotechnical Commission
LV	Low Voltage
MW	Megawatt (unit of power)
MWh	Megawatt Hour (unit of energy)
NEM	National Electricity Market
NFPA	National Fire Protection Association
PHA	Preliminary Hazard Analysis

Abbreviation	Definition
PCU	Power Control Unit
UL	Underwriter Laboratories, a product testing and certification organisation
UN	United Nations

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1 Introduction

1.1 Background

EHDJV Engineering has been engaged to develop a Risk Management Plan and Fire Safety Study for the proposed Springvale BESS, located adjacent to Westall Road Extension to the west, Spring Road to the north, Clarke Road to the east and Rowan Road to the south. The proposed Springvale BESS is within Greater Dandenong Shire.

The Springvale Battery Energy Storage System (SVB) comprises a centralised Battery Energy Storage System (BESS) and associated infrastructure, including a site substation, access tracks, underground cabling, and underground transmission power lines that will connect to the Noble Park Substation.

This Risk Management Plan (RMP) is required to achieve compliance with the CFA Guideline - Design Guidelines and Model Requirements: Renewable Energy Facilities Version 4 (CFA Guideline – August 2023). The CFA Guideline outlines the purpose and need for a Risk Management Plan (RMP). CFA engagement will occur once the project design team has approved the plan. The RMP has been developed to provide sufficient information for CFA to make informed decisions on fire risk-related matters. It is expected that the Planning Permit will require a Fire Management Plan (FMP) and Emergency Management Plan (EMP) in accordance with the requirements of the CFA Guidelines.

The RMP was prepared following an assessment of the site and analysis of information supplied by the CJV regarding the design, commissioning, and operation of the BESS Facility. As per the CFA Guideline, this report also aligns with NSW Planning's Hazardous Industry Planning Advisory Paper 2: Fire Safety Study Guidelines (2011). The various requirements outlined within the Advisory Paper are included in this report and relate to the proposal.

1.2 Scope And Purpose of this Report

This RMP aims to ensure that existing or proposed fire prevention, detection, protection, and fighting measures are appropriate for the site-specific fire hazards at the SVB and to report on the application of the mitigation measures.

In accordance with HIPAP 2 (NSW DPIE 2011b):

- This RMP encompasses the entire SVB site and all fire-related potential hazards;
- The fire protection and strategies presented are based on the worst-case scenario;
- The study considers both the aspects of a fire system: the physical components and the operational and strategic planning aspects; and
- The study considers all effects of fire at SVB This includes flame, radiant heat and explosion effects, as well as toxic materials, gases and contaminated fluids

The structure of this RMP is:

- Section 2: Project and Development Description
- Section 3: Methodologies
- Section 4: Bushfire Hazard Assessment
- Section 5: Hazard identification – BESS
- Section 6: Consequence Assessment Review
- Section 7: Consequence Analysis Modelling
- Section 8: Site Fire Prevention, Detection & Protection System
- Section 9: Site Fire Safety Strategy

1.3 RMP Objectives

The objectives of this RMP were to:

- Identify the fire incidents associated with the proposed BESS development
- Understand the consequences and impact from credible fire events for the proposed BESS development
- Determine the credibility of escalated fire events between the BESS facility and other onsite infrastructure, including the potential for an incident at the electrical substation to impact the BESS development.
- Describe the proposed BESS development's fire prevention, detection and protection measures.
- Outline the fire safety strategy for the BESS Development

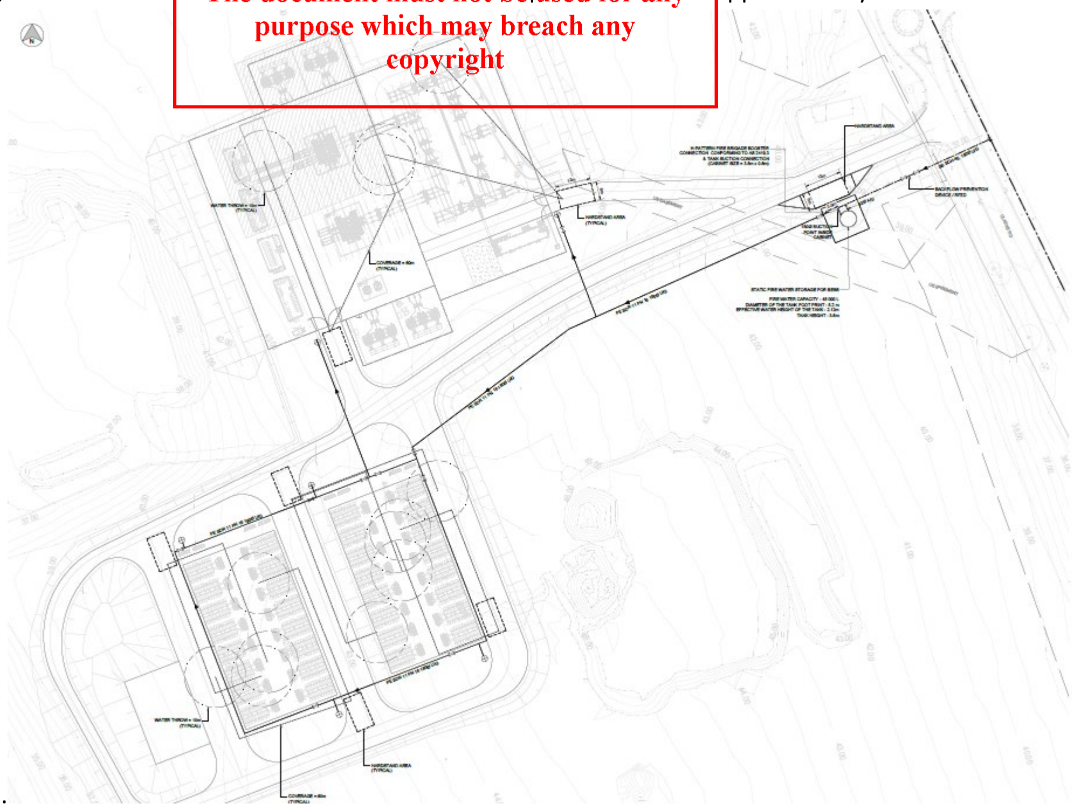
2 Project and Development Description

2.1 Location and Surrounding Land Use

The site comprises approximately 47 hectares and is generally rectangular. It is approximately 350m wide and 1.3 km long with frontages to Westall Road Extension to the west, Spring Road to the north, Clarke Road to the east and Rowan Road to the south. The site excludes four residential properties fronting Clarke Road, being numbers 90, 94, 224 and 226, which are not subject to the permit application. The subject site comprises 24 lots, each represented by 23 certificates of title.

Current access to the site is via Clarke and Rowan Roads; no access is available off Westall Road Extension or Spring Road.

The site has previously been used for sand extraction, followed by landfilling, and more recently, the provision of additional capping material. This has resulted in the formation of a plateau elevated approximately 5 metres above the



surrounding roads.

Figure 2.1 presents the SVB development layout, which shows the local context and development footprint.

Figure 2.1: Project and Development Layout

2.2 Project Infrastructure

This section describes the project components requiring firefighting intervention if control measures fail, specifically the BESS. Furthermore, the associated Energy Management System, control building and workforce are discussed.

2.2.1 Substation

The Project includes an onsite substation, to be on the western boundary in the centre Project Area. The substation will be connected to the grid via a new United Energy (UE) 66kV Switching Station (DLY: Dingley), with the interface point of connection (PoC) to be at UE's 66kV Disconnector.

The substation shall consist of the following plant equipment:

- 66kV Surge Arrester,
- 66kV Disconnector,
- 66kV VT,
- 66kV Post CT,
- 66kV Post Insulator,
- 66/33kV Three Winding Transformer,
- One combined Switchroom & Control Building

2.3 Switching Station

A 66 kV switching station, owned and operated by United Energy (UE), will be installed on-site adjacent to the substation.

The switching station will be supplied by one underground 66kV cable from Springvale South Zone Substation (SS) and another underground 66kV cable from Noble Park Zone Substation (NP).

The SS 66kV Line, NP 66kV Line and 22kV Line, the underground cable route is via a cable easement located Southeast (to Clark Rd). The cable easement will be approximately 10 metres.

2.3.1 Battery Energy Storage System (BESS)

The selected Tesla Megapack 2XL (MP2XL) model uses Lithium Iron Phosphate (LFP) battery chemistry. The BESS will utilise the Tesla Megapack 2XL (Tesla Megapack MP2 unit), which is a lithium-ion battery capable of delivering 230 MWh and featuring a capacity of up to 115 Megawatts (MW).

The battery cells are installed within an IP66 cabinet designed for outdoor installation. Each battery module is integrated with its inverter, eliminating the need for external power conversion systems or inverter modules.

2.3.2 Supporting Infrastructure

The following supporting infrastructure will also be developed as part of the Project:

1. Several new internal roads will enable access to the four array areas from the surrounding road network.
2. Emergency access points to enable access to the three array areas from the surrounding road network in the case of an emergency (e.g. fire or flood).
3. Parking and internal access roads/tracks within the three array areas to allow for construction and ongoing maintenance.
4. Fencing and landscaping around the substations and BESSs.

The locations for the emergency access points will be identified during detailed design as part of the project's emergency response plan.

Temporary infrastructure, including laydown and storage areas, a site compound, and other necessary facilities, will likely be required during the project's construction stage in each array area. Laydown areas will likely be near the primary site access points and away from environmentally sensitive areas.

Chain mesh security fencing will be installed within the project boundary to a height of up to 2.5 m. (2.2 chain mesh plus 300 mm barbed wire) The location of the security fencing will be determined in consultation with the project landholders. Fencing will restrict public access to the development footprint. Where possible, fencing will be positioned to minimise disruption to ongoing agricultural operations on land adjacent to the development footprint.

2.4 Construction

The following key activities will be completed during the construction stage of the project:

- Site establishment works and preparation for construction
    - Establishment of a temporary construction site compound in a fenced-off area, including a site office, containers for storage, parking areas and temporary laydown areas
    - Construction of access tracks and boundary fencing installation
    - Site survey to confirm infrastructure positioning and placement
    - Geotechnical investigations to confirm the ground condition.
- Construction activities
    - Completion of substation augmentation
    - Establishment of the centralised BESS compound
    - Testing and commissioning of project infrastructure.

Requirements for heavy civil works (e.g. grading and compaction) will be minimised as much as practicable. Civil works will be required to prepare the BESS areas by installing fencing, internal access tracks, and minor earthworks. Heavier civil works will be required for specific infrastructure where a level pad is necessary (e.g. substation, BESS).

Construction equipment, materials, and infrastructure will be transported via road. This will include using heavy and oversized vehicles to deliver large equipment (e.g., transformers).

Laydown areas and waste handling, fuel, and chemical storage areas will be strategically placed to minimise potential environmental impacts during construction.

The construction stage will take approximately 24months from the commencement of site establishment works to commissioning the four array areas. It will require a peak construction workforce of up to 200 people (TBC).

Construction activities will be conducted from 6:00 a.m. to 6:00 p.m., Monday through Saturday. No work is planned on Sundays or public holidays. Approval is also sought to undertake activities which are inaudible at non-involved dwellings, emergency work, and deliveries and dispatches (where required by authorities for safety reasons) outside of standard construction hours.

2.5 Operations

The facility is anticipated to require regular maintenance throughout its operational life. This will include the following ongoing tasks:

- Site maintenance
  - Vegetation maintenance
  - Weed and pest management
  - Fence and access road management
  - Upgrading drainage channels
  - Landscaping.
- Infrastructure maintenance
  - Equipment, cabling, substation and communications system inspection and maintenance.
  - There is a requirement to monitor the infrastructure for differential settlement. This will drive a requirement for re-levelling, particularly batteries, which will be founded on adjustable footings

Up to 5 full-time employees (TBC) will be required throughout operations. The operational workforce will also be responsible for monitoring the security of the BESS area and the project infrastructure on an ongoing basis.

Regular light vehicle access will be required throughout operations. Heavy vehicles may occasionally be necessary to replace more significant components of project infrastructure, such as inverters, transformers, and battery energy storage system (BESS) components. O&M activities will typically be undertaken by specialist subcontractors and/or equipment manufacturers.

2.6 Decommissioning

Once the project reaches the end of its investment and operational life, the project infrastructure will be decommissioned, and the development footprint will be returned to its pre-existing land use, or another land use as agreed by the project owner and the landholder at that time.

Project decommissioning will require disturbing the development footprint during the removal of equipment. A significant amount of manpower, including both staff and contractors, as well as vehicle movements, will be required during this stage of the project.

Any underground cabling below 500 mm will remain in situ following project decommissioning.

3 Methodology Overview

This section summarises the approach adopted for the Springvale Energy Hub BESS in preparing the RMP and FSS. The study was prepared with reference to:

- NSW Department of Planning (DOP) (DPHI) (2011): Hazardous Industry Planning Advisory Paper (HIPAP) No 2, *Fire Safety Study Guidelines*[1].
- Country Fire Authority (CFA) – Design Guidelines and Model Requirements – Renewable Energy Facilities Version 4, March 2023.

3.1 Risk Assessment Process

To effectively assess the fire risk associated with the proposal, this report is structured to assess risk using the following frameworks:

- Clause 13.02 -1S – Bushfire Planning
- Assessment against the requirements of the CFA Guideline *Design Guidelines and Model Requirements: Renewable Energy Facilities 2022*
- Risk assessment that meets section 5 of the CFA Guidelines.
- FRV Guideline 55 – Battery Energy Storage Systems

The risk assessment provides an opportunity to combine the information gained from the above processes and, if necessary, to make any additional recommendations. All recommendations aim to reduce the risk to an acceptable level.

The RMP approach has been adapted from HIPAP 2. To address Fire Rescue Victoria (FRV) expectations and HIPAP 2 requirements, the following steps have been completed covering the BESS facility:

- Establish FSS objectives and expectations with Fire Rescue Victoria (FRV)
- Literature and Tesla fire test documentation review
- Identification of potential fire incidents
- Consequence assessment review of fire incidents
- Review of fire prevention systems
- Review of fire detection and protection measures
- Establish a fire safety strategy

3.2 Clause 13.02-1S – Bushfire planning assessment

Clause 13.02-1S of the Planning Scheme plans to strengthen the resilience of settlements and communities and prioritise the protection of human life through several objectives. However, it should be noted the proposed SVB facility does not introduce new settlements into the landscape. The assessment has been undertaken within the context of a BESS Facility.

3.3 Bushfire Prone Area

Bushfire-prone areas (BPA) are areas that are subject to, or likely to be subject to, bushfires. The Minister for Planning has determined that specific areas are designated BPAs for the building control system. Specific bushfire construction

[1] NSW Department of Planning, "Hazardous Industry Planning Advisory Paper No. 2 - Fire Safety Study Guideline," 2011.

standards apply in designated bushfire-prone areas in Victoria. The entire BESS Site is located within a bushfire-prone area.

These bushfire construction requirements are designed to enhance bushfire protection for residential buildings. The creation of the BPA map fulfils one of the 67 recommendations made by the Victorian Bushfires Royal Commission that occurred following the 2009 Black Saturday bushfires.

While the control aims to improve residential construction, it also triggers other controls, including an assessment against Clause 13.02 of the Planning Scheme. Refer to Section 4.2.

3.3.1 Municipal Fire Management Plan

As the project is located within the City of Greater Dandenong, the assessment of the municipal fire management planning arrangements has included the Greater Dandenong Municipal Fire Management Plan 2024 – 2027 Version 3.0 May 2024.

The Plan also outline several treatments that are provided to address bushfire risk across the Shire. The treatments include:

- Planning requirements for buildings in bushfire prone areas.
- Arson prevention and detection programs.
- Community awareness arson prevention – Media campaign.
- Development of fire management plans and/ or inclusion of fire management considerations in bushland management plans.
- Implementation of fuel management works including mechanical treatments (mowing, slashing, mulching and using herbicides) and planned burning off programs including when located on roads and reserves.
- Implementation of the Electrical Line Clearance Management Plan.
- Declaration of the Fire Danger Period and days of Total Fire Ban.
- Patrols high-bushfire-risk areas on days with an elevated Fire Danger Rating.

3.4 Bushfire History

Greater Dandenong does not have a history of major bushfires; however, structure fires over the past 10 years have been significant. Between 2011 and 2020, a total of 1,280 fires involving structures occurred in the Greater Dandenong municipality. Greater Dandenong accounted for 17% of the statewide total for the same period, based on information from the CFA's Fire and Incident Report System. There has also been a history of occasional, relatively small grass and scrub fires in the Green Wedge areas and areas of remnant bushland.

Bushfire Risk Assessment

To effectively assess the fire risk associated with bushfire impacting the proposal, this section of the report is structured to assess risk using the following frameworks:

- Clause 13.02 -1S – Bushfire Planning
- Assessment against the requirements of the CFA Guideline *Design Guidelines and Model Requirements: Renewable Energy Facilities (Version 4.0 Aug 2023)*
- Risk assessment that meets section 3.3.3 of the CFA Guidelines.

The risk assessment provides the opportunity to bring the information gained from the above processes or information together and if required, make any additional recommendations. All recommendations are designed to reduce the risk to an acceptable level.

3.5 Clause 13.02-1S – Bushfire planning assessment

Clause 13.02-1S of the Planning Scheme aims to strengthen the resilience of settlements and communities, prioritising the protection of human life through several objectives. However, it should be noted that the proposed SVB does not introduce new settlements into the landscape. The assessment has been undertaken within the context of a BESS.

4 Bushfire Hazard Assessment

Figure 4.1 illustrates the Low- and High-Risk Bushfire Areas for the City of Greater Dandenong. The project site area (red rectangle) shows that the site is within the Hazardous Bushfire Risk Area and is surrounded by Low Bushfire Risk Areas.

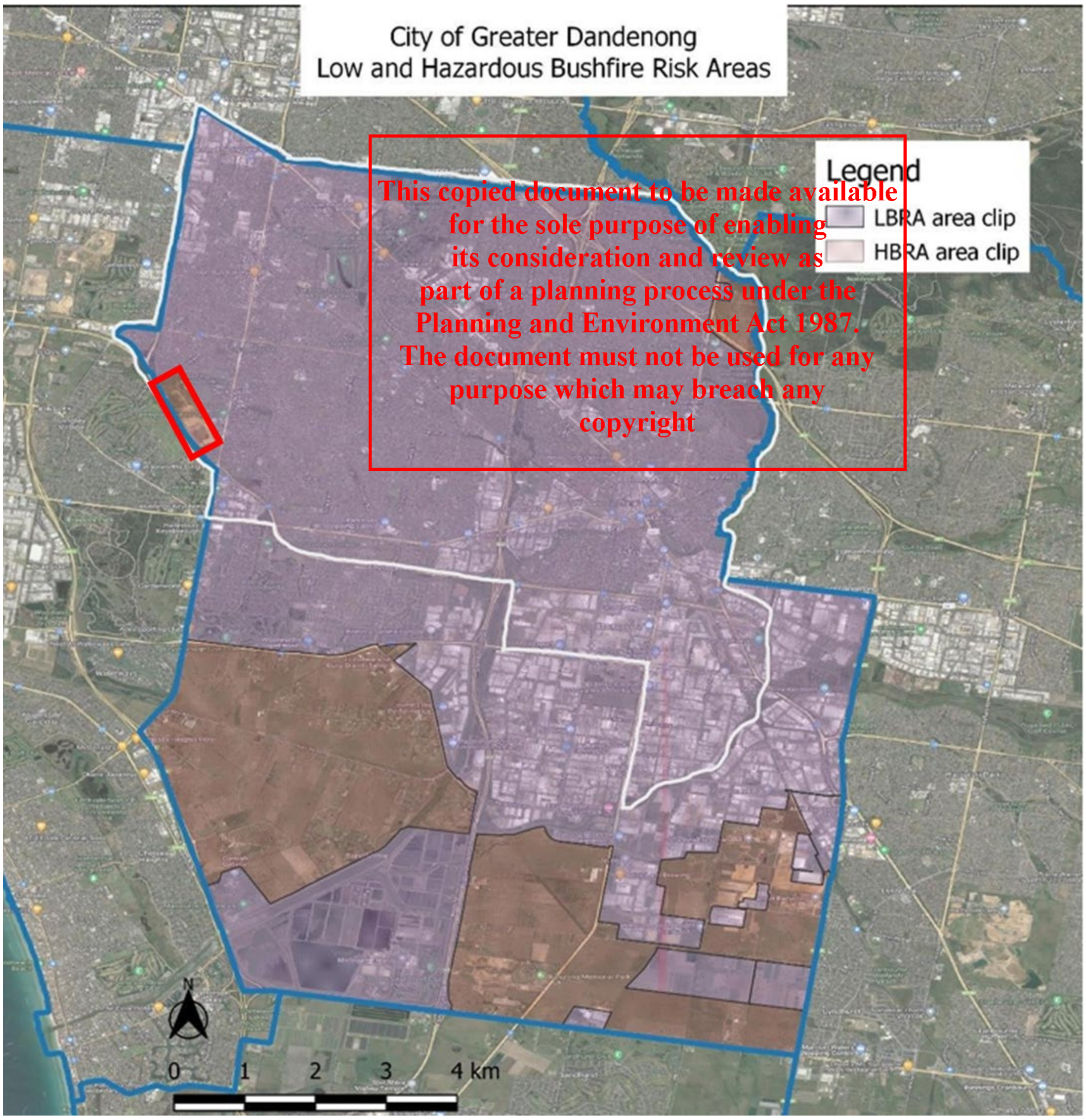


Figure 4.1: Project Location – Bushfire Risk Areas (Ref. Greater Dandenong Municipal Fire Management Plan 2024 – 2027 Version 3.0 May 2024)

As detailed in section 3.4 Greater Dandenong does not have a history of significant bushfires.

Table 4.1 below outlines the hazard assessment relating to the proposed SVB Site. Figure 4.2 and Figure 4.3 provide an overview of the likely bushfire scenarios within the surrounding area. The assessment has identified the potential for bushfire impacts in the northeast and southwest.

Table 4.1: Assessment Against Clause 13.02

Bushfire Hazard	Conditions	Likely Scenario	Considerations type
The site for the development	Once completed, the BESS will be required to comply with conditions as specified within the CFA Guideline, which includes the management of vegetation surrounding the BESS and other infrastructure during the fire danger period. During construction, there is a risk of a fire igniting and spreading through unmanaged vegetation. During the construction phase, properties surrounding the construction area will remain in use.	A bushfire starting on the property is a possibility, particularly during the construction phase, due to the increased number of people working on the project and the operating machinery. Bushfires that are started by lightning, arson or other human-caused events could burn through the BESS and threaten the surrounding properties and the BESS. The access track network and vegetation management requirements around the BESS and other infrastructure will limit bushfire spread under elevated fire danger conditions. During construction, any work that is occurring near unmanaged grassland has the potential to start a bushfire and leave the property.	During the construction phase of the BESS, where possible, all vegetation within 100 metres of the works area (where achievable) is to be managed during the fire danger period, with all grassland less than 100mm in height. When fire danger conditions are elevated (Catastrophic), the Emergency Management Plan will outline procedures for closing the site during the construction phase and limiting maintenance operations unless critical. The CFA Guideline requires the provision of vegetation management surrounding the BESS area and other infrastructure. The access roads will be established during the construction phase and maintained throughout the project's lifespan. These access roads will likely assist with bushfire containment under lower fire danger conditions.
Neighbourhood (400 metres) and local conditions (one kilometre)	Within one kilometre of the BESS Site, the surrounding landscape is predominantly residential and commercial built environment. There is an area of grassland, namely Spring Road Reserve, to the	Under strong wind conditions, a bushfire can travel quickly across the landscape. The quantity of fuels heavily influences grassfires within the grasslands and the strength of the wind.	The provision of access roads throughout the SVB will assist with containing bushfires and providing increased accessibility to the landscape. The managed areas will also significantly limit the chances of a bushfire starting at the BESS.

Bushfire Hazard	Conditions	Likely Scenario	Considerations type
	immediate west and Spring Valley Park to the Northeast of the BESS Site. The surrounding road network provides access and egress opportunities for emergency services, and in some cases, these are maintained as fire breaks.	Roadsides will contribute to bushfire spread due to the presence of unmanaged fuels and trees that are likely to generate short-distance ember attacks. The nature of the grasslands adjacent to the BESS site properties results in a highly fragmented landscape where some areas are considered to contain reduced fuel (Spring Valley Park), and other areas have elevated fuels due as the area is maintained as a reserve (Spring Road Reserve).	
Landscape conditions (10 kilometres)	The landscape surrounding the BESS Site consists primarily of a residential and commercial built environment, with limited grassland within a 10-kilometer area. The nature of the grasslands adjacent to the BESS site properties results in a highly fragmented landscape where some areas are considered to contain reduced fuel (Spring Valley Park), and other areas have elevated fuels due to the area being maintained as a reserve (Spring Road Reserve).	The likely bushfire behaviour will involve fast-running grass fires with varying intensities, heavily influenced by changes in vegetation types and other landscape features, including dwellings, managed areas, and roadways. The grass fire would approach predominantly from a north/northeast direction and a South/southwest direction.	The CFA Guideline requires the protection of the BESS infrastructure from bushfire impact. The provision of access roads will enhance firefighters' ability to access the areas surrounding the SVB.

4.1 Bushfire Hazard Landscape Assessment

Figure 4.2 and 6 outlines the outcome of the bushfire hazard landscape assessment. The assessment identifies the two likely scenarios that may occur at the BESS Facility. Both scenarios are consistent in that the likely bushfire impact on the BESS Site is from either the north-west or south-west. Table 4.2 describes each of the scenarios contained within Figure 4.2 and Figure 4.3.

Table 4.2: Bushfire Scenarios

Scenario	Description
A	Bushfires burning under a north-northwesterly wind influence will burn through predominantly grassland fuels. These fuels will vary due to different farming practices, as well as the use of private, municipal, and state roads and residential and commercial properties. Traditionally, a north-westerly wind influence is associated with elevated fire danger days. Other landscape features, including the surrounding firebreaks, are listed within the Municipal Fire Management Plan and the roadside management plan. Westall Road and the Dingwell Highway would provide fire breaks as these roads bound the project site. The site APZs and road network will likely provide additional areas where bushfire spread may be interrupted, depending on the fire danger conditions.
B	A bushfire that approaches under the influence of a south-westerly wind usually occurs after a north-westerly wind has been influencing the weather conditions. The wind change can occur after a bushfire has been burning for some time under the north-westerly influence. Depending on the location of the bushfire, the entire western and southern side of the BESS Facility may come under threat simultaneously. This type of bushfire behaviour is consistent with large grassfires that have occurred in the past in the surrounding Victorian landscape. The presence of the Spring Road Reserve to the immediate west and Spring Valley Park to the Northeast of the BESS Site will likely contribute to the generation of embers. The fragmented vegetation that is associated with reserves and parks within residential and commercial areas will influence bushfire behaviour. The road network will also help slow or stop the bushfire from spreading.
C	Bushfires burning under an easterly wind influence will burn through predominantly grassland fuels. These fuels will vary due to different farming practices, as well as the use of private, municipal, and state roads, residential and commercial properties. The fragmented vegetation that is associated with reserves and parks within residential and commercial areas will influence bushfire behaviour. The road network will also help slow or stop the bushfire from spreading. Other landscape features, including the surrounding firebreaks, are listed within the Municipal Fire Management Plan and the roadside management plan. Westall Road and the Dingwell Highway would provide fire breaks as these roads bound the project site. The site APZs and road network will likely provide additional areas where bushfire spread may be interrupted, depending on the fire danger conditions.

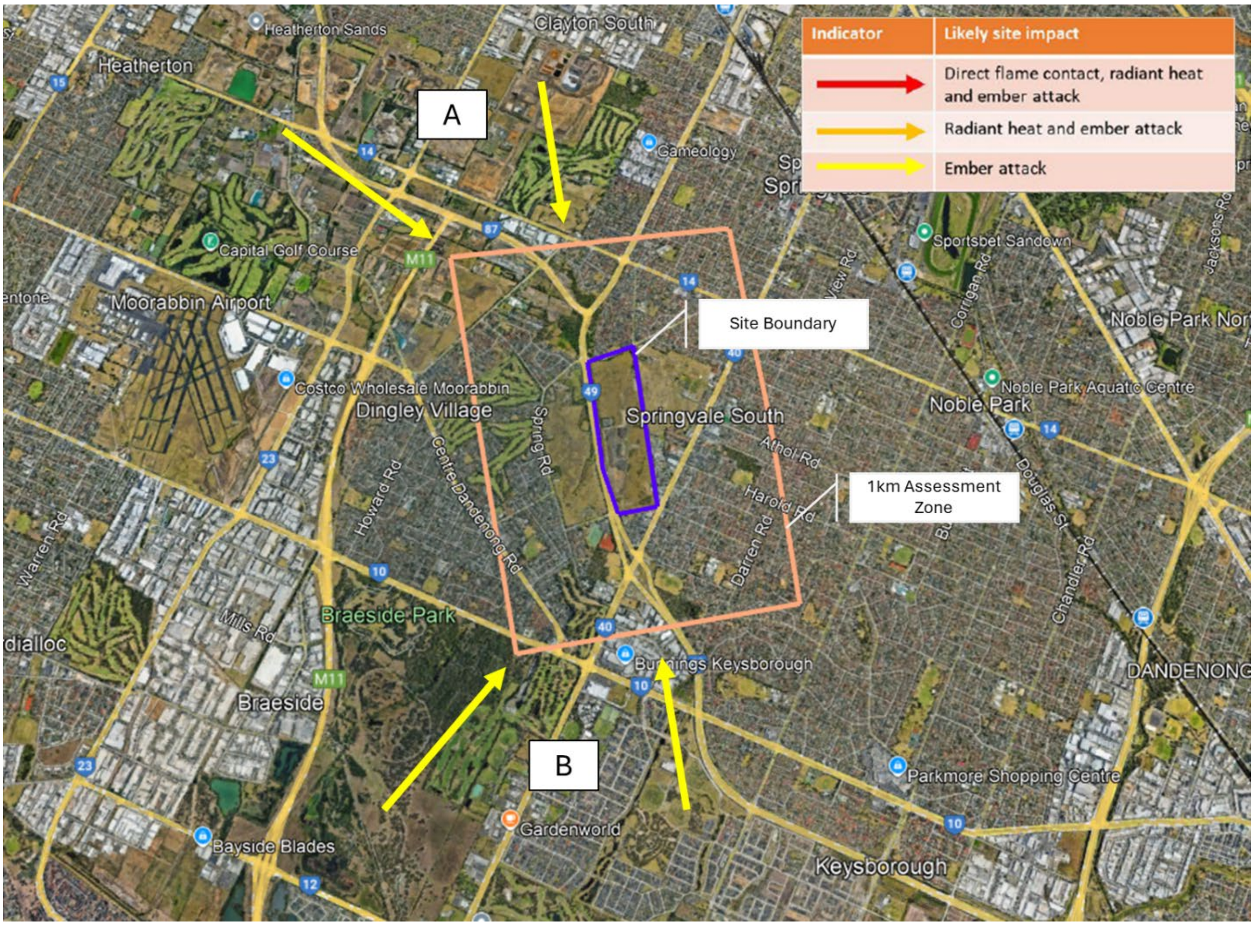


Figure 4.2 One Kilometre Landscape Assessment

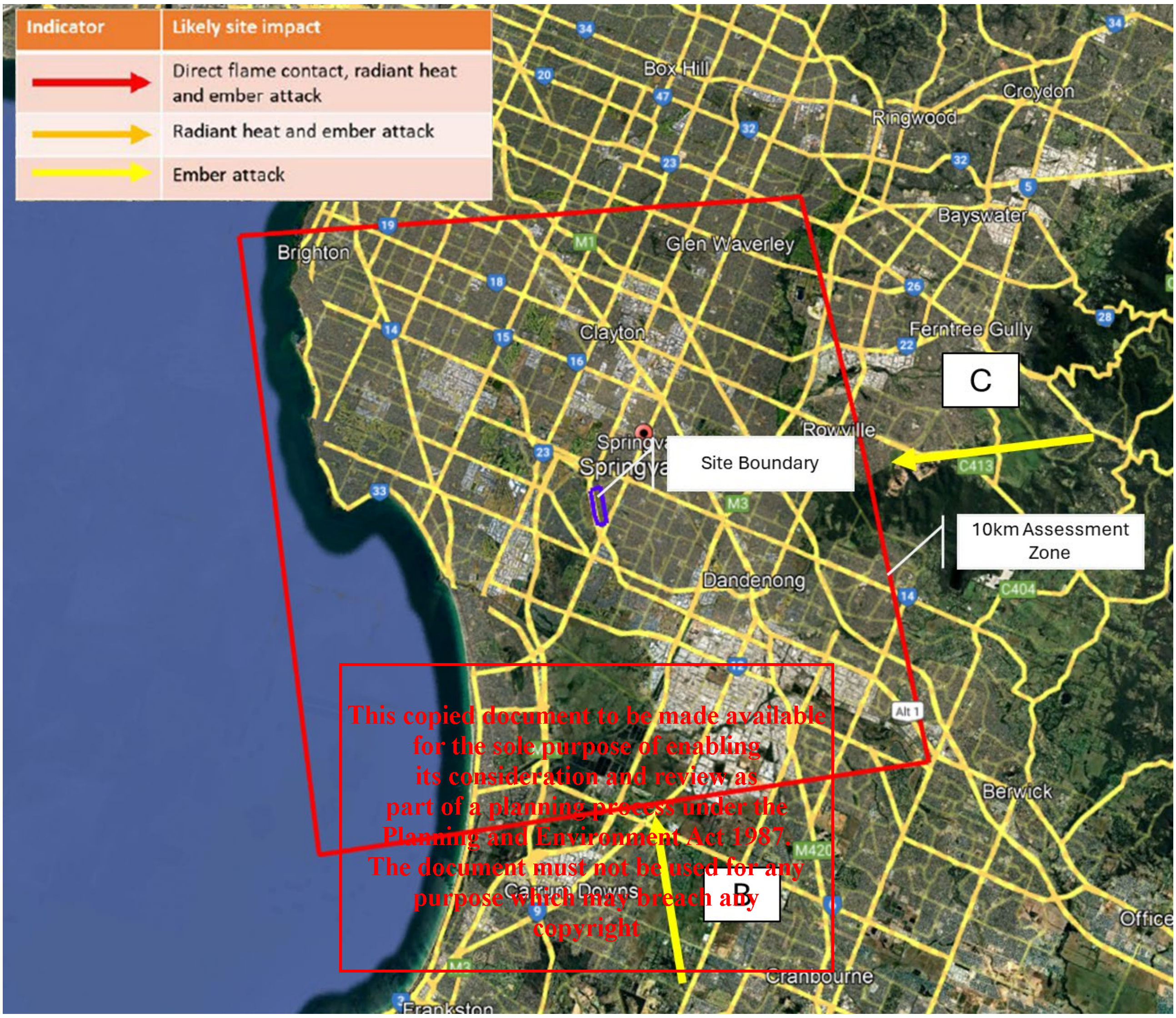


Figure 4.3 Ten Kilometre Landscape Assessment

Clause 13.02 Settlement Objectives are primarily related to settlement development, for which it could be argued that a Battery Energy Storage System (BESS) do not meet these definitions. Nevertheless, an assessment of the project has been undertaken against the Settlement Objectives to facilitate a detailed consideration of the project in relation to the Clause 13.02 Policy.

Table 4.3: Response to Clause 13.02 – Settlement Objectives

Settlement planning objectives	Project response	Achieved (✓ or ×)
Directing population growth and development to low risk locations, being those locations assessed as having a radiant heat flux of less than 12.5 kilowatts/square metre under AS 3959-2009 Construction of Buildings in Bushfire-Prone Areas (Standards Australia, 2009).	This project does not promote population growth and will only have people on-site during the construction phase and when undertaking maintenance during the operations phase. The design has ensured that the location of the infrastructure will be in low risk areas.	✓

Settlement planning objectives	Project response	Achieved (✓ or ×)
Ensuring the availability of, and safe access to, areas assessed as a BAL-LOW rating under AS 3959-2009 Construction of Buildings in Bushfire-prone Areas (Standards Australia, 2009) where human life can be better protected from the effects of bushfire.	The BESS project will result in areas that will achieve a Bushfire Attack Level (BAL) Low rating when assessed against AS3959. This will include the BESS, substation and compound areas. Depending on the location of a bushfire in the surrounding landscape, there are several travel routes available to leave the area and travel to an area deemed to be BAL LOW. These locations would include Skipton and Linton. There is a Neighbourhood Safer Place in located within Linton. The identification and travel routes to the various locations that meet the BAL LOW requirements will be addressed within the Emergency Management Plan that is developed for the BESS project.	✓
Ensuring the bushfire risk to existing and future residents, property and community infrastructure will not increase as a result of future land use and development.	The BESS will be provided with a range of protection measures that will ensure the bushfire risk to existing and future surrounding properties will not increase. These measures include: · Asset Protection Zone surrounding the BESS area, substation and other works areas. · BESS design considerate of fire risk and provided with suitable monitoring systems with the aim of preventing fires. · Access road network to be developed and maintained to allow for access to all areas of the site. · Provision of static water supplies to support firefighting operations at the BESS and throughout the SVB.	✓
Achieving no net increase in risk to existing and future residents, property and community infrastructure, through the implementation of bushfire protection measures and where possible reducing bushfire risk overall.	The fire protection measures required by the CFA Guideline ensures that there is no net increase in risk to existing and future residents. The site for the BESS has been chosen to ensure separation from existing dwellings is achieved.	✓

Settlement planning objectives	Project response	Achieved (✓ or ×)
Assessing and addressing the bushfire hazard posed to the settlement and the likely bushfire behaviour it will produce at a landscape, settlement, local, neighbourhood and site scale, including the potential for neighbourhood-scale destruction.	The bushfire risk has been assessed at the landscape level. This has identified the potential for long bushfire runs to occur from the north west and south west aspects. This project will not change the current expected bushfire behaviour in the landscape, it will likely reduce the risk in the surrounding areas due to the addition of an access track network and management around the BESS and other works areas.	✓
Assessing alternative low risk locations for settlement growth on a regional, municipal, settlement, local and neighbourhood basis.	The CFA Guideline requirements ensure that the management of risk occurs that reflects the landscape bushfire risk.	✓
Not approving any strategic planning document, local planning policy, or planning scheme amendment that will result in the introduction or intensification of development in an area that has, or will on completion have, more than a BAL-12.5 rating under AS 3959-2009 Construction of Buildings in Bushfire-Prone Areas (Standards Australia, 2009).	The BESS Site will achieve a less than BAL 12.5 rating when assessed against AS3959 through the provision of Asset Protection Zones around the infrastructure.	✓

4.2 Assessment against Clause 13.02 summary

The assessment against Clause 13.02 has identified that the BESS Site is within an area where the potential for grassfires in the surrounding landscape influences the landscape bushfire risk. These grassfires can travel long distances, depending on prevailing weather conditions. However, the proposal has been designed to limit both the potential impact on the BESS facility and the risk of fires leaving the property and entering the surrounding landscape. As the project is required to meet the requirements outlined in the CFA Guidelines, this will ensure that the settlement planning objectives are met.

4.3 Analysis against CFA Guideline

CFA has produced Guidelines outlining their requirements for addressing fire risk in renewable energy installations. Section 5 of the Guideline outlines the process for analysing risk to identify hazards that may or can cause fires.

The CFA Guideline also specifies model requirements for renewable energy installations. Prior to undertaking the risk assessment, it is essential to evaluate the BESS project against these requirements. This will increase the effectiveness of the risk assessment.

Table 4.4provides the model requirements from CFA's Guideline and how this project addresses the specific areas.

Table 4.4: Response to CFA Guideline

Model requirement	Compliance	Comments
Section 2 – consulting with CFA		
Early consultation, prior to the development of the planning permit application, ensures that CFA can effectively consider emergency response implications.	✓	CFA has been consulted on the project and ongoing consultation will continue to occur through the development of the Fire Management Plan and Emergency Management Plan once the Planning Permit has been issued. This Risk Management Plan has been developed to support the consultation with CFA and demonstrate how the fire risk is proposed to be managed.
Section 3 – Fire Risk Management		
A Risk Management Plan must be developed for the facility, in consultation with CFA, before development starts.	✓	This RMP has been developed to enable the developer to demonstrate how they propose to manage the risk of fire in relation to the project.
Section 4- Facility Location and Design		
4.1.1 High Risk Environments		
Planning applications for all renewable energy facilities proposed in high-risk environments must address the following, in addition to providing an assessment against policy at Clause 13.02-1S (Bushfire Planning):	✓	This RMP includes an assessment against Clause 13.02 within Section 4.1. The assessment has identified the potential for bushfires to approach the BESS site from either the north west or south west.
a) The impact of any ignitions arising from the infrastructure (solar panels, wind turbines, battery energy storage systems, electrical infrastructure) on nearby communities, infrastructure and assets.	✓	This report considers the impact and the likelihood of fires that leave the property. The Clause 13.02 assessment has considered this and has also been addressed within the risk assessment in Section 4.
b) The impact of bushfire on the infrastructure (e.g. ember attack, radiant heat impact, flame contact).	✓	This report considers the impact of bushfire on the infrastructure. The Clause 13.02 assessment considered this and has also been addressed within Section 4.
c) Assessment of whether the proposal will lead to an increase in risk to adjacent land and how the proposal will reduce risks at the site to an acceptable level.	✓	Clause 13.02 assessment has considered this and determined that there will be no increase in bushfire risk due to the project. The requirements, including managing vegetation around the BESS area and provision of access roads, support the management of bushfire risk.
d) Assessment of whether the proposal will lead to an increase in risk to adjacent land and how the proposal will	✓	This report considers the impact the proposal to adjacent land. This has been addressed within Section 4.

Model requirement	Compliance	Comments
reduce risks onsite to an acceptable level		
Section 4.2 – Facility Design		
Section 4.2.1 – Emergency vehicle access		
All facilities		
a) Construction of a four (4) metre perimeter road within the perimeter fire break.	✓	All Access Roads will be a minimum of four metres wide.
b) Roads must be of all-weather construction and capable of accommodating a vehicle of fifteen (15) tonnes.	✓	The Access Roads constructed for this project will be designed, constructed and maintained to ensure they can support the movement of vehicles up to 15 tonnes.
c) Constructed roads should be a minimum of four (4) metres in trafficable width with a four (4) metre vertical clearance for the width of the formed road surface.	✓	All Access Roads will be a minimum of four metres wide.
d) The average grade should be no more than 1 in 7 (14.4% or 8.1°) with a maximum of no more than 1 in 5 (20% or 11.3°) for no more than fifty (50) metres.	✓	The site is mainly flat with only small slopes present. There are no roads that will require assessment of the grade.
e) Dips in the road should have no more than a 1 in 8 (12.5% or 7.1°) entry and exit angle.	✓	The site is mainly flat with only small slopes present. There are no roads that will require assessment of dips.
f) Roads must incorporate passing bays at least every 600 metres, which must be at least twenty (20) metres long and have a minimum trafficable width of six (6) metres. Where roads are less than 600 metres long, at least one passing bay must be incorporated.	✓	Passing bays will be included within the design of the Access Tracks for the site.
g) Road networks must enable responding emergency services to access all areas of the facility, including fire service infrastructure, buildings, and battery energy storage systems and related infrastructure.	✓	The proposed access roads will provide direct access to the BESS area, and other work areas. Other infrastructure is located adjacent to Public Roads and accessible by emergency service vehicles.
h) The provision of at least two (2) but preferably more access points to the facility, to ensure safe and efficient access to and egress from areas that may be impacted or involved in fire. The number of access points must be	✓	The BESS will be equipped with dual access and egress points.

Model requirement	Compliance	Comments
informed through a risk management process.		
Section 4.2.2 Firefighting Water Supply		
All Facilities		
a) Water access points must be clearly identifiable and unobstructed to ensure efficient access.	✓	A Static water supply for the BESS will be located, where possible, at the property entrance. The final location of static water supply will be finalised in consultation with CFA.
b) Static water storage tank installations must comply with AS 2419.1-2005: Fire hydrant installations – System design, installation and commissioning.	✓	The static water supply will be located within tanks that comply with AS2419.1:2015
c) The static water storage tank(s) must be an above-ground water tank constructed of concrete or steel.	✓	The static water tanks will be above ground
d) The static water storage tank(s) must be capable of being completely refilled automatically or manually within 24 hours.	✓	Site management will have an arrangement with a local water carrier to ensure static water supplies are refilled within 24 hours. This will be addressed within the Emergency Management Plan.
e) The static water storage tanks must be located at vehicle access points to the facility and must be positioned at least ten (10) metres from any infrastructure (solar panels, wind turbines, battery energy storage systems, etc.).	✓	Static water tanks will be located at the entrances to the access roads constructed for the BESS project. They will be located at least 10 metres from all infrastructure.
f) The hard-suction point must be provided, with a 150mm full bore isolation valve (Figure 1) equipped with a Storz connection, sized to comply with the required suction hydraulic performance. **Adapters that may be required to match the connection are: 125mm, 100mm, 90mm, 75mm, 65mm Storz tree adapters (Figure 2) with a matching blank end cap to be provided.**	✓	The static water tanks will be provided with a hard suction point and adapters that will allow for the typical firefighting appliances to access the water supplies.
g) The hard-suction point must be positioned within four (4) metres to a hardstand area and provide a clear access for emergency services personnel.	✓	The hard suction points will be accessible by firefighting appliances.
h) An all-weather road access and hardstand must be provided to the hard-suction point. The hardstand must be maintained to a minimum of 15	✓	The tank will be provided with access to allow firefighting appliances to access the hard suction point.

Model requirement	Compliance	Comments
tonne GVM, eight (8) metres long and six (6) metres wide or to the satisfaction of the CFA.		
i) The road access and hardstand must be kept clear at all times.	✓	This requirement will be specified within site procedures and the Emergency Management Plan.
j) The hard-suction point must be protected from mechanical damage (eg. bollards) where necessary.	✓	Bollards will be provided to protect the static water tanks outlets from mechanical damage
k) Where the access road has one entrance, a ten (10) metre radius turning circle must be provided at the tank.	✓	Turning provisions will be provided that will enable firefighting appliances to safely turn around.
l) An external water level indicator must be provided to the tank and be visible from the hardstand area.	✓	This has been included within the design.
m) Signage (Figure 5) indicating 'FIRE WATER' and the tank capacity must be fixed to each tank.	✓	This has been included within the design.
n) Signage (Figure 6) must be provided at the front entrance to the facility, indicating the direction to the static water tank.	✓	Signage will be provided at all property entrances that shows the location of the closest static water supply to that location.
Battery Energy Storage Systems		
1) For facilities with battery energy storage systems, the fire protection system must include as a minimum:		
b) Where no reticulated water is available, a fire water supply in static storage tanks, where:	✓	Static water supplies in storage tanks will be provided.
i. The fire water supply must be of a quantity no less than 288,000L or as per the provisions for Open Yard Protection of AS 2419.1-2005 flowing for a period of no less than four hours at 20L/s, whichever is the greater.	✓	The BESS layout is being determined, and the provision of water supplies will be in accordance with the provisions of AS2419.1. Provision of firewater infill by the street main.
ii. The quantity of static fire water storage is to be calculated from the number of hydrants required to flow from AS 2419.1-2005, Table 3.3. ***(E.g., For battery installations with an aggregate area of over 27,000m2, 4 hydrant outlets are required to operate at 10L/s for four hours, which equates to a minimum static water supply of 576kL.)***	✓	The BESS area will be provided with water supplies that conform with AS2419.1.
iii. Fire hydrants must be provided and located so that every part of the battery energy storage system is within reach of	✓	Fire hydrants will be located around the site to enable coverage to be achieved.

Model requirement	Compliance	Comments
a 10m hose stream issuing from a nozzle at the end of a 60m length of hose connected to a fire hydrant outlet.		
iv. The fire water supply must be located at vehicle entrances to the facility, at least 10m from any infrastructure (electrical substations, inverters, battery energy storage systems, buildings).	✓	The water supply will be at least 10 metres from any infrastructure.
v. The fire water supply must be reasonably adjacent to the battery energy storage system and shall be accessible without undue danger in an emergency. (Eg., Fire water tanks are to be located closer to the site entrance that the battery energy storage system).	✓	The static water supply and booster assembly will be located adjacent to the main entrance to the BESS area.
vi. The fire water supply must comply with AS 2419.1-2005: Fire hydrant installations - Section 5: Water storage.	✓	The water supply will comply with the requirements outlined within Section 5. This will, as a minimum, include: • Appropriate overflows and air gaps • Large and small bore connections • Tank contents indicator • Appropriate signage • Access opening and ladders
Substations		
Fire water must be available to substations.	✓	A 45,000-litre static water supply will be located at the primary site access point. This is in conjunction with the BESS area water supply.
Section 4.2.5 – Fire Breaks		
A fire break must be established and maintained around:		
a)the perimeter of the facility, commencing from the boundary of the facility or from vegetation screening inside the property boundary	✓	Vegetation in the area around the BESS is maintained at a level that will prevent any external fire from reaching an intensity which would adversely impact the BESS across the 10 m separation distance
b) The perimeter of control rooms, electricity compounds, substations and all other buildings onsite. The width of fire breaks must be a minimum of 10m, and at least the distance where radiant heat flux (output) from the vegetation does not create the potential for ignition of on-site infrastructure.	✓	All infrastructure will be provided with a 10 metre wide fire break including: • Substation • Centralised BESS • Static water supply
Battery Energy Storage Systems		

Model requirement	Compliance	Comments
A fire break must be established and maintained around battery energy storage systems and related infrastructure.	✓	A fire break will be provided surrounding the BESS compound. The fire break will extend from the edge of the perimeter driveway to the BESS area fence.
Section 4.2.6 – Design Specific to Facility Type		
Battery Energy Storage Systems		
1) The design of the facility must incorporate:		
a) A separation distance that prevents fire spread between battery containers/enclosures and: • **Other battery containers/enclosures.** • **On-site buildings.** • **Substations.** • **The site boundary.** • **Any other site buildings.** • **Vegetation.** ***Separation must be at least the distance where the radiant heat flux (output) from a battery energy storage system container/enclosure fully involved in fire does not create the potential for ignition of these site elements.***	✓	The site design will be in accordance with the manufacturer's specifications. The manufacturer design specifications have been tested against international standards. Appropriate separation will be provided to enable effective firefighting operations to occur and to limit the potential for fire spread between battery packs.
b) A fire break around the battery energy storage system and related infrastructure, of a width of no less than 10m, or greater where determined in the Risk Management Plan. **Fire breaks must be non-combustible, constructed of concrete, mineral earth or non-combustible mulch such as crushed rock.** ***The width must be calculated based on the ignition source being radiant heat of surrounding vegetation, including landscaping.***	✓	Surrounding the BESS area will be a perimeter access road that is within a 10m fire break. The remainder of the vegetated areas within the BESS compound will be maintained during the fire danger period.
c) A layout of site infrastructure that: **i. Considers the safety of emergency responders.** **ii. Minimises the potential for grassfire and/or bushfire to impact the battery energy storage system.** **iii. Minimises the potential**	✓	The site layout has been designed to ensure safe and effective access for firefighters and minimises the potential for grassfires to impact on the area.

Model requirement	Compliance	Comments
for fires in battery containers/enclosures to impact on-site and offsite infrastructure.		
2) Battery energy storage systems must be:		.
a) Located so as to be reasonably adjacent to a site vehicle entrance (suitable for emergency vehicles).	✓	Emergency vehicle access is available to the site .
b) Located so that the site entrance and any fire water tanks are not aligned to the prevailing wind direction (therefore least likely to be impacted by smoke in the event of fire at the battery energy storage system.)	✓	The static water supply will be located adjacent to the main entrance. This provides effective access for firefighters
c) Provided with in-built detection and suppression systems. Where these systems are not provided, measures to effectively detect and/or suppress fires within containers must be detailed within the Risk Management Plan.	✓	The BESS packs will be installed as per the manufacturer's specifications. Where detection and suppression systems are recommended, these will be installed.
d)provided with explosion prevention via sensing and venting, or explosion mitigation through deflagration panels.		All BESS technologies are provided with multiple sensors and alerts that will detect if a fault is occurring. Procedures will ensure that upon detection of faults, the battery will be shut down immediately until it has been checked by an operator.
e) Provided with suitable ember protection to prevent embers from penetrating battery containers/enclosures.	✓	The BESS packs will be designed to prevent embers from penetrating into the packs.
f) Provided with suitable access roads for emergency services vehicles, to and within the site, including to battery energy storage system(s) and fire service infrastructure.	✓	Access is provided to the BESS area and the fire hydrant systems.
g) Installed on a non-combustible surface such as concrete.	✓	The BESS packs will be installed on a non-combustible surface.
g) Provided with adequate ventilation.	✓	The battery packs are provided with ventilation systems that meet the manufacturer's specifications.
h) Provided with impact protection to at least the equivalent of a W guardrail-type barrier, to prevent mechanical	✓	The BESS area is provided with security fencing with restricted access to the BESS containers. Reduced

Model requirement	Compliance	Comments
damage to battery containers/enclosures.		speed limits and access restrictions limit potential for vehicle impact with BESS containers.
i) Provided with enclosed wiring and buried cabling, except where required to be above-ground for grid connection.	✓	This will be included within the design.
j) Provided with spill containment that includes provision for management of fire water runoff.	✓	Suitable spill containment will be provided around the equipment that holds dangerous goods. In most cases the equipment itself is manufactured with its own bunding. A fire water runoff basin will be provided within the BESS property. This area will enable fire water to be captured and if required, to be disposed of. Water runoff will be managed on site. This is to be developed further in consultation with CFA.
Section 5 – Facility Construction and Commissioning		
Section 5.1.4 – Emergency Management		
An Emergency Management Plan must be developed for the construction and commissioning phase of the facility.	✓	An Emergency Management Plan will be developed for both the construction and operations phase.
Section 6 – Facility Operation		
Fire Management Plan		
A Fire Management Plan must be developed for the facility, in consultation with CFA, before development starts.	✓	A Fire Management Plan will be developed in consultation with CFA, before development starts.
Section 6.2.1 Bushfire and Grassfire		
If your facility is at-risk of bushfire, prevention and preparedness activities must be detailed in the Fire Management Plan.	✓	A Fire Management Plan will be developed in consultation with CFA, before development starts and will include specify bushfire prevention and preparedness.
Section 6.2.2 – Vegetation and Fuel Management		
Facility operators must undertake the following measures during the Fire Danger Period:		
a) Grass must be maintained at or below 100mm in height during the declared Fire Danger Period.	✓	This requirement will be included within the Fire Management Plan for the areas surrounding the terminal station, BESS and the operations and maintenance area.

Model requirement	Compliance	Comments
b) Long grass and/or deep leaf litter must not be present in areas where heavy equipment will be working, during construction or operation.	✓	This requirement will be included within the Fire Management Plan.
c) Restrictions and guidance must be adhered to during the Fire Danger Period, days of high (and above) fire danger and Total Fire Ban days (refer to www.cfa.vic.gov.au).	✓	This requirement will be included within the Fire Management Plan.
d) All vehicles and heavy equipment must carry at least a nine (9)-litre water stored-pressure fire extinguisher with a minimum rating of 3A, or firefighting equipment as a minimum when on-site during the Fire Danger Period.	✓	This requirement will be included within the Fire Management Plan.
Section 6.2.3 – Arc Flash Hazard Management		
Where required, appropriate demarcation of arc boundaries to at least 10m from PCU arc flash outlet flaps (blow-out panels) must be provided.	✓	This requirement will be included within the Fire Management Plan.
Section 6.2.4 – Facility and System Monitoring		
Appropriate monitoring for facility infrastructure must be provided, to ensure that any shorts, faults or equipment failures with the potential to ignite or propagate fire are rapidly identified and controlled, and any fire is notified to 000 immediately	✓	This requirement will be included within the Fire Management Plan. In addition to the detection and suppression systems, the site will be provided with a SCADA system that will monitor the day to day operations of the BESS. The system includes a range of sensors that will detect faults and report them to the monitoring centre. The system is preprogramed to send alert messages and includes: • Over temperature • Under temperature • Under-voltage warning • Power off fault • Voltage and current changes. These alerts are automatically transmitted to a monitoring centre. There are appropriate levels of back up communication systems installed in the event of power failures or other events that may interrupt the communications connections.
Section 6.2.5 – Maintenance		

Model requirement	Compliance	Comments
All Facilities		
Inspection, maintenance and any required repair activities must be conducted for all infrastructure, equipment and vehicles at the facility. Maintenance must be in line with any relevant Australian Standards and the manufacturer's requirements.	✓	This requirement will be included within the Fire Management Plan.
Section 9 – Fire Management Planning		
All Facilities		
A Fire Management Plan must be developed for the facility, in conjunction with CFA, before commissioning of the facility	✓	A Fire Management Plan will be developed prior to the commissioning of the BESS. This Plan will be provided to CFA for their consideration and feedback.
Section 7 – Emergency Planning		
All Facilities		
An Emergency Plan must be developed for the operational phase, specific to the facility, in consultation with CFA, before development starts.	✓	An Emergency Management Plan will be developed prior to the commissioning of the BESS. This Plan will be provided to CFA for their consideration and feedback.
Section 8 – Provision of Emergency Information		
An Emergency Information Book must be developed and available to emergency responders. Emergency Information Books must be located in Emergency Information Containers, provided at each vehicle entrance the facility.	✓	An Emergency Information Book will be housed within an Emergency Information Container and located near the primary site access. The final location of Emergency Information Containers will be determined in conjunction with CFA.

4.4 Analysis against FRV Guideline 55

The developed RMP & FSS is fully aligned with FRV Guideline 55 and demonstrates compliance and best-practice application. It not only meets but also exceeds guideline expectations in areas such as modelling, hazard analysis, and system monitoring. The only notable distinction is the adoption of a non-intervention fire strategy, which is justified through engineering evidence rather than prescribed directly by the guideline.

A comparison summary is provided in Table 4.5 below.

Table 4.5: Analysis against FRV Guideline 55

Aspect	FRV Guideline 55 (Requirements / Expectations)	Developed RMP & FSS (Springvale BESS)	Alignment / Gap
Purpose & Scope	Provides fire safety and risk management framework for BESS installations, focusing on hazard mitigation and firefighter safety	Developed to meet CFA + HIPAP 2 + FRV requirements and support planning approval for Springvale BESS	Strong alignment (project-specific implementation of guideline intent)
Risk Assessment Approach	Requires qualitative, semi-quantitative, or quantitative risk assessments depending on scale	Uses structured risk assessment aligned with HIPAP 2 including consequence modelling, hazard identification, and scenario analysis	Fully aligned (quantitative + modelling used appropriately)
Fire Safety Study (FSS)	Mandatory for commercial/industrial and utility-scale BESS; must be site-specific and include deterministic analysis	Comprehensive FSS developed including HAZID, modelling, fire scenarios, and fire safety strategy	Fully compliant
Preliminary Hazard Analysis (PHA)	Required for large/urban BESS to assess off-site impacts	PHA used as input to HAZID and consequence modelling	Aligned
Hazard Identification (HAZID)	Must consider fire, explosion, toxic gas, electrical hazards	Detailed HAZID covering battery fires, propagation, transformer fires, toxic gases, vandalism	Exceeds expectations (very detailed)
Consequence Analysis	Requires modelling of heat, explosion, toxic gases (semi/quantitative)	Extensive modelling (heat radiation, HF dispersion, transformer fires) using recognised methods	Strong compliance
Deterministic Analysis	Required to assess fire propagation, separation distances, ventilation performance	Demonstrated via modelling, UL9540A test data, and engineering analysis of fire propagation	Fully aligned
Fire Safety Strategy	Must ensure prevention, detection, protection, and mitigation of escalation	Strategy based on non-intervention approach, supported by design features and modelling	Aligned but strategically specific (non-intervention justified by testing)
Fire Propagation Control	Requires validated separation distances and mitigation measures	Demonstrates no propagation via testing, modelling, and spacing design	Strong compliance
Ventilation Requirements	Must manage flammable/toxic gases during thermal runaway via analysis	Ventilation integrated in Tesla design + supported by modelling and FSS assumptions	Compliant (though more manufacturer-driven)
Emergency Response Plan (ERP)	Required for larger/indoor BESS; must include communication, response, safety procedures	Detailed ERP requirements defined, including coordination with FRV and Tesla	Fully aligned
Emergency Information Book (EIB)	Required for large/complex BESS installations	EIB included and to be located onsite for responders	Compliant

Aspect	FRV Guideline 55 (Requirements / Expectations)	Developed RMP & FSS (Springvale BESS)	Alignment / Gap
Firefighter Safety Considerations	Must address electrical hazards, reignition, access, unknown battery state	Explicitly addressed via non-intervention strategy, exclusion zones, and ERP procedures	Strong alignment
Access & Firefighting Infrastructure	Requires access roads, hydrants, staging areas, water supply	Detailed compliance with CFA requirements (roads, hydrants, water tanks, access points)	Fully compliant
Fire Water & Runoff Management	Must ensure adequate supply and containment	Static water supply, hydrants, and runoff basin included	Compliant
Monitoring & Detection Systems	Requires fault detection, remote monitoring, early warning systems	Advanced SCADA + BMS monitoring with automatic alerts and shutdown	Exceeds expectations
Design Standards & References	Requires compliance with AS/NZS, NFPA, UL standards	Explicit alignment with AS/NZS, UL9540A, and international standards	Fully aligned
Site-Specific Considerations	Requires consideration of surroundings, exposures, and land use	Includes bushfire risk assessment, surrounding land use, and planning controls	Exceeds baseline requirements

5 Hazard Identification - BESS

5.1 Overview

A hazard identification (HAZID) review was conducted to identify credible fire-related incidents associated with the BESS Development. The HAZID included fires that could initiate within the proposed BESS facility. The FSS HAZID table is shown in Table 5.4.

The FSS HAZID considered the hazardous materials and processes associated with the proposed BESS development and reported incidents at other sites that utilise Tesla battery products.

The following information sources were referenced to inform potential fire incidents:

- Tesla was consulted to identify incidents involving their Megapack lithium-ion batteries to understand the nature and extent of credible BESS fire events.

5.2 Fire Hazard Identification (HAZID)

A hazard identification (HAZID) review was undertaken to identify credible fire-related incidents related to the BESS development. The HAZID considered the potential for escalation of fires between the BESS. The HAZID considered the hazardous materials, processes and historical incidents associated with the proposed BESS Development.

The HAZID was based on the PHA for the proposed BESS development. Tesla was consulted to identify incidents involving their Megapack lithium-ion batteries to understand the nature and extent of credible BESS fire events.

Table 5.1 provides a summary of the HAZID for consequence assessment review, which has been used to inform the fire safety strategy.

Table 5.1: Potential Fire Incidents carried forward for Consequence Analysis

HAZID Ref.	Description	Carried forward to Consequence Analysis
1	Fire involving a Tesla Megapack MP2 unit	Yes
2	Propagated fire to adjacent Tesla Megapack MP2 unit	Yes
3	Fire involving a BESS transformer	Yes

5.3 Consequence Assessment Review

The identified fire incidents were reviewed to understand their potential consequence from a radiation impact.

For BESS-related fires, radiation impact analyses were based on Tesla-supplied information (UL9540A[2] and destructive (i.e. burn down) unit test) for the Megapack battery product line. The review was supplemented by Tesla fire specialist modelling and modelling in the BESS Preliminary Hazard Analysis (PHA).

The review found that UL9540A and unit-level destructive fire test results for the Tesla Megapack unit indicated that fire propagation should not occur if the BESS units follow the separation spacing as per the installation manual. Third-party fire specialist validation of fire radiation and runaway modelling supported the test results[3]. The review aligns

[2] Unit level test

[3] Fisher Engineering Inc. , "Tesla Megapack 2 and Megapack 2XL Fire Protection Engineering Analysis," 2023.

with observations of actual BESS fires involving the Tesla Megapacks (i.e. Big Battery Fire in Victoria and Bouldercombe BESS fire) where incident propagation was limited to asset damage but no fire propagation involving adjacent battery units.

Fire modelling for the Megapack MP2 batteries indicated that fire incidents do not pose significant offsite fatalities or severe injury impacts. Fire test results and modelling confirmed that the fire will not propagate to adjacent BESS units.

5.4 Fire Safety Strategy

The proposed fire safety strategy is based on the identified fire incidents at the BESS facility and an understanding of the potential for escalation.

5.4.1 BESS Development

For the BESS facility, the fire safety strategy is **non-intervention** and covers:

- Fire (and propagated event) involving a Tesla Megapack MP2 unit
- Fire involving a BESS transformer.

The strategy was developed in consultation with Tesla and the SEF operations personnel based on the MP2XL fire safety design features and Tesla fire testing to inform unit separation distances and minimise potential fire propagation.

The proposed design and operational fire prevention, detection and protection safeguards for the BESS facility will minimise the potential for a BESS unit fire and limit the propagation potential.

5.5 Lessons Learnt – BESS Fires

Lithium-ion BESSs have been incorporated into electricity networks to balance energy supply and demand as electricity networks are decarbonising. Lithium-ion batteries have been around since the 1990s, but the rate of technological advancement has been so rapid that code and standard development have struggled to keep up.

As with many industries, scaling up is challenging; what works for a single battery cell will not necessarily be effective for hundreds of thousands of battery cells packaged into a BESS.

5.5.1 Cheltenham, Victoria 2025[4]

On Thursday 30 January 2025 at 8:46am, fire crews responded to a factory fire in Cheltenham in Melbourne's south-east. The fire was reported at 8.38am, with a call to Triple Zero (000) reporting that lithium-ion batteries had caught alight. Crews arrived at the Chesterville Road scene within five minutes, finding a 60-metre by 60-metre factory well alight, firefighters immediately escalating the response. A community advice message was issued for Cheltenham, Highett, Moorabbin and Moorabbin East – all residential areas. There was no reported threat to the community or toxic plume recorded from the fire event.

Approximately 25 fire trucks - including two ladder platforms and a teleboom - along with 70 firefighters, responded to the incident at its peak. It took fire crews about two and a half hours to contain the fire with the fire being deemed under control by 2.32pm, with firefighters remaining on scene overnight.

[4] https://www.frv.vic.gov.au/firefighters-respond-cheltenham-factory-fire-0

5.5.2 Bouldercombe, Queensland 2023

On September 26th, 2023, at 7:45 pm, a fire broke out at the Bouldercombe Battery Project, which is owned and operated by Genex Power. The battery is one of 40 lithium Tesla Megapack 2.0 units at the site. The site was unoccupied at the time. Several crews attended; however, the site has a non-intervention strategy, and they were advised to let the fire burn out.

The fire in the 50 MW/100 MWh battery caused a brief blaze and brought the project's commissioning to a halt while the cause was investigated. The fire was blamed on a fault in the power interface with the grid, not within the Megapack battery itself. The incident was described as a "low intensity fire" that was allowed to burn out without water being required to fight it.

The Bouldercombe battery is the second big battery commissioned on the Queensland grid.

From this LIB fire event example, it can be demonstrated that a non-intervention approach on battery farms allows for the fire to burn out and remain contained without using fire water intervention.

5.5.3 Geelong, Victoria 2021

On the 30th of July 2021, a fire broke out at the 450 MWh BESS project in Geelong, Victoria, Australia. A thermal runaway occurred in one of the 212 Tesla Megapacks while the system was commissioned. The fire spread to a neighbouring Megapack but did not propagate any further. The Megapack underwent UL9540A fire testing to establish separation distances and minimize thermal runaway propagation to adjacent units. However, several factors led to a larger fire than expected, but thankfully no explosion.

Fisher Engineering found that a leak in the liquid cooling system caused the power electronics' arcing, leading to thermal runaway. The commissioning procedures had the BESS unit switched off via a keylock switch, effectively a lock-out tag-out, but that caused many of the safety systems (telemetry, fault monitoring, electrical fault safety devices) to be disabled or have limited functionality. The detection of fire and the onset and escalation of thermal runaway were unknown because telemetry data (e.g., temperatures and fault alarms) were not being transmitted to Tesla's off-site control facility due to the commissioning procedure.

Lastly, the wind conditions on the day, 20-30 knots, caused flames exiting the roof of the originating Megapack to impinge on the neighbouring Megapack's thermal roof directly; something the UL9540A testing would not have shown due to the low wind conditions permitted in the test procedure. Tesla's ERP and the facility's subject matter experts instructed the fire brigade to let the unit burn out and only apply cooling water to nearby exposures of the unit on fire. Cooling efforts lasted approximately 6 hours, followed by a fire watch for almost 72 hours, highlighting the importance of a detailed ERP, availability of subject matter experts and pre-incident planning with the fire service.

5.5.4 Arizona, USA 2019

On the 22nd of April 2019, a BESS explosion occurred in Arizona, USA, at a public utility that had been using a 2 MWh BESS for 2 years. Thermal runaway occurred in a cell and cascaded to adjacent cells and modules in a rack. The BESS was outfitted with a total flooding clean agent fire suppression system; however, the system was incapable of stopping thermal runaway. Due to the nature of the suppression system, the ventilation system was turned off to hold the clean agent as per its design; therefore, there was no means to exhaust the flammable off-gases. No pre-incident planning was done for the site and the emergency response plan (ERP) had no guidance on extinguishing, ventilation, or entry procedures. When the fire department finally entered the container, the fresh air introduced enough oxygen to cause an explosion, injuring serval firefighters and destroying the BESS.

The incident investigation by DNV GL included a statement from 3M, the manufacturer of Novec 1230, that clean agent fire suppression could not prevent or suppress cascading thermal runaway in lithium-ion battery systems. However, such systems could be effective in an initial confined fire.

5.6 Stored Hazardous Materials

5.6.1 BESS development

The Tesla Megapack MP2XL units use lithium-ion battery technology, which is classified as DG Class 9 (Miscellaneous). Potential fire incidents involving this battery chemistry type are discussed in Section 5.8.

The hazard analysis has identified other materials related to the BESS facility that could lead to a fire. Materials include transformer oil, battery coolant (ethylene glycol aqueous solution), and refrigerant. Whilst these materials are not classified as dangerous goods (DGs), there have been numerous incidents associated with transformer oil fires, which were carried forward to the HAZID. A summary of materials and their properties is given in Table 5.3.

5.7 Fire Incident Summary

5.7.1 BESS Development

5.7.1.1 BESS Fire

The HAZID indicates that a fire hazard is associated with the operation of lithium-ion batteries. This FSS has identified the following incidents involving the Megapack 2 units that require further investigation:

- Fire (due to thermal runaway) involving the battery module.
- Toxic vapour generated in a battery fire. The combustion products may contain toxic substances (e.g. decomposition of lithium hexafluorophosphate within the battery electrolyte to hydrogen fluoride (HF)).
- Explosion. During a thermal runaway or fire event, flammable gases may accumulate in confined spaces (e.g. enclosed cabinets), potentially leading to an explosion.

The HAZID also identified the potential for incident propagation from:

- The BESS module is on fire, escalating to the adjacent BESS module.

5.7.1.2 BESS Transformer Oil Fire

Transformer oil is primarily used for insulation and cooling and is contained within the transformer. Although the oil is not flammable under normal conditions, it can become combustible if excessively heated. The HAZID identified electrical faults, overheating, or mechanical damage that could lead to leaks and, if the oil is ignited, a fire. BESS transformer oil fires were carried forward for further review in this FSS.

5.8 Incidents Involving Tesla Megapack Batteries

An incident literature review was conducted to further inform the potential BESS fire incidents at the Springvale BESS site. The review sought to identify whether there have been incidents involving Tesla Megapack batteries. In Australia, there have been two incidents involving Tesla products:

- Victorian Big Battery (VBB) fire incident in 2021, involving Megapack1 (MP1) BESS units[5].
- The Queensland (Bouldercombe) fire incident in 2023, involving Megapack2 (MP2) BESS units[6].

Of relevance to this FSS:

- Despite the differences in battery lithium-ion chemistry (NMC for MP1 and LFP for MP2), both incidents resulted in a fire, involving most of the unit on fire. A fully developed fire in the BESS unit is a credible event.
- The fires did not propagate to involve adjacent battery units. In the VBB fire there was some impact on the adjacent BESS unit. Consideration of a propagated BESS fire event was considered credible for this study.
- In the Bouldercombe incident the Queensland fire brigade was present but did not intervene with the BESS fire, allowing the BESS unit to burn down.
- For both incidents, significant off-site impacts such as injury or fatality from exposure to heat radiation or toxic fumes was not reported. Consideration of fire impacts is discussed in Section 6 based upon Tesla fire testing and modelling.

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[5] Fisher Engineering, Inc., “Report on Technical Findings - Victorian Big Battery Fire (July 30, 2021),” 25 January 2022. [Online]. Available: https://victorianbigbattery.com.au/wp-content/uploads/2022/12/VBB-Fire-Independent-Report-of-Technical-Findings.pdf. [Accessed 4 May 2023].

[6] “ABC News,” 2024. [Online]. Available: https://www.abc.net.au/news/2023-09-27/tesla-battery-fire-at-queensland-renewable-energy-project/102905302.

5.9 Fire Scenarios for Consequence Assessment Review

The HAZID was used to forward screen those incidents for consequence assessment review, which informed the fire safety strategy. Table 5.2 summarizes the incidents carried forward.

Table 5.2: Potential fire incidents carried forward for consequence review

HAZID Ref.	Description	Carry forward consequence review
1	Fire involving a Tesla Megapack MP2 unit	Yes
2	Propagated fire to adjacent Tesla Megapack MP2 unit	Yes
2	Fire involving a BESS transformer	Yes

Table 5.3: Potentially Hazardous Materials (BESS Development)

Material	DG Class	Category	Commentary	Considered in FSS
BESS battery (Lithium ionLFP)	9	Miscellaneous DGs	Transport movement threshold will not be exceeded. Movements are expected to occur during construction only and minimal during operation and maintenance (e.g. battery replacement).	Yes
BESS coolant (50% ethylene glycol aqueous solution)	-	-	Not classified as DG.	No
BESS refrigerant (R134a)	2.2	Non-flammable Non-toxic	Class 2.2 is not considered to be potentially hazardous with respect to off-site risk.	No
Transformer oil (natural ester FS3)	-	-	Not classified as DG. It has a high boiling point > 260°C. However, considered in the FSS HAZID as a potential fire source.	Yes

Table 5.4: Hazard Identification

Event	Cause	Consequence	Mitigation Measures
BESS Fire	Battery Specific • Faulty equipment • Arc flash • Mechanical damage or failure of battery case (e.g. overload, insulation breakdown, connection failures) • Battery thermal runaway (e.g. short circuit, overheating, overcharge) • Human error during maintenance	• Release of toxic and/or explosive combustion products • Escalation/ incident propagation • Injury and/or fatality to onsite employees • Potential offsite impact	• Equipment and systems will be designed and tested to comply with relevant international and/or Australian standards (e.g. AS/NZS 5139) and guidelines • Equipment will be procured from reputable supplier • Independent owner's engineers' endorsement • Installation, operations and maintenance by trained personnel in accordance with relevant procedures • All relevant TransGrid's requirements for the HV transformer and switchyard will be met • Circuit breakers provided for the HV transformer • To minimise fire escalation between the BESS sub-units and onto other adjacent infrastructure, the BESS configurations will follow the specified clearances required by the manufacturer and/or applicable standards (refer to Section 8) • Preventative maintenance (e.g. insulation, replacement of faulty equipment) • BESS BMS fault detection and shut-off function • BESS fire and explosion protection system (battery system specific features, refer to Section 8) • Activation of emergency shutdown • Emergency Response Plan
Generation of explosive gas (e.g.	• Thermal runaway	• Fire and/or explosion in battery enclosure	• Equipment and systems will be designed and tested to comply with the relevant international

Event	Cause	Consequence	Mitigation Measures
hydrogen) **Note: covered as a fire in a BESS unit**	• External fire (e.g. fire from adjacent infrastructure)	• Release of toxic combustion products • Injury and/or fatality to onsite employees	and Australian standards (e.g. AS/NZS 5139) and guidelines • Equipment will be procured from reputable supplier • Independent owner's engineers' endorsement • Installation, operations and maintenance will be undertaken by trained personnel in accordance with relevant procedures • To minimise fire escalation between the BESS sub-units and onto other adjacent infrastructure, the BESS configurations will follow the specified clearances required by the manufacturer and/or applicable standards • Ventilation requirements as per manufacturer's instruction • BESS BMS fault detection and shut-off function • BESS fire and explosion protection system (battery system specific features, refer to Section 8) • Activation of emergency shutdown • Fire Management Plan • Emergency Response Plan
Thermal runaway in battery **Note: covered as a BESS fire**	<u>Elevated temperature</u> • External fire (e.g. fire from adjacent infrastructure, power plant, gas yard, neighbouring sites) <u>Electrical failure</u> • Short circuit • Excessive current/voltage	• Fire and/or explosion in battery enclosure • Escalation to the entire BESS • Injury and/or fatality to onsite employees	• Equipment and systems will be designed and tested to comply with the relevant international and Australian standards (e.g. AS/NZS 5139) and guidelines • Equipment will be procured from reputable supplier • Independent owner's engineers' endorsement

Event	Cause	Consequence	Mitigation Measures
	• Imbalance charge across cells Mechanical failure • Internal cell defect • Damage (crush/ penetration/puncture) • Coolant leak Systems failure • BMS failure • Thermal management system failure		• Installation, operations and maintenance will be undertaken by trained personnel in accordance with relevant procedures • To minimise fire escalation between the BESS sub-units and onto other adjacent infrastructure, the BESS configurations will follow the specified clearances required by the manufacturer and/or applicable standards (refer to Section 8) for assessment) • BESS BMS temperature monitoring, fault detection and shut-off function • Cell chemistry selection • BESS fire and explosion protection system (battery system specific features, refer to Section 8) • Automated thermal detection and response • Activation of emergency shutdown • Emergency Response Plan
BESS overheating	• Extreme temperature or humidity Note: covered as a BESS fire	• Potential for escalation to a thermal runaway event • Fire and/or explosion in battery enclosure • Injury and/or fatality to onsite employees • Asset damage	• Design BESS units for worse case ambient condition • Equipment will be procured from reputable supplier • Independent owner's engineers' endorsement • To minimise fire escalation between the BESS sub-units and onto other adjacent infrastructure, the BESS configurations will follow the specified clearances required by the manufacturer and/or applicable standards (refer to consequence assessment)

Event	Cause	Consequence	Mitigation Measures
			• BESS BMS temperature monitoring, fault detection and shut-off function • Cell chemistry selection • BESS fire and explosion protection system (battery system specific features, refer to Section 8 • Automated thermal detection and response • Activation of emergency shutdown • Emergency Response Plan
Vandalism **Note: covered as a BESS fire**	• Unauthorised personnel access • Trespassing • Deliberate damage to BESS infrastructure Asset damage	• Asset damage • BESS failure/fire • Potential hazard to unauthorised person (e.g. electrocution) • Injury and/or fatality to trespasser • Effects to unauthorised person are expected to be localised and not expected to have an off-site impact. The impact is to a member of public but occurs onsite. • For a fire event, the effects are not expected to have an off-site impact as the BESS will be situated in a secured area.	• The BESS will be located within a secure area and will be fenced • There is 24/7 security provided by the security house operated by Visy • Warning signs (i.e. trespassers and on-site hazards) • Security cameras will be provided for the BESS area • Secure battery unit cabinets design • Automated thermal detection and response • Emergency response plan
BESS Transformer fire	• Faulty equipment • Transformer oil leak • Arc flash • Vandalism External fire (e.g. fire escalation from adjacent BESS)	• Release of toxic combustion products • Escalation to adjacent infrastructure • Injury and/or fatality to onsite employees	• Equipment and systems will be designed and tested to comply with relevant international and/or Australian standards (e.g. AS/NZS 5139) and guidelines • Equipment will be procured from reputable supplier

Event	Cause	Consequence	Mitigation Measures
		As the BESS and HV transformer will be situated in a secured area, the effects are not expected to have an off-site impact.	• Independent owner's engineers' endorsement • All relevant TransGrid requirements will be met • Installation, operations and maintenance by trained personnel in accordance with relevant procedures • To minimise fire escalation between the BESS sub-units and onto other adjacent infrastructure, the BESS configurations will follow the specified clearances required by the manufacturer and/or applicable standards (refer to consequence assessment) • Preventive maintenance (e.g. insulation, replacement of faulty equipment) • Electrical switch-in & switch-out protocol • BESS fire and explosion protection system (battery system specific features, refer to Section 8) • Automated thermal detection and response • Activation of emergency shutdown • Emergency Response Plan

6 Consequence Assessment Review

6.1 Overview

Fire incidents identified during the HAZID were reviewed to assess their potential consequences related to radiation and, as applicable, toxic gas impacts. The consequence assessment has considered the potential for incident propagation within the BESS facility.

For BESS-related fires, radiation impact analyses are based on information supplied by Tesla for the Megapack (MP) batteries. The fire and toxic gas modelling supplemented the review. These were used to consider the potential for incident propagation within the BESS.

The findings of the consequence review are presented in the following sections.

6.2 BESS Development

6.2.1 BESS Unit Fire and Propagation Potential (Tesla Fire Testing)

Tesla has conducted unit-level tests to demonstrate that fire escalation between units will not occur if the BESS unit layout adheres to the clearance requirements (Table 3.1).

The fire engineer has received the fire test reports, including setup details, measured data, and observations. Key outcomes from the Tesla testing (Ref: [7], [8], [9], [10]) are outlined below.

6.2.1.1 UL-9540A test

The UL 9540A test evaluates the potential for BESS thermal runaway. It gathers data to assess or develop mitigation measures against this failure event, its propagation, or consequences such as explosions or fires. Within the industry, the UL-9540A test is considered the most appropriate published methodology for providing comprehensive, consistent, and reliable data for battery failure testing.

The UL 9540A unit-level test was conducted on the Tesla MP2XL unit at the Northern Nevada Research Center and certified by TÜV. The key test outcomes are as follows:

- Thermal runaway did not escalate to a fully developed unit fire, and only a few cells were involved in the fire.
- The thermal runaway and resulting fire did not propagate to the target MP2 units, which were installed 6 inches behind and 6 inches to the side of the initiating unit.
- Explosion hazards, including deflagration, projectiles, flying debris, detonation, or other explosive gas discharge, were not observed.
- Small traces of hydrogen fluoride (HF) were detected in the collected samples. However, the concentration was well below the immediate danger to life and health (IDLH) value for HF.
- No free-flowing liquid or runoff from the damaged cells was observed.
- All performance criteria specified by UL 9540A were met.

[7] Fisher Engineering Inc. , "Tesla Megapack 2 and Megapack 2XL Fire Protection Engineering Analysis," 2023.
[8] Fisher Engineering Inc. , "Tesla Megapack UL 9540A Test Results: Interpretive Report and FPE Code Narrative," 2020.
[9] Fire & Risk Alliance (FRA), "Fire Protection Engineering and UL 9540A Interpretation Report, Rev0," 2024.
[10] Fire & Risk Alliance, "Destructive Fire Test and Fire Modeling Report, Rev0," 2024.

6.2.1.2 Destructive unit test

<u>MP2</u>

A destructive unit test was performed at the Northern Nevada Research Center in 2022 to assess the fire propagation behaviour of MP2XL battery. This test was conducted under more severe conditions than those required for the UL 9540A test. In this test case, 48 cells were simultaneously forced into thermal runaway, exceeding the worst-case scenario anticipated from Tesla's field assessments. The following was found:

- The test was intended to result in an entire unit fire. However, fire propagation did not occur in all battery cells, and only half the MP2XL unit was affected.
- Uncontrolled explosion (deflagration) did not occur.
- Flames were observed emanating from the front doors, which had been opened.

<u>MP1</u>

The UL 9540A test was performed on a MP1 unit and progressed to a large-scale fire involving the entire unit (destructive). The key observations were:

- Fire did not spread from the initiating MP1 unit to the target units installed 6 inches behind and to the side.
- No projectiles, deflagration, or flying debris were observed. The explosion protection system, including overpressure vents, was effective in mitigating explosion hazards.
- Radiation levels measured at the 8-foot spacing were below the radiation level required for escalation.

6.2.2 BESS Unit Fire and Propagation Potential (Tesla Fire Model)

6.2.2.1 MP2 Fire modelling

Based upon the destructive unit test, Tesla engaged a third-party engineering fire specialist (Ref [3]) to validate dynamic (time response) fire radiation (heat flux) and propagation models. The results of the modelling were:

- Heat flux model:
- For a MP2XL unit on fire, the model estimated a peak heat flux of 12.8 kW/m^2 at a distance of 6 inches (back and side) and 11.8 kW/m^2 at a distance of 8 feet[11] (front), considering worst-case wind conditions. The model was also validated against MP1 test results (described above).
- Thermal runaway model:
  This model predicts if a fire could escalate from the initiating unit to neighboring units. The dynamic model predicts the temperature rise in neighboring units of a burning MP2XL unit against estimated heat fluxes over time (covering best and worst-case wind conditions). The model demonstrated that the temperature of unit cells in neighboring units located 8 feet in front, 6 inches behind, or 6 inches to the side of the initiating MP2XL unit would not reach the thermal runaway temperature (239°C), and propagation would not occur.

6.2.3 BESS Unit Fire and Propagation Potential

6.2.3.1 Offsite impact

The heat radiation and toxic gas (hydrogen fluoride) modelling conducted to cover the MP2XL battery unit. The calculations for a complete BESS unit on fire are shown in Section. 7.1.

The modelling is useful in terms of estimating the 'stand back' distance for emergency response and public. Of note:

[11] The 8 foot (2.4 metre) spacing is the recommended separation spacing in the Tesla MP1 and MP2 Installation Manual.

- The distance to a heat flux level of 23 kW/m^2 (escalation) was 8 metres (module long side) and 3 metres (module end side). Based on the BESS layout, the predicted heat radiation impact on neighbouring sites from a BESS unit on fire is not expected.
- The distance to a heat flux level of 4.7 kW/m^2 (injury) was up to 7 metres. Based on the BESS layout, the radiation impact would not extend to the offsite area.
- Depending on the weather conditions and wind direction, toxic gas could potentially extend off-site into the surrounding areas. However, the toxic gas (injury) is not expected to reach offsite occupied areas.

6.2.4 BESS Transformer Fire

Fire modelling was undertaken for a transformer oil (natural ester FR3) leak and fire; the calculations are shown in Section 7.3 The results indicate that:

- A transformer fire would not result in a heat flux of 23 kW/m^2 (potential for escalation) reaching the BESS unit (end side).

7 Consequence Analysis Modelling

7.1 BESS Unit on Fire - Modelling Approach

Consequence modelling was undertaken based on the Stefan–Boltzmann correlation to analyse the heat transfer effect between two parallel planes, simulating a BESS unit on fire and the heat radiation exposure to a receptor, as shown in Figure 7.1. Distances to heat radiation levels in accordance with HIPAP No. 4 Risk Criteria for Land Use Safety Planning[12], were calculated.

To estimate the heat radiation generated from a BESS unit on fire, the emitted heat flux was calculated using the Stefan - Boltzman Law:

$$E_{emitted} = e\sigma T^4$$

Where E is the radiant emittance, e is the emissivity, σ is the Stefan-Boltzmann constant and T is the surface temperature.

The heat flux received was estimated using the view factor method, where d is receiver distance to BESS unit on fire:

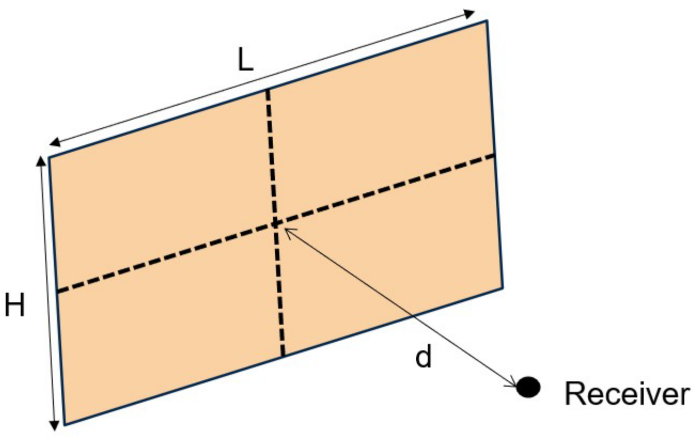
$$\emptyset = \frac{1}{2\pi}\left[\frac{a}{(1+a^2)^{1/2}}\tan^{-1}\frac{b}{(1+a^2)^{1/2}} + \frac{b}{(1+b^2)^{1/2}}\tan^{-1}\frac{a}{(1+b^2)^{1/2}}\right]$$

$$a = \frac{0.5\,H}{d}, \quad b = \frac{0.5\,L}{d}$$

To calculate the heat radiation experienced by the receptor at a height of 1.5 m (approximately half of the BESS unit's height), the BESS unit's surface area (front aspect) is divided into four equal sections. Figure 7.1: The graphical depiction of the parameters (L, H, d) Illustrates the graphical depiction of the parameters used in the calculation.

$$E_{received} = 4\,\emptyset\,E_{emitted}$$

Figure 7.1: The graphical depiction of the parameters (L, H, d)



[12] NSW Department of Planning, "Hazardous Industry Planning Advisory Paper No. 4 - Risk Criteria for Land Use Safety Planning," 2011.

7.1.1 Input and Assumptions

The modelling input and assumptions used were as follows:

- The flame temperature of the emitting surface was set at 1,000°C, which is a typical value for lithium metallic fires[13],
- An emissivity value of 0.9 (a black body has an emissivity value of 1).
- Receptor height was set at 1.5 m.
- The heat radiation calculation was performed for the front aspect of the BESS unit, assuming a full planar fire. This is conservative as the front element has the largest surface area and, consequently, the highest heat radiation impact. This approach is deemed suitable for determining off-site impacts.

7.1.2 Heat Radiation Criteria

Consequences of various heat radiation levels in accordance with HIPAP No. 4 Risk Criteria for Land Use Safety Planning[14], are shown Table 7.1. For this FSS, distances to 4.7 kW/m^2 (injury), 12.6 kW/m^2 (fatality), and 23 kW/m^2 (structural failure) were calculated.

Table 7.1: Consequences of heat radiation

Heat radiation (kW/m^2)	Effect
1.2	Received from the sun at noon in summer
2.1	Minimum to cause pain after 1 minute
4.7	Will cause pain in 15-20 seconds and injury after 30 seconds' exposure (at least second-degree burns will occur)
12.6	· Significant chance of fatality for extended exposure. High chance of injury · Causes the temperature of wood to rise to a point where it can be ignited by a naked flame after long exposure · Thin steel with insulation on the side away from the fire may reach a thermal stress level high enough to cause structural failure
23	· Likely fatality for extended exposure and chance of fatality for instantaneous exposure · Spontaneous ignition of wood after long exposure · Unprotected steel will reach thermal stress temperatures which can cause failure · Pressure vessel needs to be relieved, or failure would occur
35	· Cellulosic material will pilot ignite within one minute's exposure · Significant chance of fatality for people exposed instantaneously

[13] Ouyang, D., Liu, J., Chen, M., & Wang, J. , "Investigation into the fire hazards of lithium-ion batteries under overcharging," Applied Sciences, 7(12), p.1314, 2017.

[14] NSW Department of Planning, "Hazardous Industry Planning Advisory Paper No. 4 - Risk Criteria for Land Use Safety Planning," 2011.

7.1.3 Results

The distances to the specified heat radiation levels are presented in Table 7.2. The distance to the injury level (4.7 kW/m^2) was used to determine the potential for off-site impact.

Table 7.2: Heat Radiation Impact – BESS Unit on Fire

BESS	Dimension (mm)	Surface temperature (°C)	Distance (m) at receptor height (1.5 m) to radiation levels 4.7 kW/m^2 (injury)	12.6 kW/m^2 (fatality)	23 kW/m^2 (structural failure)
		Front			
MP2XL	8,800 x 2,785	1000	15	9	6
		Side			
MP2XL	1,650 x 2,785	1000	7	3	3

7.2 Dispersion of Toxic Gas - Modelling Approach

In the event of a BESS fire, there is a potential for toxic gas to be generated:

1. from the decomposition of the battery electrolyte and/or
2. as a result of combustion products.

For LFP batteries, hydrogen fluoride (HF) is a potential byproduct resulting from electrolyte decomposition following a BESS fire event. In this study, as HF is considered the most toxic decomposition product, the dispersion of HF was modelled to better understand its impact on receptors.

Consequence modelling was performed using the Gexcon EFFECTS v12.3.0 software (Plume Rise from Fire model) to simulate HF dispersion during a BESS fire. The HF generation rate was based on published experimental literature for LFP batteries. The downwind distances to the Acute Exposure Guideline Level (AEGL) concentrations for HF were determined.

7.2.1 Input and Assumptions

The modelling input and assumptions used were as follows:

- Hydrogen fluoride is considered the most toxic decomposition product from the battery fire[15]
- A lithium-ion battery cell experiment[16], indicates that the HF quantity released from a 1 Wh battery varies between 20 mg and 200 mg, depending on the battery type and state of charge. As a conservative approach, the generation rate of 200 kg per 1 MWh was adopted for the analysis. The HF generation rate was calculated based on the capacity of a single BESS unit and a fire duration of 1 hour. The resulting HF generation rate used for analysis is conservative, as fire durations are typically longer than 1 hour.
- Release is continuous, with a concentration averaging time of 60 minutes used for reporting.
- A surface roughness factor of 0.1 m was used (representing low crops and occasional significant obstacles).

[15] Larsson, F., Andersson, P., Blomqvist, P., & Mellander, B. E., "Toxic flouride gas emissions from lithium-ion battery fires," Scientific reports, 2017.
[16] P. P. e. al, "Study of the fire behaviour of high-energy lithium ion batteries with full-scale burning test," Journal of Power Sources, vol. 285, pp. 80-89, 2015.

- The heat release rate from the battery (with 100% state of charge) is estimated to be 882 kW/m^2,Ref [4].
- The plume was assumed to be released from the top of the BESS unit. This is viewed as a reasonable approach, based on observations from recent BESS fire incidents, such as the VBB fire.
- Receptor height was set at 1.5 m.
- A range of wind and weather stability conditions was selected.

7.2.2 Dispersion criteria

The AEGL concentration levels (60-minute exposure) for HF are presented in Table 7.3. These concentrations were used to inform exposure-related harm levels (irritation, injury and fatality).

Table 7.3: AEGL values for HF (60-minute)

AEGL level	Health effects	HF concentration (ppm)
AEGL-1	Irritation threshold	1
AEGL-2	Injury threshold	24
AEGL-3	Life-threatening health effects threshold	44

7.2.3 Results

The distances to AEGL concentrations at a receptor height of 1.5 m are presented in

Table 7.4. The distance to the injury level (AEGL-2) was used to determine the potential for off-site impact.

Table 7.4: Toxic dispersion impact (HF) – BESS unit on fire

BESS model	Size (LxWxH, mm)	Battery Capacity (MWh)	Mass Flow Rate (kg/s)	Heat Release (kW/m^2)	Wind Weather Stability	Distance (m) at Receiver Height (1.5m) to AEGL		
						AEGL-1 (irritation)	AEGL-2 (injury)	AEGL-3 (fatality)
TBC	8,800 x 1,650 x 2,785	3.9	0.2	882	B3	40	12	9
					D2	7	5	4
					D5	68	21	17
					F1	2	1	1

7.3 Transformer Fire - Modelling Approach

A loss of transformer oil containment could result in a pool fire. The distance to the 23 kW/m^2 heat radiation was used to determine the potential fire escalation to the BESS units. The pool fire modelling was conducted using the Gexcon EFFECTS v12.3 software.

7.3.1 Input and Assumptions

The key inputs and assumptions are as follows:

- Surface area: equivalent to the transformer footprint (3.7m x 3.3m), with 25% assumed to be occupied by the transformer structure.
- Material: natural ester (FS3) or soybean oil with a flash point of >265°C and a molecular weight of 800-900 kg/kmol. In EFFECTS, beta-cholesterol with a flash point of 271°C and a molecular weight of 387 kg/kmol was identified as the closest match to FS3.
- Total volume in overall unit: 7,500 litres.
- Wind speed: 5 m/s.

7.3.2 Results

The modelling indicates that the distance to the 23 kW/m² (escalation) from the pool's centre is approximately 4 m. Given that the distance from the transformer centre to the nearest BESS unit is more than 4 m, a transformer fire would not impact the BESS units.

8 Site Fire Prevention, Detection & Protection Systems

8.1 Overview

This section summaries the fire prevention, detection and protection systems for the:

- BESS facility. Telsa has provided these measures for the MP2XL batteries from the installation manual[17] and fire test documentation[18].

8.2 BESS Megapack incidents

8.2.1 Fire Prevention and Protection Systems

Consultation was undertaken with Tesla to identify the safety design features for the MP2XL battery units, summarized in Table 8.1.

Table 8.1: Tesla MP2XL – fire safety systems

No	Description	Role In Fire Strategy
1	Battery Management System (BMS)	Each battery module has its own BMS. The BMS is designed to detect and automatically react to fault conditions (i.e. over-temperature, loss of communication, over-voltage) that could lead to thermal runaway. Depending on the alarm and trip limits, the BMS automatically isolates the affected battery module or permanently disconnects the module.
2	Thermal Management System (TMS)	To prevent the thermal runaway (from operating in high external temperature), the TMS maintains the temperature inside the BESS cabinet within an optimum range via a closed-loop liquid system. The cooling liquid is a mixture of water and ethylene glycol solution. Key components of the TMS are a thermal bay within the BESS cabinet and a thermal roof, which contains fans and radiators and provides a ventilation airspace for the battery cabinet.
3	Overcurrent protection	The MP2XL has several passive and active safety control mechanisms installed within the battery module circuit and distribution circuit that would be available to interrupt a fault current. Electrical fault protection features cover: • Battery module overcurrent protection • Inverter DC protection • Inverter AC protection • Ground fault protection

[17] Tesla, "Megapack 2 XL Design and Installation Manual, Revision 1.9," 2023.
[18] Fisher Engineering Inc. , "Tesla Megapack 2 and Megapack 2XL Fire Protection Engineering Analysis," 2023.

No	Description	Role In Fire Strategy
4	Explosion prevention and mitigation	Explosion control systems for the MP2XL units include: a) Overpressure vents: The overpressure vents are installed in the ceiling of the sealed battery bay's IP66 enclosure. Once opened, the overpressure vents permit gases, combustion products, and flames to safely exhaust from the battery bays into the thermal roof and out of the MP2XL via the roof vents. By designing this natural ventilation flow path, flammable gases are prevented from accumulating within the MP2XL cabinet, thereby reducing the risk of a deflagration or explosion that could compromise the cabinet's integrity, cause the front doors to open, or expel projectiles from the cabinet. This was observed in the fires involving Megapack batteries (Section 8.2). b) Sparker system: The system is designed to ignite flammable gases at very short intervals. By continuously sparking, the flammable gases will ignite near their lower flammable limit (LFL) very early in a thermal runaway event before they accumulate within the enclosure and become an explosion hazard. They are installed at various locations throughout the battery module bays.

9 Site Fire Safety Strategy

The SVB must establish a fire safety strategy, which involves an organisational approach to minimising the likelihood, severity, and extent of a fire incident, as well as the potential for its propagation.

The proposed fire safety strategy for the SVB is based on the identified fire incidents of the BESS facility.

9.1 BESS Facility

The strategy was developed based on technical information provided by Tesla regarding the MP2XL fire safety design features (Section). 8.2.1) and Tesla fire testing (Section 6.2.1) to inform unit separation distances and minimise the potential for fire propagation.

The proposed design and operational fire prevention, detection and protection safeguards for the BESS Facility will also minimise the potential for a BESS unit fire and limit the propagation potential.

This approach covers incidents for:

- Fire at the BESS unit
- Fire at the BESS transformer

To support the non-intervention strategy, this FSS has recommended enhancing automated fire detection and response, including process isolation, system shutdown, and updating the Emergency Response Plan.

An Emergency Response Plan must be developed to cover BESS-related fire incidents, including communication protocols with Tesla and FRV, as well as notification to neighbours.

SVB will have access to Tesla as part of the emergency response, which will independently monitor the Megapack battery performance and alarms. In the event of a BESS fire incident, Tesla will provide subject matter experts to FRV and Springvale Energy Hub, both during and after the emergency event.

9.2 Fire Brigade Provisions

The SVB will be serviced by Fire Rescue Victoria (FRV). FRV has a Springvale station approximately 1.9 km from the SVB access point. The nearest fire stations are shown in Figure 9.1 and Table 9.1. Access to the site is via Clarke Road, with the site entrance as shown in Figure 9.2.

Table 9.1: Fire Stations Near SVB

Station Name	Address	Distance (km)
FRV Station 89 / Springvale CFA	518 Springvale Rd, Springvale South VIC 3172	1.9
FRV Station 29	529 Clayton Rd, Clayton South VIC 3169	5.8
Keysborough Fire Brigade	121 Chapel Rd, Keysborough VIC 3173	5.5

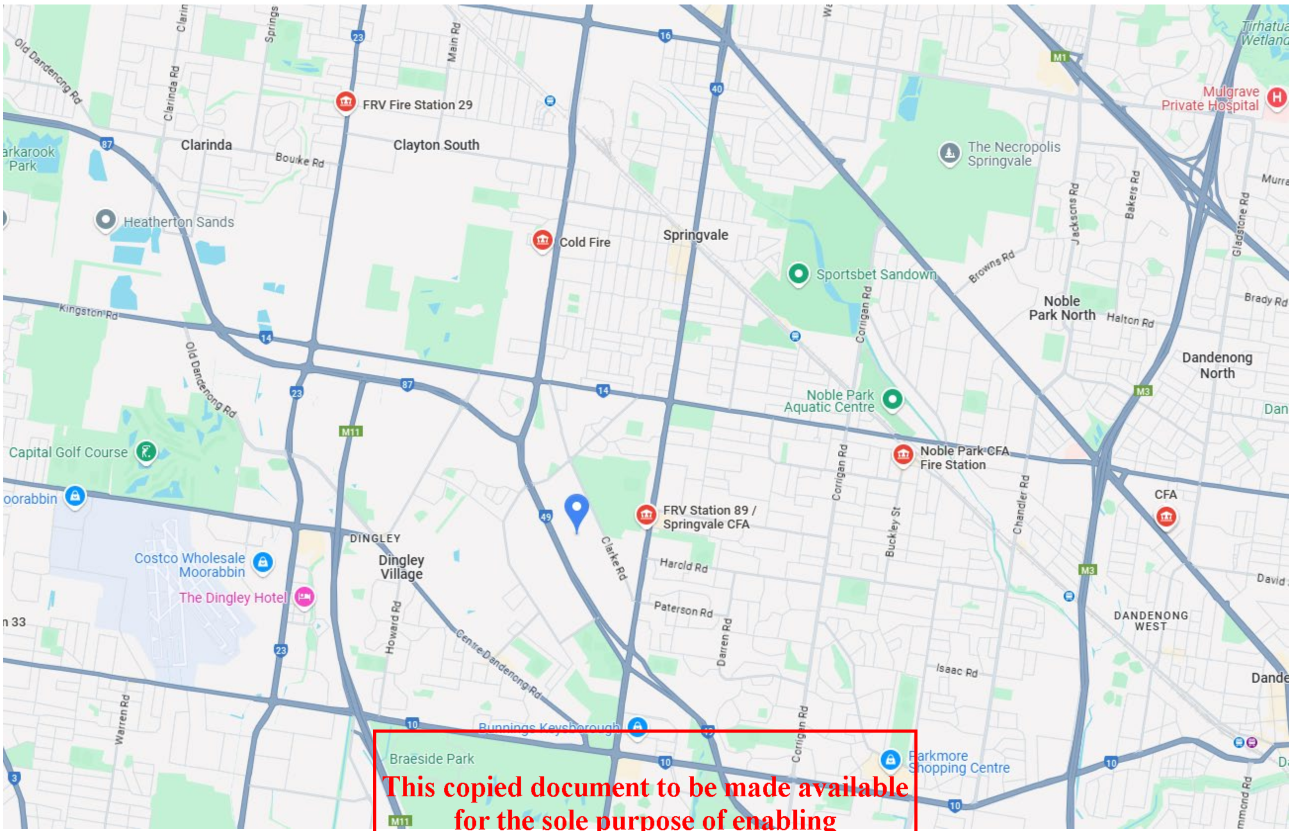


Figure 9.1: Local Fire Brigade Locations

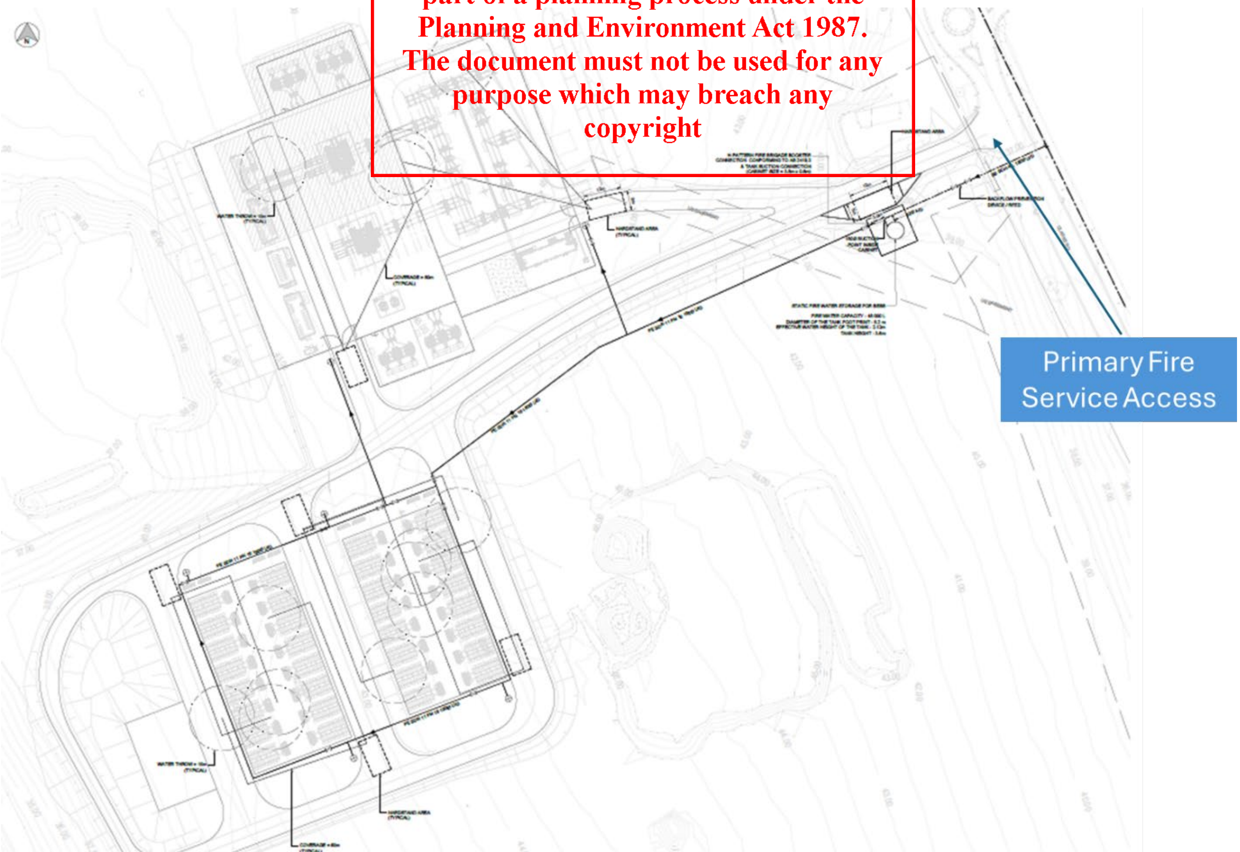


Figure 9.2: Fire Brigade Access

9.2.1 Fire Brigade Internal Site Access

The primary access point will be provided along the eastern boundary of the Project Area, off Clarke Road. A secondary access point is provided from Rowan Road.

Internal access roads, consisting of compacted gravel and approximately 4 m wide, would be constructed throughout the project area to accommodate construction and operational traffic movements and emergency access. Roads will be maintained throughout the Project's life to ensure safe and accessible travel for emergency vehicles.

The project access roads shall achieve the following:

- A four-metre perimeter road must be constructed within the ten-metre perimeter Fire Break.
- Roads are to be of all-weather construction and capable of accommodating a vehicle of fifteen (15) tonnes.
- Constructed roads must have a minimum trafficable width of four (4) metres and a vertical clearance of four (4) metres for the width of the formed road surface.
- The average grade must be no more than 1 in 7 (14.4% or 8.1°) with a maximum of no more than 1 in 5 (20% or 11.3°) for no more than fifty (50) metres.
- Dips in the road must have an entry and exit angle of no more than 1 in 8 (12.5% or 7.1°).
- Passing bays must be incorporated at intervals of no more than 600 metres, and each bay must be at least 20 metres long, with a minimum trafficable width of 6 metres. Where roads are less than 600 metres long, at least one passing bay is to be incorporated.
- Road networks must enable emergency services to access all areas of the facility.
- Two access points must be available to the site to ensure safe and efficient access to and egress from areas that may be impacted or involved in a fire.

9.3 Post-Fire Incident Actions

Due to the characteristics of thermal runaway and the compartmented nature of the enclosures, there is a small potential that after an initial thermal runaway event/fire the initiating cause is not fully removed, and batteries could re-heat themselves and reignite.

To mitigate against this potential, the following actions are to be taken following a fire event in an enclosure:

- Upon the visual conclusion of the fire event, fire watch should continue until thermal imaging confirms that the enclosure's temperature has returned to ambient.
- Following the above period, if it is safe to do so, the batteries/battery racks are to be removed from the enclosure and isolated. The batteries may be isolated for inspection and checking. Batteries, especially if damaged are to be isolated outside in a clear area with no combustibles (e.g. on a hardstand or gravel pad). In this case, they may be monitored and maintained in this clear area isolation for a few days to a week to warrant against re-ignition.
- If the batteries may not be removed immediately due to danger of fire, heat, electrification or other dangers or damage:
  - A non-intervention fire brigade response shall be taken,
  - If possible, reinstate a temporary gas or smoke detection system to the enclosure, and/or
  - Provide on-site monitoring of the enclosure for at least a week or until feasible to decant the battery modules from the enclosure to an isolated area.
- Before any enclosure or battery is reinstated and connected back to the energy grid, all fire safety systems within the enclosure, including detection systems, must be fully reinstated and connected back to the main GEMS system.

The BESS Integrator should provide the site with site-specific ERP (see Section 9.4 for requirements) in collaboration with the Battery Manufacturer for use by the Owner/Operator and Fire Service.

9.4 ERP Requirements

This section discusses the Emergency Response Plan (ERP) requirements in accordance with HIPAP 1 (Emergency Planning).

According to HIPAP 1, a site-specific emergency plan minimises the effect of accidents inside and outside a facility, in this case, the BESS site. It is a collection of clearly defined, systematically developed and carefully monitored procedures. It is implemented by personnel with adequate training and resources. An emergency plan should be:

- Specific to the facility and the major hazards a risk assessment identifies.
- Effective in addressing the consequences of a major accident on-site and offsite; integrated into the site ERP;
- Developed in consultation with employees, emergency services and people likely to be affected by the consequences of a major accident, including other closely located facilities.
- Understood by employees, visitors and other people likely to be affected.
- Subject to testing, review and update at appropriate intervals; and

The ERP should include, but is not limited to:

- Procedures in the event of fire concerning the attending fire brigade.
  - When and how to contact the fire brigade.
  - Provide critical information during the initial call and then in subsequent communications.
  - How to communicate with them remotely and on-site.
  - Site access protocols.
  - Expected actions for the attending fire brigade given the non-intervention strategy e.g. setting up exclusion zones.
- Plans showing locations of site entry points, as well as key infrastructure.
- Plans showing locations of fire extinguishers.

The ERP process should also determine whether the tactical fire plan is required, whether additional signage is needed, what content should be contained within the Emergency Services Information Package (ESIP), and whether any additional briefing materials are required for the local RFS.

Additional signage may include:

- Signage to site access points so they are identifiable and not obstructed (e.g. 'Emergency vehicle access – do not block').
- Appropriate signage warns of hazards, explains how to contact the site operator, and indicates the location of critical information for emergency responders.
- Any signage is to be permanently affixed, weather resistant if external, high-contrast, clearly visible, and readable at an expected viewing distance.

The primary consideration in planning is protecting people, property, and the environment from adverse impacts during an emergency. The key to a good management plan is that it is dynamic and interactive, with ongoing review through continual monitoring and consultation. This cyclical nature is summarised below in Figure 9.3.

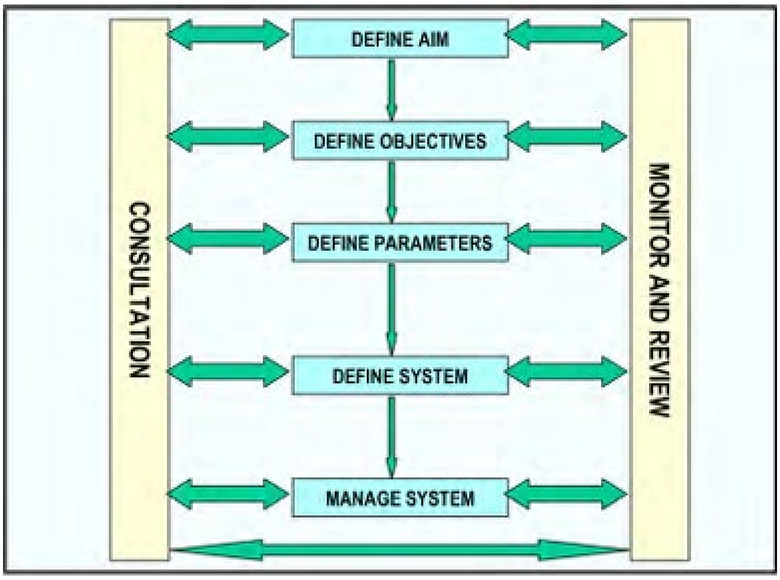


Figure 9.3: Emergency Planning Process

HIPAP 1 is split into five sections that detail all aspects of emergency planning and its needs. Section 3 of HIPAP 1 explains all issues that must be addressed when preparing an emergency plan. Appendix 2 of HIPAP 1 contains a 33-point checklist that summarises the components of a site-specific emergency plan.

An Emergency Information Book will be housed within an Emergency Information Container and located near the primary site access. The final location of Emergency Information Containers will be determined in conjunction with CFA.