Updated Hazard and Risk Assessment

Panorama Battery Energy Storage System (BESS) – SSD 50587460

Panorama BESS SubCo Pty Ltd

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SLR Project No.: 660.30234.00007

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Making Sustainability Happen

Revision Record

Revision	Date	Prepared By	Checked By	Authorised By
R06-v1.5	13 May 2025	Dr Peter Georgiou	Dr Craig Simpson	Dr Peter Georgiou
R06-v1.0	22 June 2023	Dr Peter Georgiou	Dr Craig Simpson	Dr Peter Georgiou

Basis of Report

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Acronyms and Abbreviations

ADG	Australian Dangerous Goods (colloquial), as in the ADG Code: Commonwealth Government, National Transport Commission, *"Australian Code for the Transport of Dangerous Goods by Road and Rail"*, Edition 7.9, 2024
ALARP	As Low as Reasonably Practical
APZP	Asset Protection Zone
ARPANSA	Australian Radiation Protection and Nuclear Safety Agency
BESS	Battery Energy Storage System
BMS	Battery Management System
DoP	NSW Department of Planning (part of the NSW Department of Planning, Housing and Infrastructure)
EIS	Environmental Impact Statement
HIPAP	Hazardous Industry Planning Advisory Paper
HRA	Hazard and Risk Assessment
ICNIRP	International Commission on Non-Ionizing Radiation Protection
MLRA	Multi-Level Risk Assessment
PHA	Preliminary Hazard Analysis
PRS	Preliminary Risk Screening
SEARs	Secretary's Environmental Assessment Requirements
SEPP	State Environmental Planning Policy, eg Resilience and Hazards SEPP
SLR	SLR Consulting Australia Pty Ltd
SSD	State Significant Development

Units

ha	Hectare (= 10,000 m^2)
kL	Kilolitre (= 1,000 litres)
km	Kilometre (= 1,000 metres)
kV	Kilovolt (= 1,000 volts)
kVA	Kilovolt-Amp
kW	Kilowatt (= 1,000 volts)
m	Metre
MW	Megawatt (= 1,000,000 watts)
MWh	Megawatt-hour

1.0 Introduction

SLR Consulting Australia Pty Ltd (SLR) has been engaged by Panorama BESS SubCo Pty Ltd (the Applicant) to undertake an updated Hazard & Risk Assessment (HRA) for proposed amendments to the Panorama Battery Energy Storage System (BESS) and associated infrastructure Project – SSD-50587460 - to be located adjacent to the existing 132 kV Transgrid electricity substation near Bathurst NSW.

A Hazard and Risk Assessment was previously prepared by SLR supporting the Project as exhibited in the Environmental Impact Statement (EIS).

- SLR Report 660.30234-R06-v1.0, *“Hazard and Risk Assessment, Panorama BESS, SSD-50587460”*, 20 March 2023.

The Project is deemed to be State Significant Development (SSD).

Accordingly, SLR’s 2023 Hazard and Risk Assessment addressed the Secretary’s Environmental Assessment Requirements (SEARs), as per SSD-50587460, dated 9 December 2022.

Specifically, SLR’s 2023 Hazard and Risk Assessment addressed the following “Key Issues”:

Hazards – including:

- A preliminary risk screening completed in accordance with *State Environmental Planning Policy No. 33 – Hazardous and Offensive Development and Applying SEPP 33* (DoP, 2011);
- A Preliminary Hazard Analysis (PHA) must be prepared in accordance with the *Hazardous Industry Planning Advisory Paper No. 6, “Hazard Analysis” and Multi-Level Risk Assessment* (DoP, 2011). The PHA must consider all recent standards and codes and verify separation distances to on-site and off-site receptors to prevent fire propagation and compliance with *Hazardous Industry Advisory Paper No. 4, “Risk Criteria for Land Use Safety Planning* (DoP, 2011); and
- An assessment of potential hazards and risk including but not limited to bushfires, land contamination, spontaneous ignition, electromagnetic fields or the proposed grid connection infrastructure against the *International Commission on Non-Ionizing Radiation Protection* (ICNIRP) *Guidelines for limiting exposure to Time-varying Electric, Magnetic and Electromagnetic Fields.*

1.1 Amendments to the Project

Since the Project was exhibited in the EIS, the Applicant has made changes to the specification and design of the BESS.

These involve a change in technology of the battery energy storage from the SolBank 2.0 system to the SolBank 3.0 system, and an increase in the Development Footprint to address the following issues:

BESS System

- Improvements in battery energy storage technology since the submission of the EIS mean that the SolBank 3.0 system offers an increased capacity and enhanced energy density per battery container while reducing the BESS layout footprint by approximately 20% or 0.35 ha.

Site Layout

- The total area of the Development Footprint identified during the EIS process was 3.47 ha.
- Since the submission of the EIS, detailed civil engineering optimisation has taken place recommending that the location and orientation of the development footprint should move to the west by approximately 40 m. To accommodate this change, benching of the BESS would require additional civil battering to improve the safety and landform stability of the Project.
- As a result, the amended Development Footprint would be approximately 5.18 ha.
- Finally, and in response to submissions received, the Applicant has also undertaken an additional visual impact assessment and is proposing to install a visual screen to be added to the perimeter of the BESS Facility. The following screening has been proposed:
    - 3.0 m high perforated metal screen panels along the part northern, western and southern perimeter of the BESS Facility;
    - 0.1 m stainless steel square posts and stainless steel base plates; and
    - The panels and posts coloured “Evergreen” or similar.

1.2 Structure of Report

The remainder of this HRA report is structured as follows:

- **Section 2** Description of the Proposed BESS
- **Section 3** Preliminary Risk Screening
- **Section 4** Preliminary Hazard Assessment
- **Section 5** Bushfire Risk Assessment, Mitigation and Management
- **Section 6** BESS Hazards and Risk Management
- **Section 7** EMF Hazards and Risk Management

1.3 Relevant Regulatory Documents

The HRA has been undertaken according to the following regulatory standards and guidelines (listed by sub-category):

Australian Standards (AS)

- AS/NZS 5139:2019 *Electrical Installations – Safety of Battery Systems for Use with Power Conversion Equipment*.
- *AS1940-2017: The storage and handling of flammable and combustible liquids*.
- AS3780-2023 *The storage and handling of corrosive substances*.
- AS4452-1997: *The storage and handling of toxic substances*.
- AS/NZS 1851: *Maintenance of fire protection equipment*.
- AS/NZS 1850: *Portable fire extinguishers*.
- AS 3439-2002: *Low voltage switchgear and control gear assemblies*.

Commonwealth of Australia

- Commonwealth Government, National Transport Commission, *Australian Code for the Transport of Dangerous Goods by Road and Rail*, Edition 7.9, 2024.

NSW Department of Planning

- NSW Department of Planning, 2011a, (HIPAP 1) Hazardous Industry Planning and Advisory Paper No. 1 – *Emergency Planning*.
- NSW Department of Planning, 2011b, (HIPAP 2) Hazardous Industry Planning and Advisory Paper No. 2 – *Fire Safety Study Guidelines*.
- NSW Department of Planning, 2011c, (HIPAP 4) Hazardous Industry Planning and Advisory Paper No. 4 – *Risk Criteria for Land Use Safety Planning*.
- NSW Department of Planning, 2011d, (HIPAP 6) Hazardous Industry Planning and Advisory Paper No. 6 – *Hazard Analysis*.
- NSW Department of Planning, 2011e, *Multi-Level Risk Assessment*.
- NSW Department of Planning, 2011f, *Applying SEPP 33 - Hazardous and Offensive Development Application Guidelines.*
- NSW State Environmental Planning Policy (*Resilience and Hazards*) 2021 (herein Resilience and Hazards SEPP).
- NSW Government Code of Practice, *Managing Risks of Hazardous Chemicals in the Workplace,* August 2019.
- NSW Government, *Notifications of Schedule 11 Hazardous Chemicals and Abandoned Tanks – Guidance Material*, Safework NSW, WH&S Regulation, 2017.

EMF & EMR

- ARPANSA (Australian Radiation Protection and Nuclear Safety Agency), *Report by the ARPANSA Radiofrequency Expert Panel on Review of Radiofrequency Health Effects Research – Scientific Literature 2000-2012,* ARPANSA Technical Report No 164, 2014.

- ARPANSA (Australian Radiation Protection and Nuclear Safety Agency), *Radiation Protection Standard for Maximum Exposure Levels to Radiofrequency Fields – 3 kHz to 300 GHz,* Radiation Protection Series S-1 (Rev.1), February 2021.
- ICNIRP (International Commission on Non-Ionizing Radiation Protection) 1998, *Guidelines for Limiting Exposure to Electromagnetic Fields (100 kHz to 300 GHz)*, 2020.
- United States Environmental Protection Agency, 2021. *About Acute Exposure Guideline Levels*.

General Guidance

- ASC/ESC 5000: The Australian Battery Guide, Energy Storage Council, March 2023.
- DNV Report No. OAPUS301WIKO(PP151894, Rev.4), *Considerations for ESS Fire Safety*, prepared for Consolidated Edison and NYSERDA, NY, February 2017.
- Fire Protection Research Foundation, 2016. *Hazard Assessment of Lithium Ion Battery Energy Storage Systems*.
- FM Global, 2020. Property Loss Prevention Data Sheet 5-33, *Electrical Energy Storage Systems*.
- National Fire Protection Association, 2023 - NFPA 855 *Standard for the Installation of Stationary Energy Storage Systems*.
- Underwriters Laboratory, 2017. UL 9540A Standard for Test Method for Evaluating Thermal Runaway Fire Propagation in Battery Energy Storage Systems.
- Underwriters Laboratory, 2020. UL 9540 Standard for Safety of Energy Storage Systems and Equipment.
- UK Department for Energy Security & Net Zero - Guidance: Health and Safety in Grid Scale Electrical Energy Storage Systems, April 2024

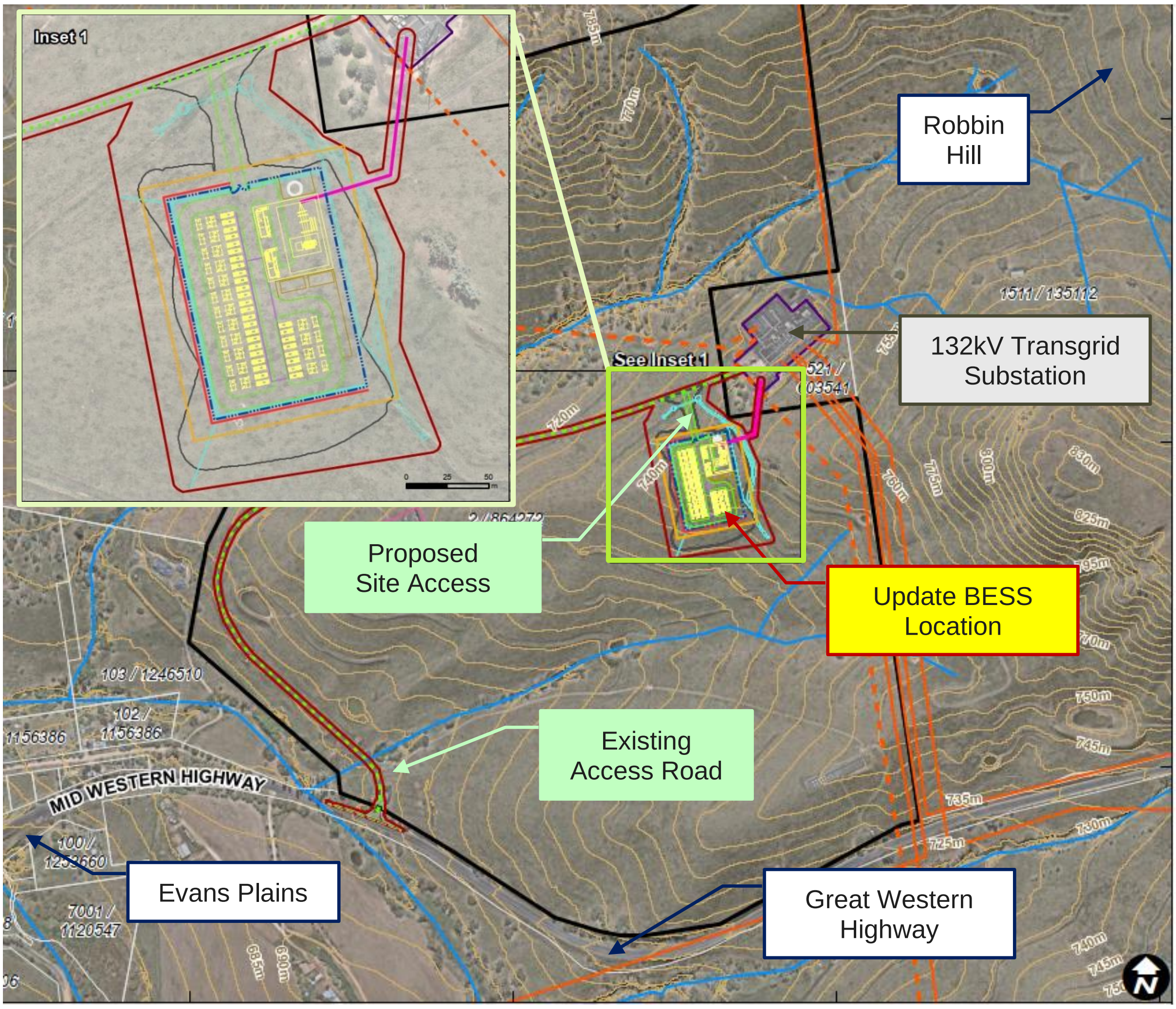
2.0 Proposed Panorama BESS Development

2.1 Development Site Update

The context of the amendments to the proposed Panorama BESS facility within the surrounds is shown in **Figure 1**.

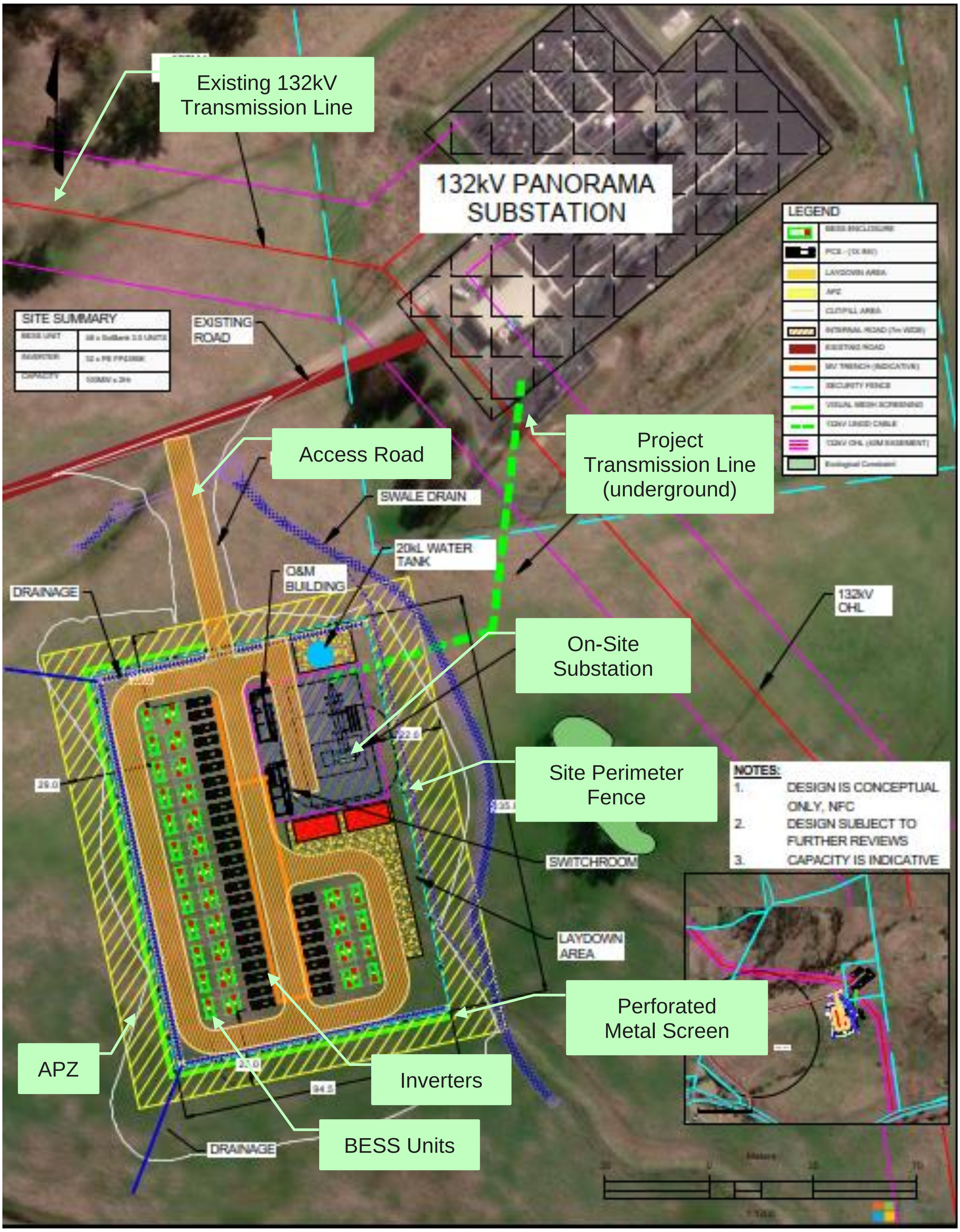
- The amended Project would still be located immediately to the south-southwest of the existing 132 kV Transgrid substation located just under 1 km from the outskirts of Robin Hill.
- The amended Project would still be served by the same private access road (off Mid-Western Highway) as the substation.
- The amended Project would move approximately 40 m to the west of the location that was indicated in the exhibited EIS.

Figure 1 Site Context of the Proposed BESS Facility



The updated (Rev.N) site plan of the proposed BESS facility is shown in **Figure 2**.

Figure 2 Site Plan of Amended Rev.N Design Panorama BESS Facility



2.2 Nearest Sensitive Receivers

The nearest sensitive receivers (refer **Figure 3** and summary in **Table 1**) are as follows:

- A residential property located at 800 Mid-Western Highway, Evans Plains (DP 86427); several rural residences located to the southwest; residences to the east on Windemere Road; and residences to the north on Hartwood Avenue.

Figure 3 Nearest Sensitive Receivers ID Map

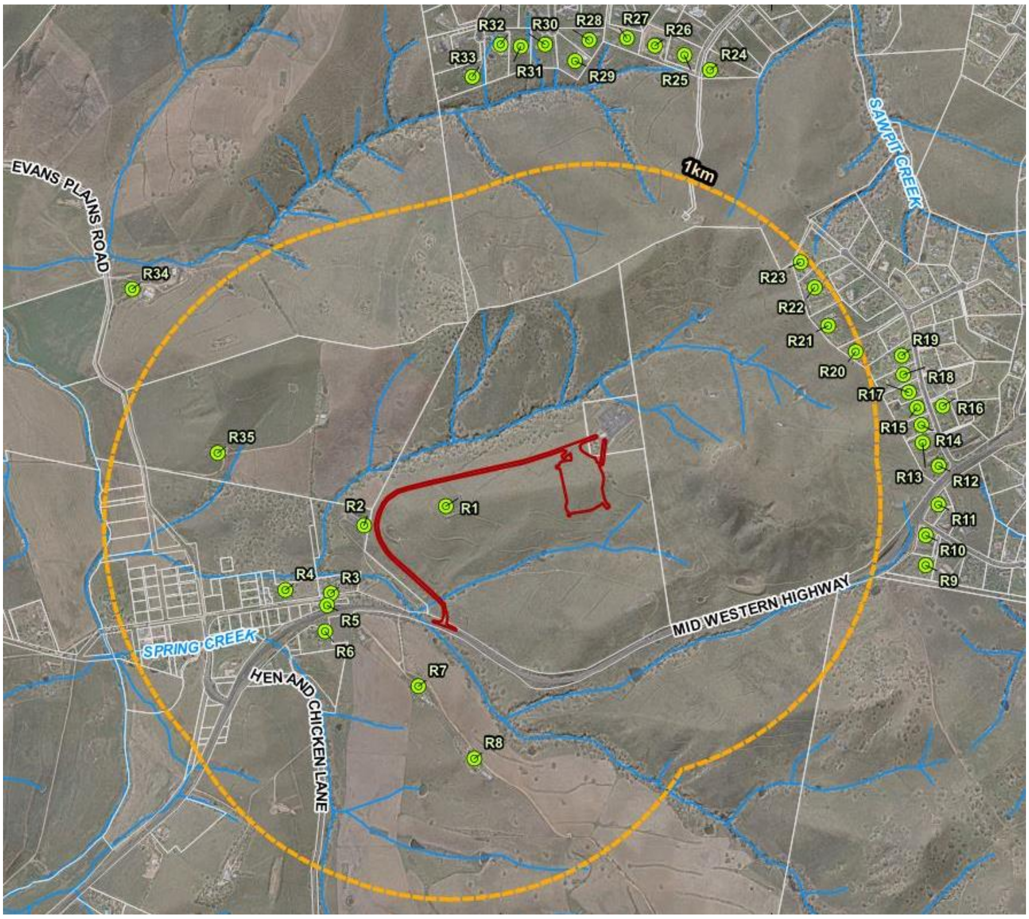


Table 1 Nearest Sensitive Receivers - Summary

ID	Address	Type	Distance (m)	Direction
R1	800 Mid Western Highway, Evans Plains	Residential	490	West
R2	16 Stewart Street, Evans Plains	Residential	790	West
R3	24 Stewart Street, Evans Plains	Residential	950	West-southwest
R7	831 Mid Western Highway, Evans Plains	Residential	870	Southwest
R35	403 Evans Plains Road, Evans Plains	Residential	1340	West
R9-R11	McLennan Close, Robin Hill	Residential	1210	East-southeast
R12-R23	Windemere Road, Robin Hill	Residential	990	Northeast
R24-R33	Hartwood Avenue, Robin Hill	Residential	1,480	North

3.0 Preliminary Risk Screening

Preliminary risk screening of the proposed development is required under the Resilience and Hazard SEPP to determine the need for a Preliminary Hazard Analysis. The preliminary screening assesses the storage of specific dangerous goods classes that have the potential for significant, off-site effects. Specifically, the assessment involves the identification of classes and quantities of all dangerous goods to be used, stored or produced on site with respect to storage depot locations as well as transported to and from the site.

The Project's hazardous materials and associated potential risks are:

- Materials/Activities involved in Construction Phase Activities
- Materials/Activities involved in Operational Phase Activities
- Materials/Activities involved in De-Commissioning Phase Activities
- Facility Electrical Equipment other than the Project BESS units

Hazards and risks related to the BESS element of the Project are examined separately.

3.1 Dangerous of Other Hazardous Materials

3.1.1 Construction Phase Materials / Activities

The key elements of the construction phase of the Project are as follows:

- Access roads and a construction site car park will be built; the site will be surveyed to provide exact installation locations for all facility components. The site will then be mechanically cleared (loose debris, etc), and perimeter security fencing constructed.
- Assuming no contaminated land is encountered on site, any excavated soil will be used for backfilling activities or stockpiled to be available for use during the De-Commissioning phase of the Project, with none leaving the site.
- A Construction Workshop will be built to receive goods and for general maintenance activities.
- Underground wiring trenches will be dug.
- BESS units, Inverter pads, cabling, the sub-station, Control Room, etc, will then be installed.

No toxic chemicals or processes will be involved in the construction of any of the above.

Dangerous goods during this phase will therefore consist of:

- Fuel for use by construction plant and equipment, which will be stored on-site.
- Tiny amounts of clinical waste stored safely by medical or first aid staff at the Project First Aid Station – these will be disposed of at the nearest district hospital or another suitable facility as required.

3.1.2 Operational Phase Materials / Activities

No hazardous chemicals will be produced during operation of the facility.

Quantities of regulated substances will be stored on-site (for maintenance, repair, emergency, etc, purposes) which are expected to be used entirely, leaving no waste. These will be stored in a properly maintained (and code-compliant) storage area with suitable signage, any PPE requirements if relevant, etc.

They will include fire extinguishers, machine oils and lubricants, hydraulic fluid and spare (emergency) fuel.

Maintenance of the Project site will require vegetation throughout to be kept low, both for occupational health and safety reasons and fire safety. In relation to such maintenance, if any herbicides are used, the Project is committed to only using general use, over-the-counter, herbicides, as opposed to restricted use herbicides sometimes used in intensive commercial operations where such herbicides require a special restricted use license. Similarly, if a growth regulator is used in order to slow down vegetation growth, only commonly-used products will be chosen such as those regularly used on highway roadsides, golf courses, etc.

3.1.3 De-Commissioning Phase Materials / Activities

The De-Commissioning phase of the Project will mirror the Construction phase in terms of materials and equipment activities.

3.1.4 Other Electrical Equipment (excluding BESS Units)

In relation to other equipment:

- Transformers contain transformer oil for insulation and cooling. Toxic PCBs are no longer used as a cooling fluid; instead, non-toxic mineral or biodegradable oils are used.

3.2 Resilience and Hazard SEPP Risk Screening

The dangerous goods that will require transportation and storage at the Project site are identified in **Table 2** and **Table 3,** along with their respective SEPP-relevant ADG Thresholds.

Table 2 ADG Classification of SEPP Related Dangerous Goods - Storage

Class	Category	Item / Usage	SEPP Thresholds	Project Storage
Class 2.2	Non-flammable Non-toxic	Fire Extinguishers . Fire Suppression Gas	na	na
Class 3	Flammable Liquids	Fuel (diesel) . CONSTRUCTION	5 tonne	1 tonne
Class 3	Flammable Liquids	Fuel (diesel) . OPERATION		Nil
Class 6.1	Toxic Substances	Pesticides (Herbicides) . ground cover management	2.5 tonne	< 100 kg
Class 9	Miscellaneous Dangerous Substances and Articles	BESS Li-ion batteries	Na	Refer PHA **Section 4**

Table 3 ADG Classification of SEPP Related Dangerous Goods - Transport

Class	Category	SEPP-Allowed Quantity	SEPP-Allowed Movements	Project Quantity	Project Movements
Class 2.2	Fire Suppression Gas	na			
Class 3 PGII	Fuel (diesel) . CONSTRUCTION	3 tonne (bulk) 10 tonne (packs)	>750/yr cumul. >45/wk	1 tonne	100/yr cumul. 5/wk
Class 3 PGII	Fuel (diesel) . OPERATION			Nil	Nil
Class 6.1 PGII	Pesticides (Herbicides)	1 tonne (bulk) 3 tonne (packs)	All	< 100 kg	1 per 3-4mo
Class 9	Li-ion batteries	na	>1,000/yr cumul. >60/wk	Na	Refer PHA **Section 4**

The final quantity and transportation parameters of the materials listed in **Table 2** and **Table 3** will be confirmed during detailed design but, as currently foreseen, they do not exceed the relevant storage (or transport) thresholds.

Storage protocols will comply with relevant guidelines and standards, eg AS 1940-2017 for the storage of fuels and pesticides/herbicides at the Project laydown area.

3.3 Dangerous Goods Storage

The storage and handling of dangerous goods to be used or stored at the facility and transported to/from the facility is not considered potentially hazardous with regards to the screening thresholds contained in the Resilience SEPP. Further detailed analysis, ie via a Preliminary Hazard Analysis, is therefore not required.

The Project's BESS units are battery powerpacks consisting of lithium ion batteries. Lithium ion batteries are classed as Class 9 Miscellaneous Dangerous Substances and articles, which are excluded from the Resilience and Hazard SEPP screening process.

However, the hazards associated with these batteries mandate that a Preliminary Hazard Analysis is required to further assess the hazards and risks associated with the lithium ion batteries, in accordance with the SEARs requirements for the Project.

This is covered in **Section 4** of this HRA.

4.0 Preliminary Hazard Analysis

Risk Management involves a determination of the level of risk to people, property, the environment and surrounds, taking into account the implementation of controls.

In accordance with the Resilience and Hazard SEPP, a Preliminary Hazard Analysis must be prepared in accordance with *Hazardous Industry Planning Advisory Paper No.6 - Guidelines for Hazard Analysis* (HIPAP No.6, DoP, 2011) and *Multi-Level Risk Assessment* (MLRA, DoP, 2011).

The assessment process typically comprises two elements:

- Hazard Analysis (HA); and
- Multi-Level Risk Assessment (MLRA).

HA (Hazard Analysis)

The objective of HA is to develop a comprehensive understanding of the hazards and risks associated with an operation or facility and of the adequacy of safeguards. The hazard analysis process may include qualitative and quantitative methods.

Consideration should include:

- the nature and quantities of hazardous materials stored and processed on the site;
- the type of plant and equipment in use;
- the adequacy of proposed technical, operational and organisational safeguards;
- the surrounding land uses or likely future land uses; and
- the interactions of these factors.

MLRA (Multi-Level Risk Assessment)

MLRA provides guidance on the criteria for using the results of the screening, classification and prioritisation steps to determine which of three levels of further analysis is appropriate.

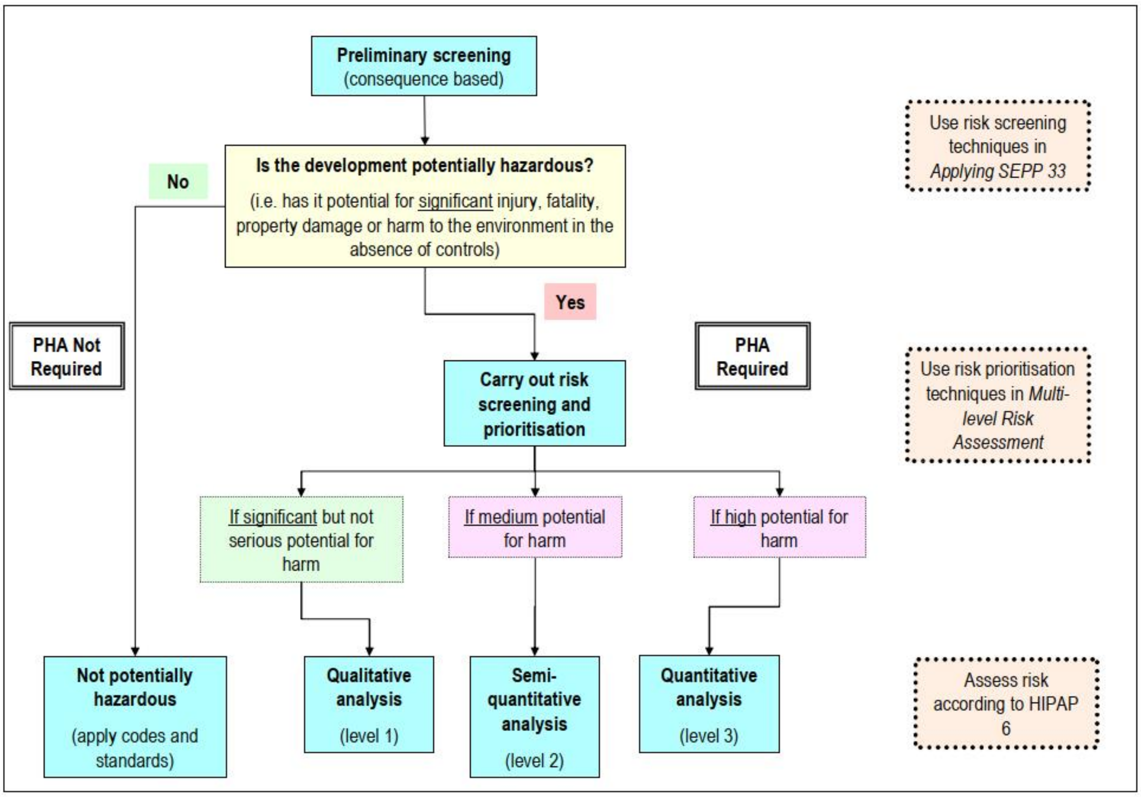
- Level 1 is an essentially qualitative approach based on comprehensive hazard identification to demonstrate that the activity does not pose a significant off-site risk.
- Level 2 supplements the qualitative analysis by sufficiently quantifying the main risk contributors to show that risk criteria will not be exceeded.
- Level 3 is a full quantitative analysis.

The overall MLRA approach can be seen in **Figure 4**.

HA & MLRA

Combining HA and MLRA should result in the estimation of the level of risk to people, property and the environment from operations at the Site and in the presence of controls.

Figure 4 The Multi-Level Risk Assessment Approach[1]



4.1 Further Discussion of HA (Hazard Analysis)

HA relies on a systematic and analytical approach to the identification and analysis of hazards and the quantification of off-site risks to assess risk tolerability and land use safety implications. The level and extent of analysis must be appropriate to the hazards present and therefore, need only progress to the extent necessary for the particular case.

4.1.1 Methodology

The procedures adopted for assessing hazardous impacts involve the following steps:

Step 1: Hazard identification;

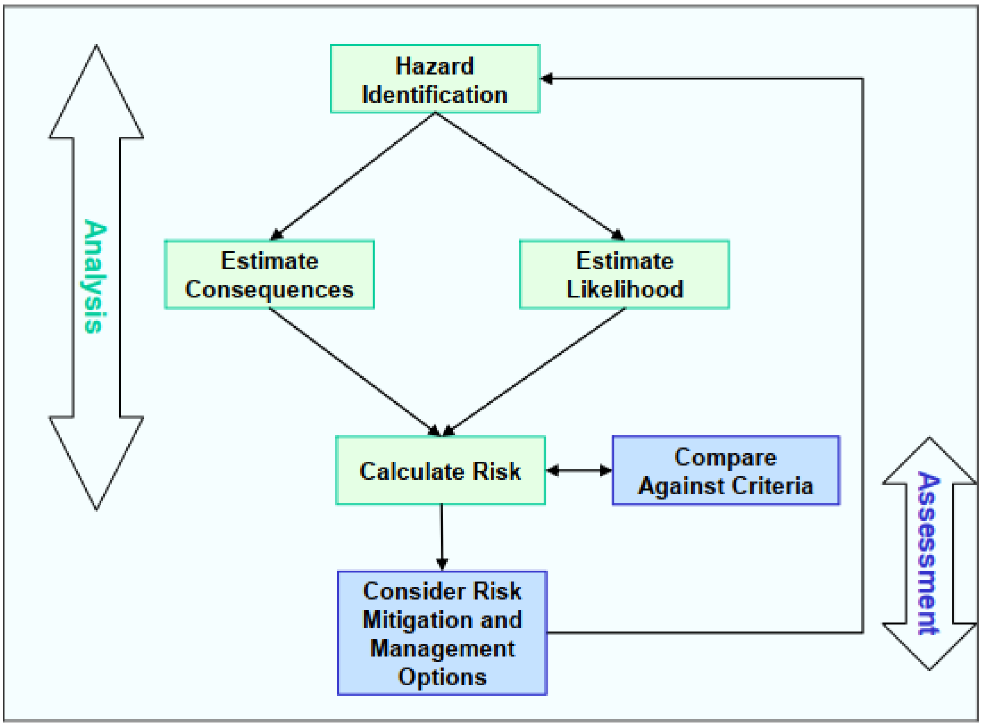
Step 2: Hazard (matrix) analysis (consequence and probability estimations); and

Step 3: Risk evaluation and assessment against specific criteria.

A schematic of the hazard analysis process is shown in **Figure 5**.

[1] Source Planning NSW, 2011a Multi-Level Risk Assessment, New South Wales Government, figure 3)

Figure 5 Basic Methodology for Hazard Analysis (source: HIPAP 6)



4.1.2 Step 1: Hazard Identification

The first step involves the identification of all theoretically possible hazardous events as the basis for further quantification and analysis. This does not in any way imply that the hazard identified, or the theoretically possible impact, will occur in practice. Essentially, it identifies the particular characteristics and nature of hazards to be further evaluated in order to quantify potential risks.

Hazard identification was undertaken on the following basis:

- SLR's previous experience with grid-scale BESS facilities; and
- Engagement with the Project Team to confirm anticipated hazards and identify additional hazards, involving events which are outside normal operating conditions, and which have the potential to create negative impacts, both internally and externally.
- The results are documented in **Table 10, Table 11** and **Table 12**.

4.1.3 Step 2: Hazard (Matrix) Analysis

After a review of the events identified in the hazard identification stage and the prevention and/or protection measures incorporated into the design of the site, any events which are considered to have the potential to result in impacts or which have the potential to escalate to larger incidents are carried to the next stage of analysis.

Examples of environmental hazards associated with BESS facilities can include:

- Contaminants generated during a fire at the BESS and to a lesser extent the release of chemicals from physical damage to the BESS.
- Oils released into the environment from physical damage to a transformer.

- Combustion products released within the smoke plume and as fire residues during and following a BESS Fire Event, including hydrogen fluoride (HF), phosphoryl fluoride (POF_3) and phosphorus pentafluoride (PF_5). (Larsson *et al*, 2017).
- Other gasses released during combustion, which may include volatile organic compounds (VOCs) and volatile polyaromatic hydrocarbons (PAHs).
- Particulate matter generated during the combustion, which can include soot, PAHs, and metal oxides of nickel (Ni), aluminium (Al), lithium (Li), copper (Cu) and cobalt (Co).

The risk from these and all other hazards is assessed in subsequent sections of this report.

Consequence Estimation

This aspect involves the analysis and modelling of the credible events carried forward from the hazard identification process in order to quantify their impacts outside the boundaries of the site.

Risk (Probability Likelihood) Estimation

Where necessary, the likelihood of incidents identified above are determined by adopting probability and likelihood factors derived from published data, experience, etc.

4.1.4 Step 3: Risk Evaluation and Assessment

The risk analysis includes the consequences of each hazardous event and the frequencies of each initiating failure. The results of consequence calculations (eg for BESS Fire/Explosion radiation and overpressure contours, etc) together with the probabilities and likelihoods estimated are then compared against the accepted criteria applicable for the site.

Whether it is considered necessary to conduct the predictions would depend on the probabilities and likelihood estimated and if the risk criteria are exceeded.

4.1.5 Risk Criteria

As part of the MLRA, hazards are identified and the risk from the hazards estimated. Risk criteria take into consideration surrounding land uses, and the category of risk. They encompass such elements as injury/ irritation, individual and societal risk of fatality, property damage and harm to the biophysical environment. Criteria may be expressed in qualitative or quantitative terms.

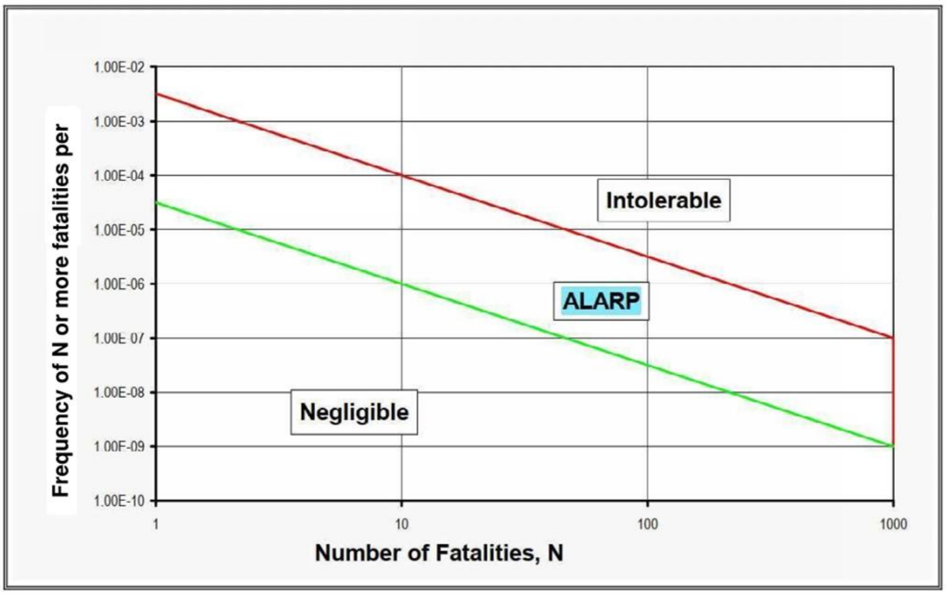
A key concept in the risk criteria is that societal risks should be *“as low as reasonably practical”*, known as the ALARP principle.

The ALARP principle has been described by the UK Health and Safety Executive (HSE) in the following terms:

> *'In weighing the costs of extra safety measures the principle of reasonable practicability (ALARP) applies in such a way that the higher or more unacceptable a risk is, the more, proportionately, an employer is expected to spend to reduce it'.*

The indicative societal risk criteria reflect these regions as three societal risk bands: negligible, ALARP and intolerable, as shown in the example below in **Figure 6**.

Figure 6 Indicative Societal Risk Criteria



In **Figure 6:**

- Below the “Negligible” line, provided other individual criteria are met, societal risk is not considered significant.
- Above the “Intolerable” line, an activity is considered undesirable, even if individual risk criteria are met.
- Within the ALARP region, the emphasis is on reducing risks as far as possible towards the negligible line. Provided other quantitative and qualitative criteria are met, the risks from the activity would be considered tolerable in the ALARP region.

The risk assessment in the current study was based on hazard identification, consequence assessment and likelihood assessment, to create an overall risk assessment.

Descriptors for the qualitative risk assessment at the various levels of consequence of a particular event, and the likelihood (or probability) of such an event occurring are presented in **Table 4** and **Table 5**.

The resulting risk ratings are defined as the following:

- Negligible - The risk is acceptably low (also referred to as “Low”).
- ALARP - As Low As Reasonably Practical, the risk has been reduced to as low a level as possible, and all feasible controls and mitigation strategies are implemented.
- Intolerable - The risk cannot be reduced to an acceptable level with residual impacts likely to have significant impact on the local environment or stakeholders. Intolerable risk which is not addressed would preclude the development of a Project.

Table 4 Qualitative Likelihood Rating

Level	Descriptor	Description
A	Almost certain	Is expected to occur in most circumstances
B	Likely	Will probably occur in most circumstances
C	Possible	Could occur
D	Unlikely	Could occur but not expected
E	Rare	Conceivable, but only in exceptional circumstances

Table 5 Qualitative Consequence Rating

Level	Descriptor	People	Environment	Water Supply
5	Catastrophic	Multiple fatality	Extreme environmental harm, eg widespread catastrophic impact	Major impact for large population, complete failure of systems
4	Major	Permanent total disabilities, single fatality	Major environmental harm, eg Widespread substantial impact	Major impact for small population, systems significantly compromised and abnormal operation if at all, high level of monitoring required
3	Moderate	Major injury or health effects, eg. major lost workday case/permanent disability	Serious environmental harm, eg widespread and significant impact	Minor impact for large population, significant modification to normal operation but manageable, operation costs increased, increased monitoring
2	Minor	Minor injury or health effects, eg. restricted work or minor lost workday case	Material environmental harm, eg localised and significant impact	Minor impact for small population, some manageable operation disruption, some increase in operating costs
1	Insignificant	Slight injury or health effects, eg. first aid/minor medical treatment level	Minimal environmental harm, eg interference or likely interference to an environmental value	Insignificant impact, little disruption to normal; operations, low increase in operation costs

The risk rating matrix has been set out in **Table 6**.

In assessing the tolerability of risk from potentially hazardous activities/events, the relevant general principles from HIPAP 6 are:

- the avoidance of all avoidable risks;
- the risk from a major hazard should be reduced wherever practicable, even where the likelihood of exposure is low;
- the effects of significant events should, wherever possible be contained within the site boundary; and
- where the risk from an existing installation is already high, further development should not pose any incremental risk.

Table 6 Risk Rating Matrix

Likelihood	Consequence				
	Insignificant	**Minor**	**Moderate**	**Major**	**Catastrophic**
Almost certain	ALARP	ALARP	Intolerable	Intolerable	Intolerable
Likely	Low	ALARP	ALARP	Intolerable	Intolerable
Possible	Low	Low	ALARP	ALARP	Intolerable
Unlikely	Low	Low	Low	ALARP	ALARP
Rare	Low	Low	Low	Low	ALARP

4.1.6 Risk of Property Damage and Accident Propagation

The siting of an installation must account for the potential for propagation of an accident causing a "domino" effect on adjoining premises. In the current study, the risk of property damage and accident propagation to adjoining residential properties is considered unlikely, based on the distances noted in **Table 1**.

The presence however of the nearby Transgrid 132 kV substation is significant.

4.2 Criteria

Reference is made to HIPAP 4:

- Planning NSW, 2011, *Risk Criteria for Land Use Safety Planning – Hazardous Industry Planning Advisory Paper No 4*, New South Wales Government.

HIPAP 4 contains the criteria relevant to this assessment.

- Individual Fatality Risk, Individual Injury Risk and Risk of Property Damage and Accident Propagation.

The relevant criteria are shown in **Table 7, 8 and 9** respectively. The criteria contain both:

- A physical element (eg a value of heat flux radiation or explosion overpressure); and
- A probability of occurrence element (eg an annual probability of occurrence of 50 in a million, 0.005%)

Table 7 HIPAP Criteria – Individual Fatality Risk

Land Use	Risk Criteria (fatal injuries per million per year)
Hospitals, schools, child-care facilities, old age housing	0.5
Residential, hotels, motels, tourist resorts	1
Commercial developments including retail centres, offices and entertainment	5
Sporting complexes and active open space	10
Industrial Applications	50

Table 8 HIPAP Criteria – Individual Injury Risk

Injury Risk Event	Risk Criteria (fatal injuries per million per year)
Heat Radiation (4.7 kW/m^2)	50
Explosion Overpressure (7 kW/m^2)	50
Exposure to Toxic Gas/Smoke/Dust (resulting in serious injury upon short-term exposure)	10
Exposure to Toxic Gas/Smoke/Dust (resulting in irritation on term exposure)	50
Industrial Applications	50

Table 9 HIPAP Criteria – Risk of Property Damage and Accident Propagation

Injury Risk Event	Risk Criteria (property damage per million per year)
Heat Radiation (23 kW/m^2)	50
Explosion Overpressure (14 kW/m^2)	50

4.3 Potential Hazardous Incidents Identified for Review

Following a review of the Project, potentially hazardous events or scenarios were evaluated to establish if further comprehensive qualitative analysis was required. These were developed in consultation with the Project Team and are being developed and documented in the Project Risk Register (spreadsheet).

A summary of the hazardous events, causes, consequences and controls have been set out in **Table 10**, **Table 11** and **Table 12** for the Construction, Operational and De-Commissioning phases of the Project. Two categories of risk are identified:

- Risk levels that are nominally acceptable, ie less than “Intolerable”, are noted as being adequately addressed via standard engineering design approaches, adherence to the relevant design codes, etc.
- Risk levels that are deemed “Intolerable” or greater are noted as requiring further detailed management and mitigation measures.

The following potential hazards could not be eliminated through first review and require further examination:

- Hazards associated with Bushfire.
- Hazards associated with BESS, specifically overheating, fire and potential explosion.

The above hazards are addressed in **Section 5 and 6** respectively.

Table 10 Construction Phase - Summary of Potential Major Incident Scenarios, Uncontrolled Risk & Residual Risk after Implementation of Controls

Hazard or Incident	Scenario	Likely Consequences	Controls	Likelihood	Consequence	Uncontrolled Risk	Residual Risk (with controls)
Break up of soil structure	Ground works and vehicle transport break up soil structure	Mobilisation of soil / sediments into surface water and nearby catchments	Site design to include secondary containment, bunding / sediment traps if needed to retain as much water and sediment as possible on site.	Possible	Moderate	ALARP	Low
Vandalism	Illegal site entry and damage to equipment. Damage to equipment from outside boundary, e.g. gunshot	Consequences depend on the extent of damage. Will range from no consequences to major structure damage to the site.	BESS site has security measures in place, such as secure fences, gates, etc to restrict unauthorised access to BESS.	Rare	Minor to Moderate	Low	Low
Physical damage to transformers	Transformers damaged during installation or from acts of vandalism	Release of oils from transformers which will be slowly absorbed into the ground.	Suite of controls covering: • Handling I – on-site personnel to have relevant training in receiving equipment, unloading, temporary placement, etc. • Handling - operational personnel to have relevant training in installation and initial equipment checks of transformers. • Substation design to include secondary	Unlikely	Minor	Low	Low

Hazard or Incident	Scenario	Likely Consequences	Controls	Likelihood	Consequence	Uncontrolled Risk	Residual Risk (with controls)
			containment to contain spill. Design to follow guidance in relevant standards such as *AS 1940 The storage and handling of flammable and combustible liquids.* • The site has security measures in place, such as secure fences, gates, etc to restrict unauthorised access to transformers and fire barriers for the transformer itself. • EMP - Emergency Management Plan will deal with emergency response to physical damage to transformers, HAZMAT, etc. • The areas of soil directly contaminated by oil may be removed to a suitable depth, for example 10cm - 20cm based on advice from a Land Contamination expert. The soil removed to be taken off site for suitable disposal based on a				

Hazard or Incident	Scenario	Likely Consequences	Controls	Likelihood	Consequence	Uncontrolled Risk	Residual Risk (with controls)
			waste classification of the soil.				
Physical damage to BESS (no combustion)	Bess damaged during installation or from acts of vandalism	Limited release of electrolyte. The main chemicals released may be gases, such as carbon dioxide (CO_2), carbon monoxide (CO), methane (CH_4), ethylene (C_2H_4) and ethane (C_2H_6)	Suite of controls covering: • Handling - operational personnel to have relevant training in routine installation and maintenance of BESS. • BESS site has security measures in place, such as secure fences, gates, etc to restrict unauthorised access to BESS. • EMP - Emergency Management Plan will deal with emergency response to physical damage to transformers, HAZMAT, etc.	Unlikely	Minor	Low	Low
Fire Impact (internal source - - but impacts on BESS units)	Fire starts in another section of the site and impinges on BESS and transformers.	If a BESS has been activated, combustion of a BESS fire may release a range of combustion products in the smoke plume and as fire residues. Combustion of the electrolyte releases	Battery management system may or may not have been activated. Site design to include adequate separation distances between battery enclosures, even during temporary storage. Taking into consideration advice from battery manufactures,	Rare	Moderate	Low	Low

Hazard or Incident	Scenario	Likely Consequences	Controls	Likelihood	Consequence	Uncontrolled Risk	Residual Risk (with controls)
		toxic gases including hydrogen fluoride (HF), phosphoryl fluoride (POF_3) and phosphorus pentafluoride (PF_5). Other gasses released during combustion will include volatile organic compounds (VOCs) and volatile polyaromatic hydrocarbons (PAHs). Particulate matter generated during the combustion can include soot, PAHs, and metal oxides of nickel (Ni), aluminium (Al), lithium (Li), copper (Cu) and cobalt (Co). Smoke plume carries particulate contaminants off site. Potentially contaminated water on site generated by	VIC CFS and relevant codes of practice and standards. In a non-BESS initiated fire, firefighting practice would protect BESS units by keeping batteries cool with water. Regarding water from firefighters, have in place a dedicated plan to safely manage and dispose of water from a firefighting incident. Site design to include secondary containment, bunding / sediment traps to retain as much water as possible on site. Once the fire is extinguished, where possible the water may be collected and removed from site for offsite disposal. Once the fire is extinguished, the areas of soil directly contaminated by the fire may be removed to a suitable depth, for example 10cm - 20cm based on advice from a Land Contamination expert. The soil removed to be taken off				

Hazard or Incident	Scenario	Likely Consequences	Controls	Likelihood	Consequence	Uncontrolled Risk	Residual Risk (with controls)
		firefighter's operations on site. Potential for environmental contamination of surface water and to a lesser extent ground water.	site for suitable disposal based on a waste classification of the soil.				
Fire Impact (external for example bushfire)	Fire starts off site, moves on site and impinges on BESS, transformers and other equipment	Fire damage to BESS and other equipment on site, including Transmission Line connection. Loss of connection of the facility and the ability of the Site to provide power to the grid in an emergency.	Suite of controls covering: • Asset Protection Zone and internal access roads allowing unimpeded firefighting capacity at the Site. • EMP - Emergency Management Plan for dealing with the threat of an external bushfire attack. • Emergency Response Training - operational personnel to have completed relevant training in dealing with an external bushfire attack. Equipment management systems, if activated, may	Unlikely /Possible	Moderate /Major	ALARP[2]	Low

[2] Mitigation measures have been considered as if the Project was located within bushfire prone land – refer **Section 5.1**

Hazard or Incident	Scenario	Likely Consequences	Controls	Likelihood	Consequence	Uncontrolled Risk	Residual Risk (with controls)
			assist while units are being commissioned.				
Concreting (hardstands etc)	Accidents arising from concrete pumps, booms, etc	Serious to critical injury to personnel	Spotter, trained personnel allowed in vicinity of works only, equipment only used on stable, level ground, SWMS, PPE, etc.	Possible	Major	ALARP	ALARP / Low
Contact with High Voltage	Contact during wiring and connection activities, or through inadvertent cabling left exposed	Serious to critical injury to personnel	Licensed electricians only; wiring in accordance with standards (AS3000/AS3012). Barricading around relevant works areas. PPE. Insulated tools.	Possible	Major to Catastrophic	ALARP / Intolerable	ALARP / Low
Seismic activity	Earthquake	Consequences depend on the extent of seismic activity. Will range from no consequences to major structure damage to the site	BESS design in accordance with AS/NZS 1170.4 Design of Structures-Seismic Risk	Rare	Insignificant to Moderate	Low	Low
Wind	Gale force winds	Physical damage to infrastructure.	The final BESS design should be in accordance with *AS/NZS 1170.2:2021 Structural design actions Wind actions.*	Rare	Insignificant to Moderate	Low	Low
Lightning Strike	Incidence of lightning	Injury, electric shock. Grass fire.	EMP procedures for dealing with lightning: weather	Possible	Major Catastrophic	ALARP / Intolerable	ALARP / Low

Hazard or Incident	Scenario	Likely Consequences	Controls	Likelihood	Consequence	Uncontrolled Risk	Residual Risk (with controls)
			monitoring, safe harbour locations, etc. Project to satisfy the applicable requirements for lightning protection specified in *AS/NZ 1768 Lightning protection.*				
Climatic concerns	Working in extreme cold or extreme heat	Workers on-site suffer heat stress or hypothermia.	WHS Plan on-site to manage workloads during days of extreme heat or cold, including monitoring weather forecasts, proper attire, work breaks, hydration, etc	Likely	Moderate to Major	ALARP / Intolerable	Low
Flooding isolation.	Road access cut off to the site due to severe flooding of local roads.	Access to the site for emergency services would temporarily not be obtainable.	Emergency response plan to consider options in this rare event. Note two access roads to site (Monash Way and Porters Road)	Rare	Minor to Moderate	Low	Low

Table 11 Operational Phase - Summary of Potential Major Incident Scenarios, Maximum Risk & Residual Risk after Implementation of Controls

Hazard or Incident	Scenario	Likely Consequences	Controls	Likelihood	Consequence	Uncontrolled Risk	Residual Risk (with controls)
Vandalism	Illegal site entry and damage to equipment Damage to equipment from outside boundary, e.g. gunshot	Consequences depend on the extent of damage. Will range from no consequences to major structure damage to the site.	BESS site has security measures in place, such as secure fences, gates, etc to restrict unauthorised access to BESS.	Rare	Minor to Moderate	Moderate	Low
Physical damage to transformers	Transformers damaged during maintenance or from acts of vandalism	Release of oils from transformers which will be slowly absorbed into the ground	Suite of controls covering: • Vehicles - operational personnel to have relevant training in routine transport around transformers. • Substation design to include secondary containment to contain spill. Design to follow guidance in relevant standards such as *AS 1940 The storage and handling of flammable and combustible liquids.* • BESS site has security measures in place, such as secure fences, gates, etc to restrict unauthorised access to transformers and fire	Unlikely	Minor	Low	Low

Hazard or Incident	Scenario	Likely Consequences	Controls	Likelihood	Consequence	Uncontrolled Risk	Residual Risk (with controls)
			barriers for the transformer itself. • Emergency Response - operational personnel to have completed relevant training in emergency response and/or HAZMAT. • EMP - Emergency Management Plan for dealing with physical damage to transformers developed and implemented. • The areas of soil directly contaminated by oil may be removed to a suitable depth, for example 10cm - 20cm based on advice from a Land Contamination expert. The soil removed to be taken off site for suitable disposal based on a waste classification of the soil.				
Physical damage to BESS (no combustion)	Bess damaged during maintenance or from acts of vandalism	Limited release of electrolyte. The main chemicals released may be gases, such as carbon dioxide	Suite of controls covering: • Handling - operational personnel to have relevant training in routine maintenance of BESS.	Unlikely	Minor	Low	Low

Hazard or Incident	Scenario	Likely Consequences	Controls	Likelihood	Consequence	Uncontrolled Risk	Residual Risk (with controls)
		(CO_2), carbon monoxide (CO), methane (CH_4), ethylene (C_2H_4) and ethane (C_2H_6)	• BESS site has security measures in place, such as secure fences, gates, etc to restrict unauthorised access to BESS. • Emergency Response - operational personnel to have completed relevant training in emergency response and/or HAZMAT. • EMP - Emergency Management Plan for dealing with physical damage to BESS developed and implemented.				
BESS Fire	Thermal runaway starts fire in one of the batteries. Overvoltage / Overcharge in one of the batteries leads to a build up of pressure in battery culminating in a catastrophic venting of gases and fire. External short circuit	Combustion of a BESS fire releases a range of combustion products in the smoke plume and as fire residues. Combustion of the electrolyte releases toxic gases including hydrogen fluoride (HF), phosphoryl fluoride (POF_3) and	Using established systems and relevant standards to prevent a thermal runaway or short circuit or other fault within the battery from occurring. Battery management system, including automatic shut down in case of any safe limits of voltage, current and temperature being exceeded. Site design to include adequate separation	Rare	Moderate	Low	Low Refer UL9540A Test Results

Hazard or Incident	Scenario	Likely Consequences	Controls	Likelihood	Consequence	Uncontrolled Risk	Residual Risk (with controls)
	Sustained electrical arch fault Ignites surrounding materials. Excessive discharge demand on battery outside design parameters Inadequate ventilation leads to build up and ignition of flammable gases (hydrogen) Inadequate management of operating environment (temperature, humidity, dusts, etc) Cascading failure/ thermal effects from adjacent battery cells within pack	phosphorus pentafluoride (PF_5). Other gasses released during combustion will include volatile organic compounds (VOCs) and volatile polyaromatic hydrocarbons (PAHs). Particulate matter generated during the combustion can include soot, PAHs, and metal oxides of nickel (Ni), aluminium (Al), lithium (Li), copper (Cu) and cobalt (Co). Smoke plume carries particulate contaminants off site. Potentially contaminated water on site generated by firefighter's operations on site. Potential for environmental contamination of	distances between battery enclosures. Taking into consideration advice from battery manufactures, QLD Fire Services and relevant codes of practice and standards. In a BESS fire, the standard firefighting practice is to let burning batteries burn out and to avoid the spread of fire to adjoining batteries, protecting the surrounding BESS by keeping those unaffected batteries cool with water. Regarding water from firefighters, have in place a dedicated plan to safely manage and dispose of water from a firefighting incident. Site design to include secondary containment, bunding / sediment traps to retain as much water as possible on site. Once the fire is extinguished, where possible the water may be collected and removed from site for offsite disposal.				

Hazard or Incident	Scenario	Likely Consequences	Controls	Likelihood	Consequence	Uncontrolled Risk	Residual Risk (with controls)
		surface water and to a lesser extent ground water.	Once the fire is extinguished, the areas of soil directly contaminated by the fire may be removed to a suitable depth, for example 10cm - 20cm based on advice from a Land Contamination expert. The soil removed to be taken off site for suitable disposal based on a waste classification of the soil.				
Site Fire	Fire starts in another section of the site and impinges on BESS and transformers.	Combustion of a BESS fire releases a range of combustion products in the smoke plume and as fire residues. Combustion of the electrolyte releases toxic gases including hydrogen fluoride (HF), phosphoryl fluoride (POF_3) and phosphorus pentafluoride (PF_5). Other gasses released during combustion will include volatile organic compounds	Battery management system, including automatic shut down in case of any safe limits of voltage, current and temperature being exceeded. Site design to include adequate separation distances between battery enclosures. Taking into consideration advice from battery manufactures, QLD Fire Services and relevant codes of practice and standards. In a BESS fire, the standard firefighting practice is to let burning batteries burn out and to avoid the spread of fire to adjoining batteries, protecting the surrounding	Rare	Moderate	Low	Low

Hazard or Incident	Scenario	Likely Consequences	Controls	Likelihood	Consequence	Uncontrolled Risk	Residual Risk (with controls)
		(VOCs) and volatile polyaromatic hydrocarbons (PAHs). Particulate matter generated during the combustion can include soot, PAHs, and metal oxides of nickel (Ni), aluminium (Al), lithium (Li), copper (Cu) and cobalt (Co). Smoke plume carries particulate contaminants off site. Potentially contaminated water on site generated by firefighter's operations on site. Potential for environmental contamination of surface water and to a lesser extent ground water.	BESS by keeping those unaffected batteries cool with water. Regarding water from firefighters, have in place a dedicated plan to safely manage and dispose of water from a firefighting incident. Site design to include secondary containment, bunding / sediment traps to retain as much water as possible on site. Once the fire is extinguished, where possible the water may be collected and removed from site for offsite disposal. Once the fire is extinguished, the areas of soil directly contaminated by the fire may be removed to a suitable depth, for example 10cm - 20cm based on advice from a Land Contamination expert. The soil removed to be taken off site for suitable disposal based on a waste classification of the soil.				

Hazard or Incident	Scenario	Likely Consequences	Controls	Likelihood	Consequence	Uncontrolled Risk	Residual Risk (with controls)
Fire Impact (external for example bushfire)	Fire starts off site, moves on site and impinges on BESS, transformers and other equipment	Fire damage to BESS and other equipment on site, including Transmission Line connection. Loss of connection of the facility and the ability of the Site to provide power to the grid in an emergency.	Suite of controls covering: • Asset Protection Zone and internal access roads allowing unimpeded firefighting capacity at the Site. • EMP - Emergency Management Plan for dealing with the threat of an external bushfire attack. • Emergency Response Training - operational personnel to have completed relevant training in dealing with an external bushfire attack. Equipment management systems (eg BESS Unit BMS) which enables automatic shutdown of any threatened piece of equipment if safe limits of voltage, current and/or temperature are exceeded.	Unlikely /Possible	Moderate /Major	ALARP[3]	Low
Contact with High Voltage	Contact during wiring and	Serious to critical injury to personnel	Licensed electricians only; wiring in accordance with	Possible	Major to Catastrophic	ALARP / Intolerable	ALARP / Low

[3] Mitigation measures have been considered as if the Project was located within bushfire prone land – refer **Section 5.1**

Hazard or Incident	Scenario	Likely Consequences	Controls	Likelihood	Consequence	Uncontrolled Risk	Residual Risk (with controls)
	connection activities, or through inadvertent cabling left exposed		standards (AS3000/AS3012). Barricading around relevant works areas. PPE. Insulated tools.				
Seismic activity	Earthquake	Consequences depend on the extent of seismic activity. Will range from no consequences to major structure damage to the site.	All equipment on site to be designed in accordance with Australian Standard *AS 1170.4:2007, Structural design actions – Part 4: Earthquake actions in Australia*.	Rare	Insignificant to Moderate	Low	Low
Lightning Strike	Incidence of lightning	Injury, electric shock. Grass fire.	EMP procedures for dealing with lightning: weather monitoring, safe harbour locations, etc. Project to satisfy the applicable requirements for lightning protection specified in *AS/NZ 1768 Lightning protection.*	Possible	Major Catastrophic	ALARP / Intolerable	ALARP / Low
Wind	Gale force winds	Physical damage to infrastructure.	The final BESS design should be in accordance with *AS/NZS 1170.2:2021 Structural design actions Wind actions.*	Rare	Insignificant to Moderate	Low	Low
Extreme ambient temperatures	Extreme temperatures	System failure due to heat.	The temperature data at the Bathurst Bureau of Meteorology weather station from 1990-2025 were as	Rare	Insignificant to Moderate	Low	Low

Hazard or Incident	Scenario	Likely Consequences	Controls	Likelihood	Consequence	Uncontrolled Risk	Residual Risk (with controls)
			follows: mean annual maxima range from 12.1ºC (July) to 28.9ºC (January); mean annual minima range from 1.9ºC (July) to 14.1ºC (January). The highest and lowest temperatures during this period were 42.1ºC and -10.6ºC respectively. The proposed Lithium-Ion battery for the Project should be designed for safe operation at the highest historical temperature of 40 ºC, plus appropriate temperature buffer determined during detailed design.				
Climatic concerns	Working in extreme cold or extreme heat	Workers on-site suffer heat stress or hypothermia.	WHS Plan on-site to manage workloads during days of extreme heat or cold, including monitoring weather forecasts, proper attire, work breaks, hydration, etc	Likely	Moderate to Major	ALARP / Intolerable	Low
Flooding isolation.	Road access cut off to the site due to severe flooding of local roads.	Access to the site for emergency services would temporarily not be obtainable.	Emergency response plan to consider options in this rare event.	Rare	Minor to Moderate	Moderate	Low

Table 12 Decommissioning Phase - Summary of Potential Major Incident Scenarios, Uncontrolled Risk & Residual Risk after Implementation of Controls

Hazard or Incident	Scenario	Likely Consequences	Controls	Likelihood	Consequence	Uncontrolled Risk	Residual Risk (with controls)
Break up of soil structure	Ground works and vehicle transport break up soil structure	Mobilisation of soil / sediments into surface water and nearby catchments	Site design to include secondary containment, bunding / sediment traps if needed to retain as much water and sediment as possible on site.	Possible	Moderate	ALARP	Low
Vandalism	Illegal site entry and damage to equipment. Damage to equipment from outside boundary, e.g. gunshot	Consequences depend on the extent of damage. Will range from no consequences to major structure damage to the site.	BESS site has security measures in place, such as secure fences, gates, etc to restrict unauthorised access to BESS.	Rare	Minor to Moderate	Low	Low
Physical damage to transformers	Transformers damaged during decommissioning or from acts of vandalism	Release of oils from transformers which will be slowly absorbed into the ground	Suite of controls covering: • Handling - operational personnel to have relevant training in decommissioning of transformers. • Substation design to include secondary containment to contain spill. Design to follow guidance in relevant standards such as *AS 1940 The storage and handling of flammable and combustible liquids.*	Unlikely	Minor	Low	Low

Hazard or Incident	Scenario	Likely Consequences	Controls	Likelihood	Consequence	Uncontrolled Risk	Residual Risk (with controls)
			• BESS site has security measures in place, such as secure fences, gates, etc to restrict unauthorised access to transformers and fire barriers for the transformer itself. • Emergency Response - operational personnel to have completed relevant training in emergency response and/or HAZMAT. • EMP - Emergency Management Plan for dealing with physical damage to transformers developed and implemented. • The areas of soil directly contaminated by oil may be removed to a suitable depth, for example 10cm - 20cm based on advice from a Land Contamination expert. The soil removed to be taken off site for suitable disposal based on a waste classification of the soil.				

Hazard or Incident	Scenario	Likely Consequences	Controls	Likelihood	Consequence	Uncontrolled Risk	Residual Risk (with controls)
Physical damage to BESS (no combustion)	Bess damaged during decommissioning or from acts of vandalism	Limited release of electrolyte. The main chemicals released may be gases, such as carbon dioxide (CO_2), carbon monoxide (CO), methane (CH_4), ethylene (C_2H_4) and ethane (C_2H_6)	Suite of controls covering: • Handling - operational personnel to have relevant training in decommissioning of BESS. • BESS site has security measures in place, such as secure fences, gates, etc to restrict unauthorised access to BESS. • Emergency Response - operational personnel to have completed relevant training in emergency response and/or HAZMAT. EMP - Emergency Management Plan for dealing with physical damage to BESS developed and implemented.	Unlikely	Minor	Low	Low
Site Fire	Fire starts in another section of the site and impinges on BESS and transformers.	Combustion of a BESS fire releases a range of combustion products in the smoke plume and as fire residues.	Battery management system may or may not have been activated. Site design to include adequate separation distances between battery enclosures, even during	Rare	Moderate	Low	Low

Hazard or Incident	Scenario	Likely Consequences	Controls	Likelihood	Consequence	Uncontrolled Risk	Residual Risk (with controls)
		Combustion of the electrolyte releases toxic gases including hydrogen fluoride (HF), phosphoryl fluoride (POF_3) and phosphorus pentafluoride (PF_5). Other gasses released during combustion will include volatile organic compounds (VOCs) and volatile polyaromatic hydrocarbons (PAHs). Particulate matter generated during the combustion can include soot, PAHs, and metal oxides of nickel (Ni), aluminium (Al), lithium (Li), copper (Cu) and cobalt (Co). Smoke plume carries particulate contaminants off site.	temporary storage. Taking into consideration advice from battery manufactures, VIC CFS and relevant codes of practice and standards. In a non-BESS initiated fire, firefighting practice would protect BESS units by keeping batteries cool with water. Regarding water from firefighters, have in place a dedicated plan to safely manage and dispose of water from a firefighting incident. Site design to include secondary containment, bunding / sediment traps to retain as much water as possible on site. Once the fire is extinguished, where possible the water may be collected and removed from site for offsite disposal. Once the fire is extinguished, the areas of soil directly contaminated by the fire may be removed to a suitable depth, for				

Hazard or Incident	Scenario	Likely Consequences	Controls	Likelihood	Consequence	Uncontrolled Risk	Residual Risk (with controls)
		Potentially contaminated water on site generated by firefighter's operations on site. Potential for environmental contamination of surface water and to a lesser extent ground water.	example 10cm - 20cm based on advice from a Land Contamination expert. The soil removed to be taken off site for suitable disposal based on a waste classification of the soil.				
Fire Impact (external for example bushfire)	Fire starts off site, moves on site and impinges on BESS, transformers and other equipment	Fire damage to BESS and other equipment on site, including Transmission Line connection. Grid connection issues if damage to TL occurs prior to isolation of the network from the facility.	Suite of controls covering: • Asset Protection Zone and internal access roads allowing unimpeded firefighting capacity at the Site. • EMP - Emergency Management Plan for dealing with the threat of an external bushfire attack. Emergency Response Training - operational personnel to have completed relevant training in dealing with an external bushfire attack.	Unlikely /Possible	Moderate /Major	ALARP[4]	Low

[4] Mitigation measures have been considered as if the Project was located within bushfire prone land – refer **Section 5.1**

Hazard or Incident	Scenario	Likely Consequences	Controls	Likelihood	Consequence	Uncontrolled Risk	Residual Risk (with controls)
Contact with High Voltage	Contact during wiring and connection activities, or through inadvertent cabling left exposed	Serious to critical injury to personnel	Licensed electricians only; wiring in accordance with standards (AS3000/AS3012). Barricading around relevant works areas. PPE. Insulated tools.	Possible	Major to Catastrophic	ALARP / Intolerable	ALARP / Low
Seismic activity	Earthquake	Consequences depend on the extent of seismic activity. Will range from no consequences to major structure damage to the site.	All equipment on site to be designed in accordance with Australian Standard *AS 1170.4:2007, Structural Design Actions – Part 4: Earthquake Actions in Australia*.	Rare	Insignificant to Moderate	Low	Low
Wind	Gale force winds	Physical damage to infrastructure.	The final BESS design should be in accordance with *AS/NZS 1170.2:2021 Structural design actions Wind actions.*	Rare	Insignificant to Moderate	Low	Low
Lightning Strike	Incidence of lightning	Injury, electric shock. Grass fire.	EMP procedures for dealing with lightning: weather monitoring, safe harbour locations, etc. Project to satisfy the applicable requirements for lightning protection specified in *AS/NZ 1768 Lightning protection.*	Possible	Major Catastrophic	ALARP / Intolerable	ALARP / Low

Hazard or Incident	Scenario	Likely Consequences	Controls	Likelihood	Consequence	Uncontrolled Risk	Residual Risk (with controls)
Climatic concerns	Working in extreme cold or extreme heat	Workers on-site suffer heat stress or hypothermia.	WHS Plan on-site to manage workloads during days of extreme heat or cold, including monitoring weather forecasts, proper attire, work breaks, hydration, etc	Likely	Moderate to Major	ALARP / Intolerable	Low
Flooding isolation.	Road access cut off to the site due to severe flooding of local roads.	Access to the site for emergency services would temporarily not be obtainable.	Emergency response plan to consider options in this rare event.	Rare	Minor to Moderate	Low	Low

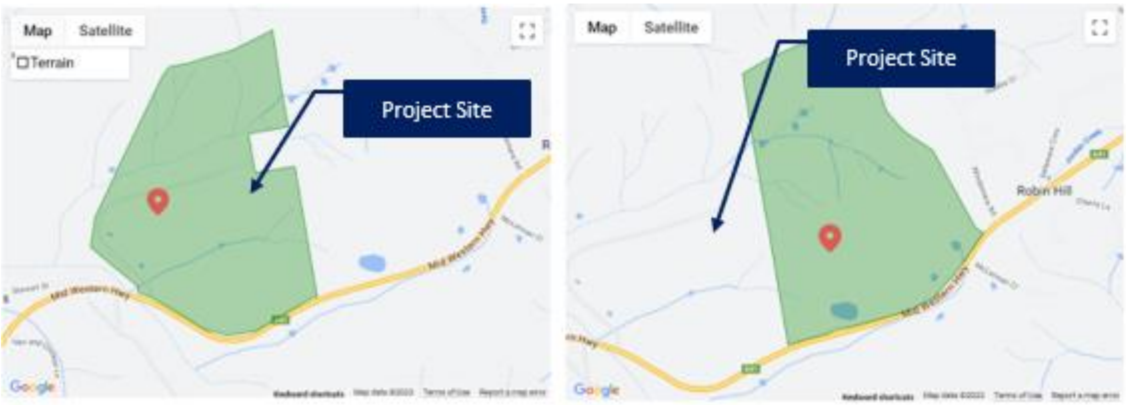
5.0 Bushfire Risk and Management Assessment

Bushfire Risk for the Project will be managed via a comprehensive Bushfire Emergency Management Plan that will span all stages of the Project: construction, operation through to final de-commissioning.

5.1 Bushfire Context

A search on the NSW Rural Fire Service (RFS) website, using the RFS mapping tool, revealed that the Project site is NOT identified as being within bushfire prone land – refer **Figure 7**.

Figure 7 RFS Bushfire Mapping Tool – Site Search Results



Source: bushfireprone.mapping@rfg.nsw.gov.au

Nevertheless, mitigation measures have been considered as if the Project was located within bushfire prone land, given:

- The critical infrastructure nature of the Project; and
- The immediate proximity is similarly critical infrastructure, ie Transgrid's sub-station.

5.2 Designated 10/50 Vegetation Entitlement Clearing Area

The NSW Rural Fire Service (RFS) mapping tool also indicates that the Subject Sites are identified as being within designated 10/50 vegetation entitlement clearing areas – refer **Figure 8**.

Figure 8 RFS Bushfire Mapping Tool – 10/50 Clearing Areas

Source: bushfireprone.mapping@rfg.nsw.gov.au

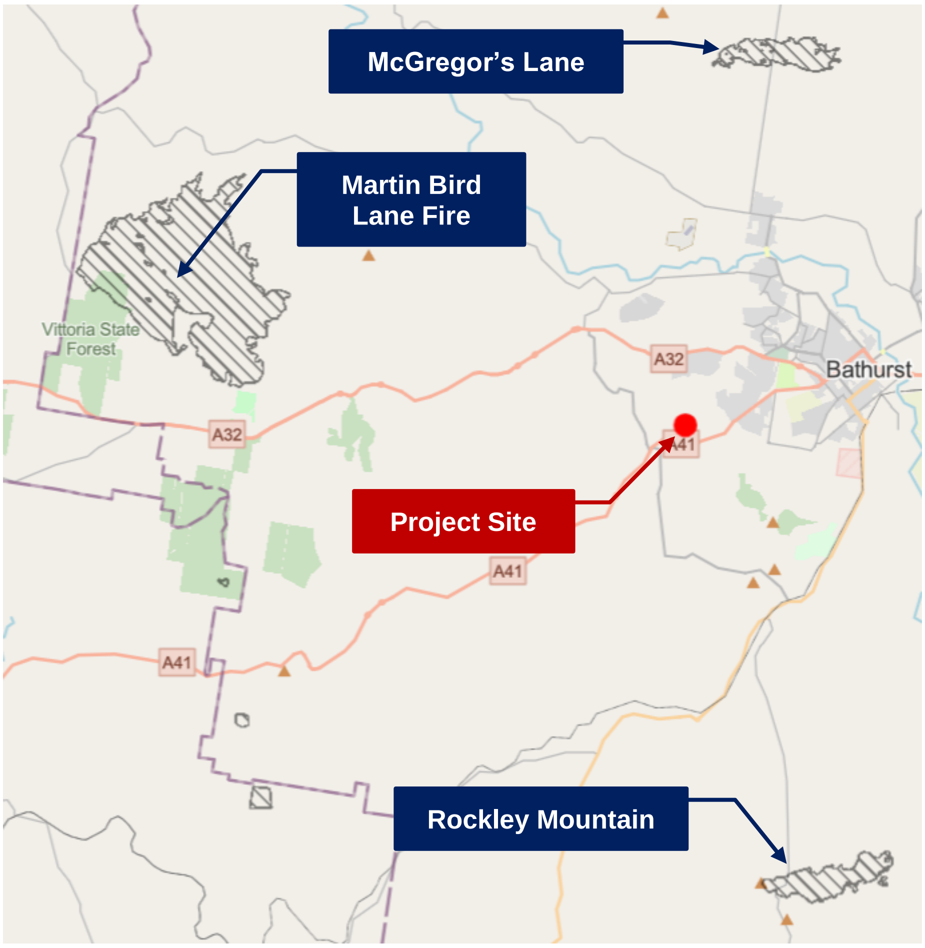
5.3 Bushfire History

The NSW Government SEED initiative mapping tool documents historical NPWS wildfires in NSW. The results for the broad area surrounding the Project are shown in **Figure 9**.

The nearest documented wildfire events are:

- Martin Bird Lane Fire - 14 km west of the Project site
  - December 2009 Wildfire 2,134 ha
- McGregor's Lane - 12 km north of the Project site
  - December 2009 Wildfire 250 ha
- Rockley Mountain - 15 km south of the Project site
  - December 2009 Wildfire 282 ha

Figure 9 NPWS Wildfire Events – Fire Historical Database (SEED Mapping Tool)



The absence of documented wildfires in the near vicinity of the site indicated by the SEED mapping tool is in line with the generally lower bushfire risk profile of the site and surrounds as suggested in **Figure 7.**

5.4 Bushfire Attack Level (BAL)

A key input in the assessment of bushfire risk is to determine the BAL (Bushfire Attack Level) of the project site of interest. The Panorama BESS site BAL has been assessed according to:

- Australian Standard AS3959:2018, "Construction of Buildings in Bushfire-Prone Areas".

In AS3959:2018, BAL is defined as:

- A means of measuring the severity of a building's potential exposure to ember attack, radiant heat and direct flame contact, using increments of radiant heat expressed in kW/m2, and the basis for establishing the requirements of construction to improve protection of building elements from attack from bushfire.

The steps involved in assessing a site specific BAL are shown in **Figure 10**.

Table 13 lists the six BALS defined in AS3959:2018.

Table 13 AS3959:2018 Bushfire Attack Levels (BALs)

Bushfire Attack Level (BAL)	Classified Vegetation within 100m of the site and heat flux exposure threshold	Description of Predicted Bushfire Attack and Levels of Exposure
BAL - LOW		There is insufficient risk to warrant specific construction requirements
BAL - 12.5	≤ 12.5 kW/m^2	Ember Attack
BAL - 19	> 12.5 kW/m^2 and ≤ 19 kW/m^2	Increasing levels of ember attack and burning debris ignited by windborne embers together with increasing heat flux
BAL - 29	> 19 kW/m^2 and ≤ 29 kW/m^2	Increasing levels of ember attack and burning debris ignited by windborne embers together with increasing heat flux
BAL - 40	> 29 kW/m^2 and ≤ 40 kW/m^2	Increasing levels of ember attack and burning debris ignited by windborne embers together with increasing heat flux with the increased likelihood of exposure to flames
BAL - FZ	> 40 kW/m^2	Direct exposure to flames from fire front in addition to heat flux and ember attack

Figure 10 BAL Analysis Methodology

Step 1
FIRE DANGER INDEX (FDI)

The Fire Danger Index (FDI) is a measure of the probability of a bushfire starting, its potential rate of spread, its likely intensity, and the success or otherwise of suppression options available (which vary with local weather conditions, fuel load build-up, most recent period of drought, etc).

Guidance is available on a State-by-State level for establishing the FDI applicable to a specific site.

Step 2
Surrounding Vegetation Classification.

Once the FDI is established, it is necessary to classify the vegetation surrounding the site, according to the seven (7) categories described in AS3959:2018:

Forest, Woodland, Scrubland, Scrub, Mallee/Mulga, Rainfall, Grassland

AS3959:2018 allows for certain “low threat” vegetation exclusions, which would then lead to a determination of a BAL-LOW outcome.

Step 3
Site to Vegetation Distance

After identifying the surrounding vegetation type, the next stage is to determine the horizontal distance of the site (buildings, infrastructure, etc) to that vegetation.

This is done for all key directions and separately computed for each different vegetation type identified in Stage 2.

Step 4
Ground Slope Under Surrounding Vegetation

Bushfires are known to travel more rapidly UP a hill rather than DOWN a hill. It is therefore necessary to establish the slope of the land beneath the vegetation surrounding the site. Note that this is not the slope of the land between the surrounding vegetation and the site, but the slope under the categorised vegetation.

AS3959:2018 Figure 2.3 provides guidance in determining the worst-case upslope or downslope of the surrounding vegetation.

Step 5
Compute the Project-Specific BAL

For each assessed direction from the site, the BAL is computed taking into account the specific vegetation category, distance and slope involved. AS3959:2018 Tables 2.4 to 2.8 can be used to determine the BAL, or suitable software (eg CSIRO’s BAL Calculation Suite)

For all compass directions assessed (ie all vegetation types in all directions) take the worst-case BAL for further consideration of bushfire management.

5.5 BAL Inputs

5.5.1 BAL Assessment Step 1: FDI

The FDI for the Panorama BESS site has been determined to be 80.

This was based on:

https://research.csiro.au/bushfire/assessing-bushfire-hazards/hazard-identification/fire-danger-index/

NSW RFS, May 2017, *NSW Local Government Areas FDI:* development.policy@rfs.nsw.gov.au

5.5.2 BAL Assessment Step 2: Vegetation Classification

Examples of the vegetation types surrounding the Panorama BESS site are shown in **Photo 1**.

The development site is not mapped by the Biodiversity Values Map and Threshold Tool (DPE 2022a) as containing biodiversity values. There is no native vegetation within the Project site. Site vegetation contains exotic pasture species, which based on the ecological site inspection conducted for the Project, have been assessed as providing only marginal artificial habitats for threatened species. Removal of these features is not likely to result in a significant impact on threatened species.

The vegetation categories defined in AS3959:2018 are listed in **Appendix A** along with descriptive summaries. Of specific interest are:

- Open/Sparse Woodland and Grassland.

5.5.3 BAL Assessment Steps 3 and 4: Distance to Vegetation and Slope Under Vegetation

The general topography surrounding the Project Site is shown in **Figure 11**.

- The topography surrounding the site slopes generally from east to west.
- A hillock located just over 300 m to the east is roughly 80 m higher than the Project site.

Figure 11 Topography of the Project Site and Surrounds

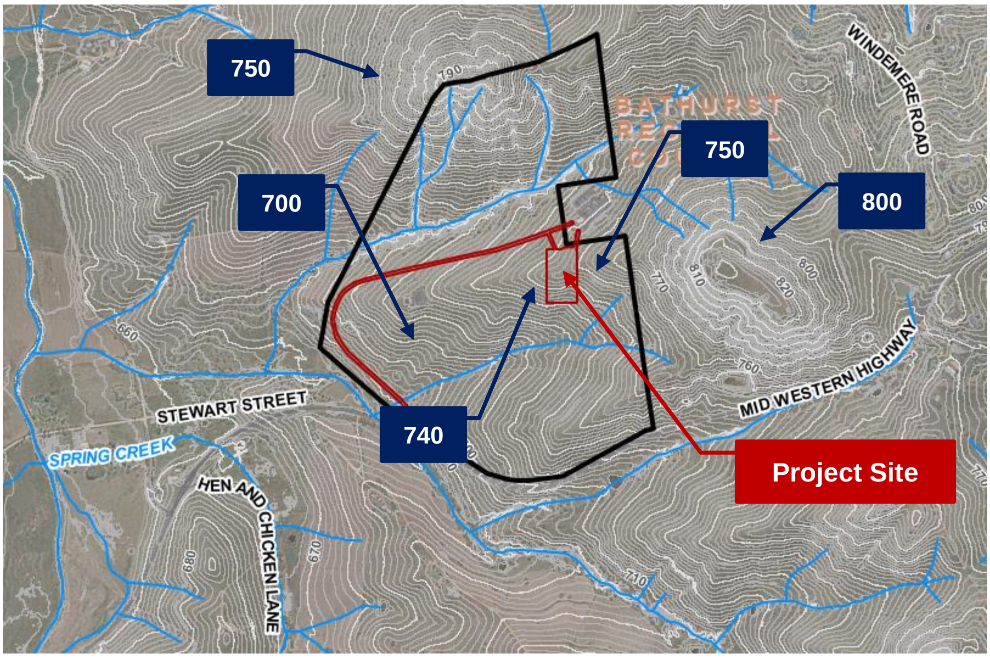
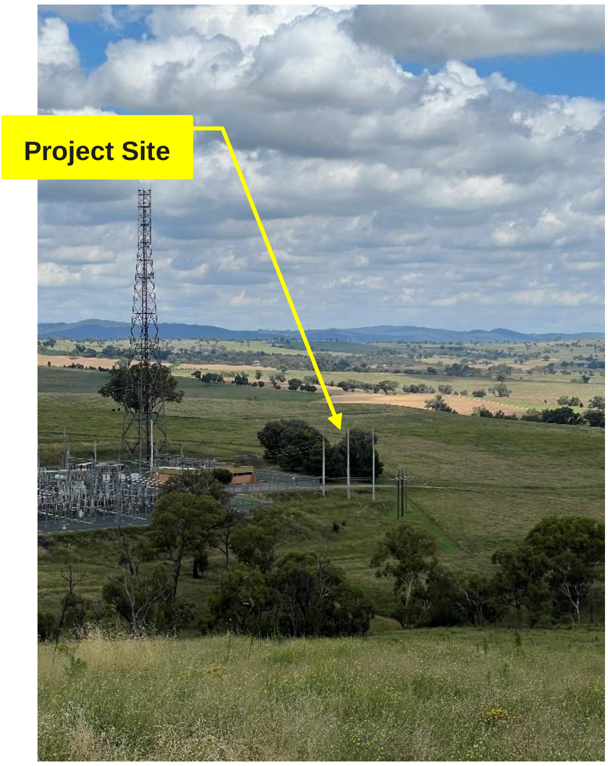


Photo 1 Photos of Project Site and Surrounds

View of Access Road to Site

View from North



View from South

View from West

Table 14 lists the distance to vegetation and vegetation slope parameters used in the BAL calculations.

Table 14 Vegetation Distance and Slope Parameters used for the BAL Calculations

Direction	Regional Ecosystem Classification	Distance to Vegetation	Slope Under Vegetation
North	Open Woodland / Grassland	**25 m**	Down - 5°
East	Open Woodland / Grassland	**22 m**	Flat - 0°
South	Open Woodland / Grassland	**25 m**	Down - 5°
West	Open Woodland / Grassland	**29 m**	Down - 10°

AS3959:2018 allows for “Exclusions” to BAL calculations for “low threat” vegetation and non-vegetated areas.

Specifically, AS3959:2018 Clause 2.2.3.2(a) states that the following shall be excluded from a BAL assessment:

- Vegetation of ANY type that is more than 100 m from the site.

On the basis of the vegetation distances shown in **Table 7** the only vegetation required for the BAL assessment of the site is the Grassland/Open Woodland immediately surrounding the site.

5.6 BAL Calculation

The BAL Calculation for the site has been carried out using:

- CSIRO’s BALA (Bushfire Attack Level Assessment) Tool

https://best-practices-assessment-tool.herokuapp.com/calculator?slope=0&vegslope=0&FFDI=60&vegtype=Tussock

Distances to the nearest vegetation have been based on the risk associated with sloping ground:

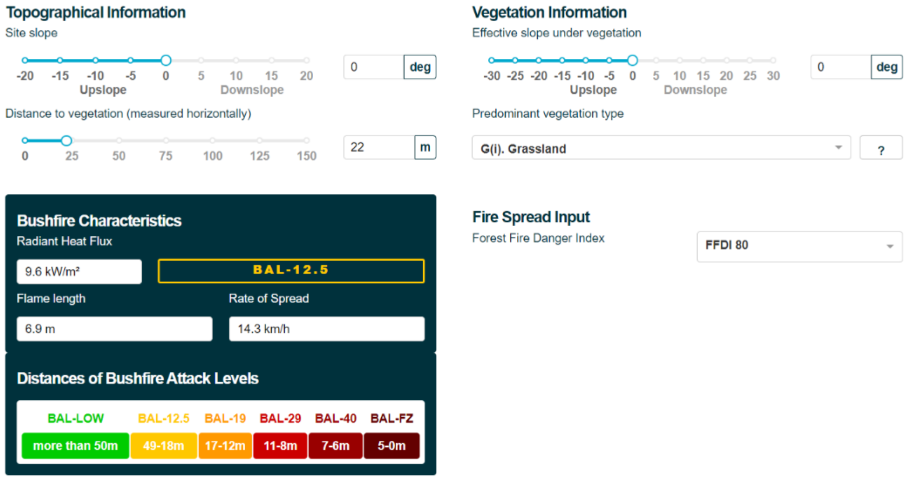
- Bushfire travels more quickly UP a hill than DOWN a hill.
- An assumption has been made that the clearance distances at the site enabled by the “inner” and “outer” areas of the site’s APZ (Asset Protection Zone) have been adjusted to reflect the site topography.
- These distances are shown in **Table 14**.

The results are shown in **Figure 12**, with the following key outcomes:

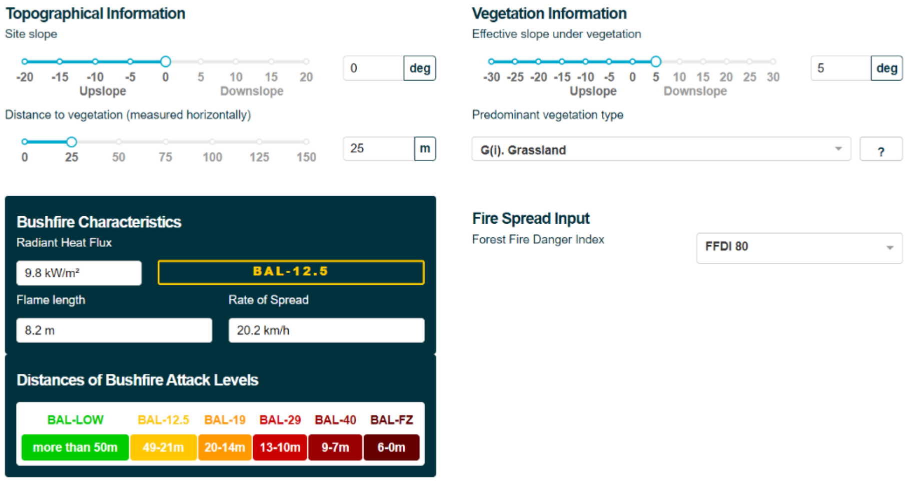
- The resulting BAL for the site is BAL-12.5 (worst-case in all directions).
- This is the lowest BAL requiring specific construction action for bushfire management as per AS3959:2018.
- Maximum radiant heat flux at the nearest site boundary is **9.9 kW/m2.**
- The above results have been enabled by varying the APZ distance for the site perimeter to the north, east, south and west, with the largest APZ distance to the west where a fire approaching the site would be travelling UPHILL.

Figure 12 Panorama BESS Site – BAL Calculation using the CSIRO BALA Tool

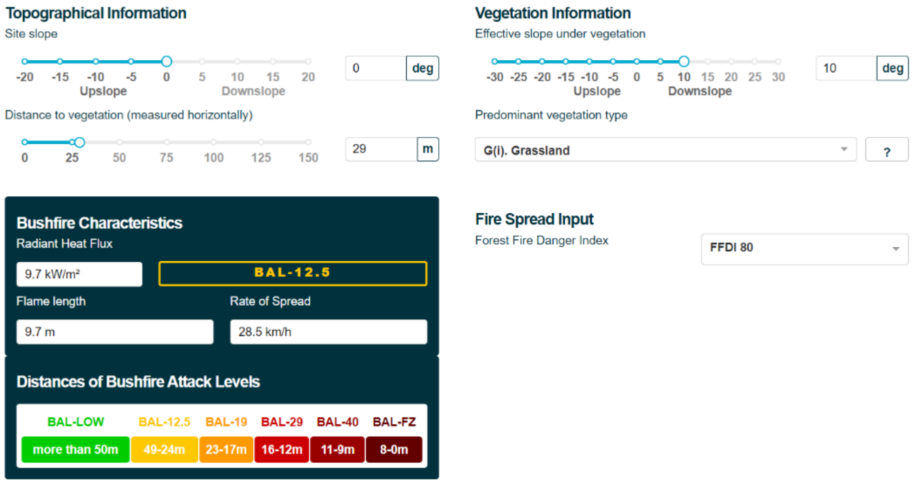
East



North / South



West



5.7 Bushfire Risk Mitigation and Management

The site requirements needed to address a potential bushfire attack fall into the following categories:

- Asset Protection Zones (APZs) to minimise the impact of radiant heat and flame contact;
- Construction Standards and Design to minimise building vulnerability to bushfire flames, radiation and embers;
- Access and Egress for the public and for firefighters and their equipment;
- Adequate Water Supply for fire suppression;
- Landscape Management; and
- Emergency Response and Management – Preparedness and Planning.

5.8 Asset Protection Zone

The recommended APZ was developed in accordance with guidance contained in:

- NSW Govt, NSW Rural Fire Service, *"Planning for Bush Fire Protection: A Guide for Councils, Planners, Fire Authorities and Developers"*, November 2019.
- NSW Govt, NSW Rural Fire Service, *"Planning for Bush Fire Protection Addendum"*, November 2022.
- NSW Govt, NSW Rural Fire Service, *"Standards for Asset Protection Zones"*.

The recommended Asset Protection Zone for the amended geometry BESS facility has been adopted for the facility and is shown in **Figure 13.**

- The recommended APZ creates a total separation from the nearest piece of equipment on the site to the nearest vegetation of the following:
  - 22 m to the east (upslope vegetation);
  - 25 m to the north and south (gentle down slope vegetation); and
  - 29 m to the west (slightly greater downslope vegetation).
- The APZ is situated on cleared ground and will provide adequate total site access for vegetation maintenance and firefighting personnel.

Benefits of the APZ and the Associated 10 kW/m2 limit at the Site Boundary

The recommended APZ achieves the following:

- The BESS site will experience a radiant heat flux level **LESS THAN 10 kW/m^2** at all footprint plan equipment boundaries.

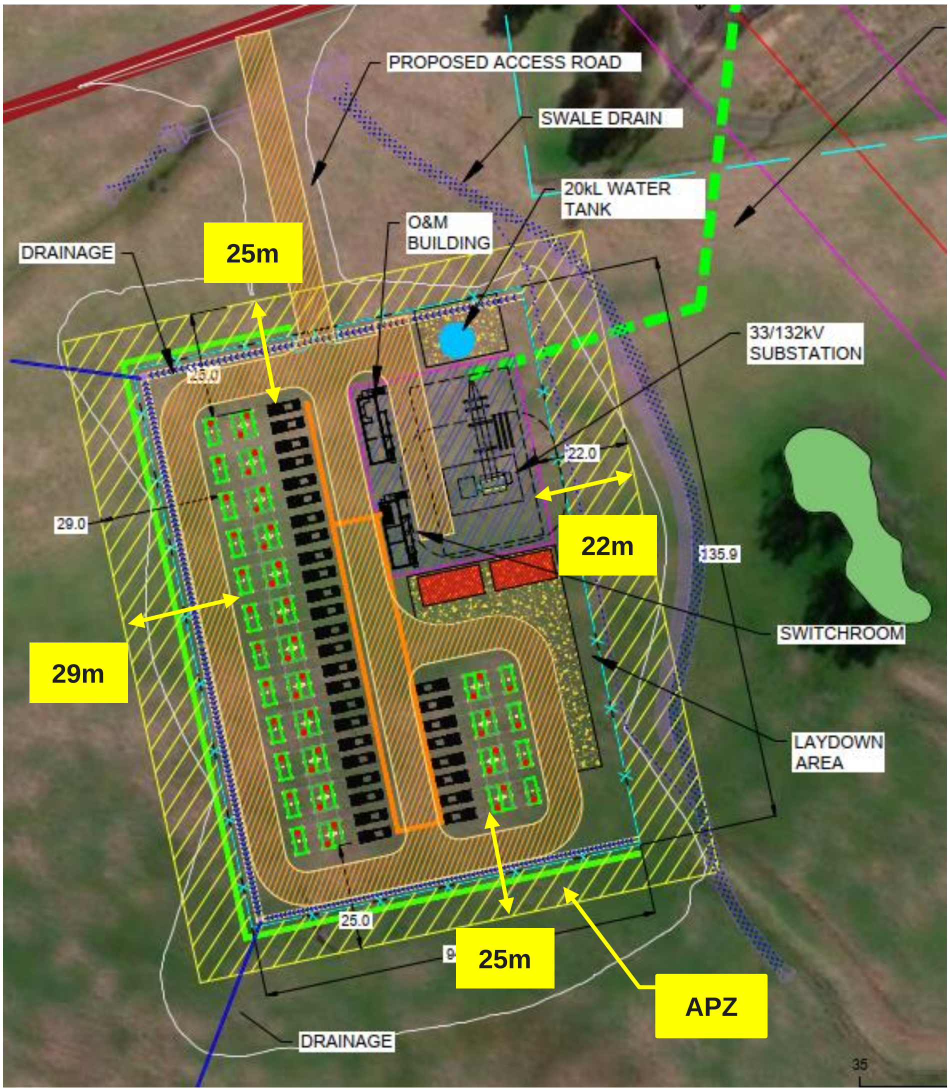
Comment on BAL recommendation.

Compliance with PBP-2019 (NSW RFS, *Planning for Bushfire Protection*, November 2019) for residential development is achieved with a target BAL-29 level – related to the ability of buildings to withstand a bushfire until firefighting resources arrive on site in an emergency.

The Panorama BESS site is subject to PBP-2019 Section 8 and therefore, a risk assessment based on the nature of the site. The more stringent BAL-12.5 level has been recommended as this would ensure that the maximum exposure at any point of a facility will be below 10 kW/m^2.

This will ensure the safety of firefighters and other emergency workers to safely defend the facility, evacuate personnel if needed and allow access to and from all areas within the Site.

Figure 13 Confirmed Asset Protection Zone for the Panorama BESS Site



The following is noted:

- A radiant heat flux of 10 kW/m^2 is the threshold for piloted ignition of dry timber and failure of plain glass, and more generally is a target maximum exposure at any point of a site building wall or façade.
- A radiant heat flux of 10 kW/m^2 is also the threshold where firefighters and other emergency services can operate, for both firefighting and evacuating occupants from threatened buildings.
- Limiting radiant heat flux level to 10 kW/m^2 at the BESS site boundary forms a critical element of the risk management for what are termed “vulnerable” uses, which includes community infrastructure for essential services.
- Accordingly, the facility’s proposed APZ achieves a performance-based outcome relevant to NSW Rural Fire Service guidelines.

Additional Project Commitment

- The Applicant commits to establishing a management regime to ensure the ongoing integrity of the proposed APZ, including responsibility for ongoing maintenance, etc.

5.9 Construction Standards and Design

The National Construction Code (NCC) is a performance based code which comprises the Building Code of Australia (BCA) as Volumes 1 and 2 and the Plumbing Code of Australia as Volume 3.

- The NCC contains Performance Requirements and Deemed-to-Satisfy provisions relating to the construction of buildings in bush fire prone areas.

The construction requirements of AS3959:2018 and the National Association of Steel-framed Housing (NASH) Standard contain Deemed-to-Satisfy solutions in the NCC, (can be varied State-to-State), for buildings in designated bush fire prone areas.

The general requirements for the construction of buildings specified in AS3959:2018 are separated according to the relevant BAL at the site of interest.

For the Panorama BESS facility, and hence for BAL-12.5, the relevant code sections are Sections 3 and 5.

Relevant Areas of AS3959:2018 Section 3

The guidance in AS3959:2018 pertains mainly to standard building construction, with a focus on external features prone to ember attack, covering items such as attached structures, garages, carports, external mouldings, bushfire shutters, glazing, etc. None of these is relevant to the BESS design.

Relevant Areas of AS3959:2018 Section 5

Again, the guidance in AS3959:2018 Section 5 pertains mainly to standard building construction, with a focus on external features prone to ember attack, covering items such as attached exposed floor supports, floor slabs, walls, external glazing, doors, roofs, verandas, etc.

Of relevance:

- Clause 5.8 states that any above-ground, water supply pipes **shall be metal.**
- Clause 5.8 also covers gas pipes and fittings – not relevant to the BESS design.

5.10 Access

Access requirements are crucial to the enabling of adequate firefighting capability and for emergency planning purposes (eg emergency evacuation). Reference is made to:

- NSW Govt, NSW Rural Fire Service, *"Planning for Bush Fire Protection: A Guide for Councils, Planners, Fire Authorities and Developers"*, November 2019.

The following general principles and RFS-compliant design apply to ensure that firefighting vehicles are provided with safe, all-weather access to the proposed BESS facility.

- BESS site firefighting access roads should be two-wheel drive, all-weather roads and appropriately sign-posted.
- Road widths accessing the site and within the site must be sufficient to accommodate firefighting vehicles. Perimeter roads are to be provided with a minimum clear width of 8 m. Non-perimeter roads are to be provided with a minimum clear width of 5.5 m.

- An unobstructed clearance height of 4 m should be maintained above all access roads including clearance from building construction, archways, gateways, overhanging structures and vegetation overhanging roads.
- In relation to vehicle turning circle requirements, any curved carriageways should be constructed using the minimum swept path dimensions shown in Table A3.2 of the above RFS 2019 Planning Guideline.
- Dead ends that are longer than 200 m must be provided with a turning head area that avoids multipoint turns. "No parking" signs are to be erected within the turning head. Example turning heads and minimum dimensions are provided in Figure A.3 of the above RFS 2019 Planning Guideline.
- Passing bays should be provided every 200 m. Where required, passing bays shall be 20 m in length and provide a minimum trafficable width at the passing point of 6 m.
- Maximum grades for sealed roads should not exceed 15° with an average grade of not more than 10°.

RFS Vehicle Specifications

In recent years, the NSW RFS has taken possession of a large number of new firefighting equipment. For specific details on RFS vehicles, refer https://www.fire.nsw.gov.au/page.php?id=161

Project Commitment:

Given the current design development stage, the Applicant has committed to the following:

- The road carrying capacity, turning circles, etc, will be designed for fully loaded firefighting vehicles of up to 23 tonnes.

Access

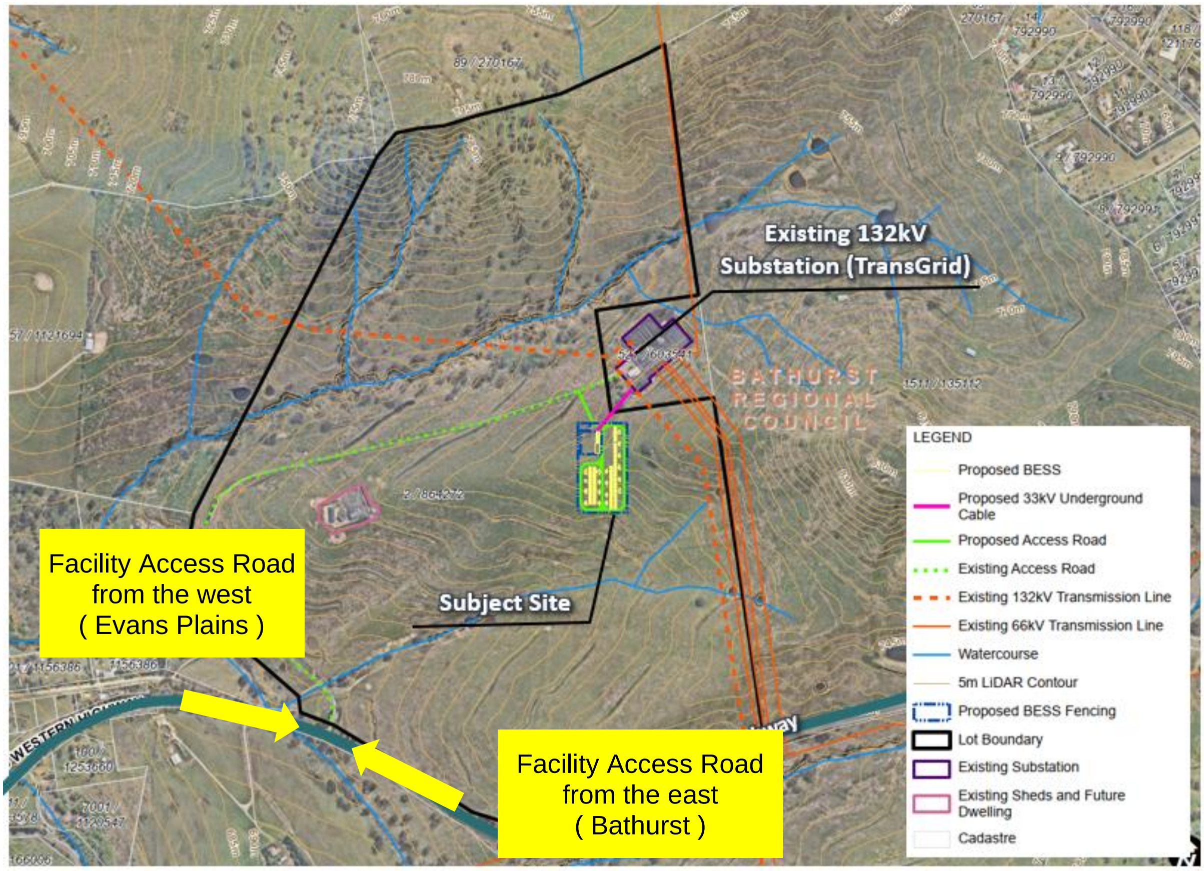
Where practical and feasible, flexible access to a facility is recommended for consideration so that access can be enabled regardless of the direction of tan oncoming bushfire.

Access provisions to the Panorama BESS site are shown in **Figure 14**.

- The access road to the facility can be approached from the EAST along Mid-Western Highway from the Bathurst direction.
- The access road to the facility can also be approached from the WEST along Mid-Western Highway from the Evans Plains direction.

Accordingly, firefighting resources have two approach paths to the facility's access road in the event of an emergency situation.

Figure 14 Panorama BESS Facility – Access



5.11 Water Supply

It is assumed that a reticulated water supply is NOT available at the site.

In this instance, an appropriate static water supply must be provided to support effective emergency services response. This will include a water tank that satisfies the following.

The water tank:

- is clearly identified by directional signage at all access points to the facility.
- must be readily accessible by firefighting appliances.
- should be located as close as possible to the BESS facility security perimeter.
- shall have a volume as specified in AS 2304:2011.
- shall be constructed of concrete or metal; all connecting above-ground water service pipes and taps being metal.
- will be located in an area such that medium rigid vehicles (eg a 15-tonne fire appliance) have clear access within 4 m of the tank and with sufficient parking adjacent for other emergency service vehicles.

- if serviced by a rural fire brigade, is provided with IPA-rated rural fire brigade tank fittings including a 65 mm Storz outlet valve and relevant coupling. Ball valves and pipes should be adequately sized for water flow and shall be constructed of metal. The supply pipes from the tank to the ball valve should have the same bore size to ensure flow volume.
- Raised tanks have their stands constructed from non-combustible material or bush fire-resisting timber (see *Appendix F* AS 3959).

Project Commitments:

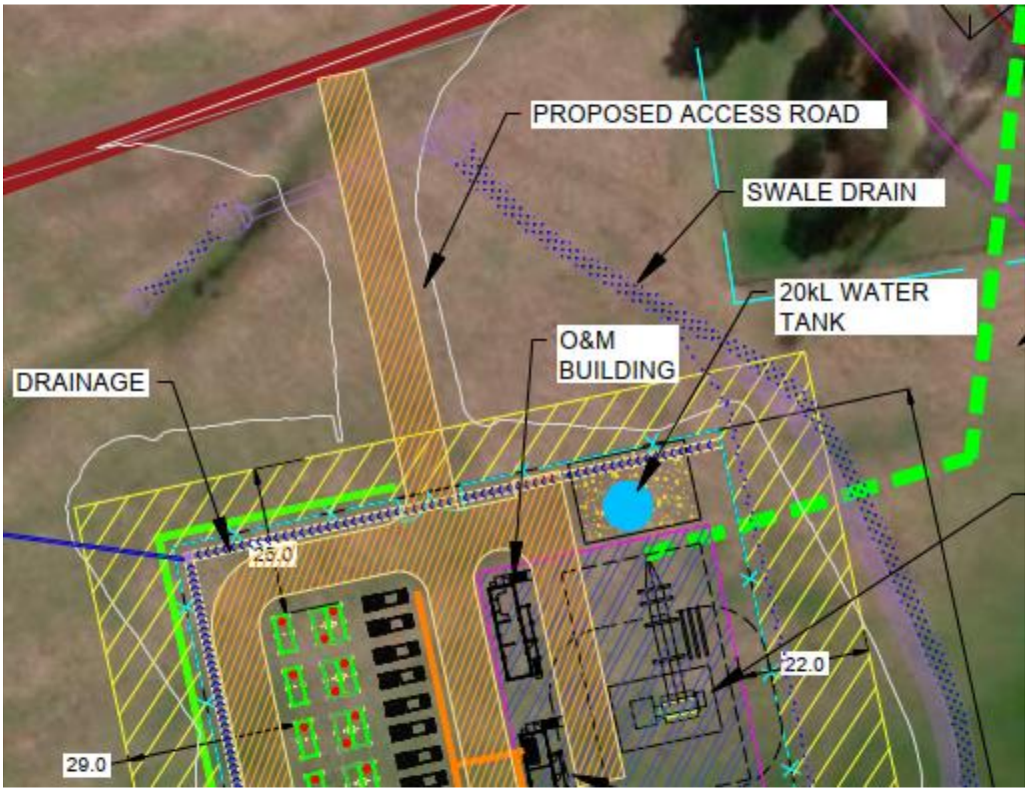
It is noted that the BESS site area is approximately 14,000 m^2.

Given the size of the development footprint, the Applicant has committed to the following:

- Ensure that the above water tank requirements are met.
- Provide a minimum 20 kL dedicated water supply for firefighting purposes.

The proposed water tank is shown in **Figure 15**.

Figure 15 Dedicated Firefighting Water Supply

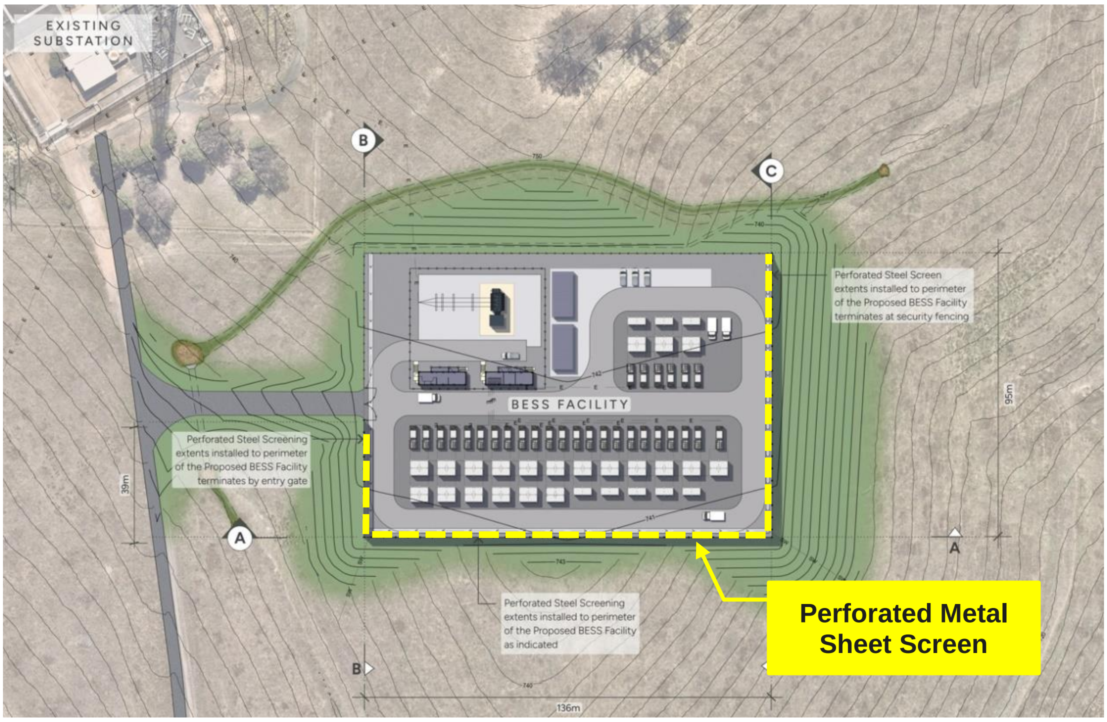


5.12 Landscape Plan

The landscape design for the amended BESS Facility design incorporates perforated steel screening finished in a recessive colour palette to minimise visual impact and blend with the surrounding environment – refer **Figure 16.**

The selected fire-rated Duratec Intensity 'Evergreen' finish ensures the screening integrates with the natural landscape, reducing contrast and reflective light from its western orientation. The perforated panels are fire-retardant and are positioned to the visually exposed perimeter of the amended BESS Facility design to provide effective visual screening while maintaining airflow and security.

Figure 16 Amended Panorama BESS Facility Landscape Concept Plan



While the BESS will have no added vegetation landscaping for visual screening purposes, some ground cover vegetation will be added to the immediate surrounding berms to assist in soli stability and to further ameliorate visual impacts of the facility.

The critical areas for landscape management at the site are therefore (i) the APZ, and (ii) the vegetation immediately surrounding the site.

- The Bushfire Emergency Management Plan for the facility (refer **Section 6.12**) shall contain a provision preventing any vegetation from taking hold within the proposed APZ zone around the site, thereby reducing the bushfire hazard risk and maintaining adequate access to firefighting personnel and equipment.
- The Bushfire Emergency Management Plan for the facility shall also contain a provision pertaining to the management of the vegetation surrounding the site, specifically limiting the height of pasture species surrounding the site to less than 1 m.

As noted in **Section 5.2** the Project is located on a lot designated as an approved 10/50 vegetation clearance zone – refer:

- NSW RFS, *"10/50 Vegetation Clearing Code of Practice for New South Wales"*, September 2015.

Clearing of vegetation under the 10/50 Code can only be conducted with the consent of the landowner. In a designated 10/50 zone, vegetation clearing can be undertaken involving …

> the removal, destruction (by means other than fire) or pruning of any vegetation (including trees) within 10 m; and
>
> the removal, destruction (by means other than fire) or pruning of any vegetation, (except for trees) within 50 m …

of an external wall of a building containing habitable rooms that comprises or is part of residential accommodation or a **high-risk facility**; or of an external wall of a building that comprises or is part of a farm shed.

The area recommended for vegetation clearing will cover:

- The APZ around the Site; and
- The Project's Site Access Road which links to the Private Access Road from Mid-Western Highway to the nearby Panorama Substation.

It is noted the part of the APZ lies outside the security fence of the BESS facility.

It is understood that landowner permission has been granted for the proposed clearing required for the APZ as well as the ongoing vegetation clearing/maintenance for the duration of the Project.

5.13 Management of Bushfire Risk Initiators

Potential "internal" bushfire risk initiators are summarised in **Table 8**, according to the stage of the Project.

Table 15 Potential Bushfire Initiators

Project Phase	Impact
Construction	Clearing activities (eg slashing, mowing and diesel-powered tool use), lightning strikes, storage of fuels/chemicals, hot welding activities, cigarette butts thrown from cars travelling within the site, traffic accidents, etc.
Operational	Ground cover/vegetation within site, ignition of electrical equipment, especially during repairs and maintenance activities, traffic accidents.
De-Commissioning	Decommissioning activities would have similar impacts to that for construction.

The Project's Bushfire Emergency Management Plan (BEMP) will include mitigation measures designed to address the risks detailed in **Table 15**.

5.14 Bushfire Emergency Management Plan (BEMP)

During the detailed design phase of the Project, a Bushfire Emergency Management Plan (BEMP) will be prepared for the Project. Key elements within the BEMP will be:

- APZ locations and management details;
- Schedule of BAL-related requirements and building footprints as well as any specific construction details;
- Access provisions such as locations, passing bays and alternate emergency access;
- Water supplies and bush fire suppression systems;
- Landscaping management requirements; and
- A Bushfire Emergency Management and Evacuation Sub-Plan within the overall BEMP.

5.14.1 Detailed Requirements of the BEMP

The following is a more detailed listing of the BEMP.

- The BEMP will identify specific responsibilities for actions required within the BEMP for the Applicant and Ultimate Operator, as well as Council.
- The BEMP will contain a detailed site layout plan identifying the locations of all site infrastructure, APZs, access routes and water supply details.
- The BEMP will identify key bushfire risks associated with the BESS facility and the strategies developed to mitigate them, including minimum APZ calculations, access requirements, firefighting water supply quantity and other design details aimed at facilitating an effective response to bushfire.
- The BEMP will include site-specific factors relevant to the site's protection from bushfire: the likely direction of bushfire attack if historic evidence indicates a bias in prevailing wind conditions during the fire season, location of evacuation routes and safety zones and identification of secondary risks, eg from nearby sites (if relevant).
- The BEMP will include: a description of the activities to be conducted on the site and in particular personnel movements covering both regular staff, maintenance staff and irregular visitors.
- The BEMP will list the storage or handling of any hazardous chemicals in quantities that would be equivalent to or exceed the threshold quantities set out in the relevant standards.
- The BEMP will show all transportation routes into and out of the site covering personnel, delivery of materials, access routes for emergency services or disaster response, etc. Details will be provide covering road layout, accessways, passing bays, evacuation routes, easements on site, designated routes for fire-fighting appliances, etc. These will be detailed in an Emergency and Evacuation Sub-Plan.
- The BEMP will clearly indicate the total extent of clearing, revegetation and landscaping proposed for the site, which is to be indicated on a site plan, including the APZ for the site. The means by which the APZ will be maintained, including who responsible, will be clearly enunciated.
- The BEMP will include information covering fire maintenance trails, if relevant.

- The BEMP will provide warning and evacuation procedures, plans and routes including capacity of public roads especially perimeter roads and traffic management treatments, and responsibility for their maintenance.
- The BEMP will detail all fire-fighting requirements including infrastructure and water supply, design standards for tanks, fittings and connection details, etc.

5.14.2 Community Engagement

- The BEMP will include recommendations to be passed on the ultimate BESS Operator (if not the Applicant) covering surrounding resident education and awareness.

5.14.3 Local Firefighting Resources

The BEMP will provide a listing of the nearest local firefighting resources, phone/email contacts, etc. The nearest Fire and Rescue NSW stations are currently:

- Bathurst Fire Station
  - 56 Suttor Street, Bathurst NSW 2795 (02) 6339 8516
- Kelso Fire Station
  - 4 Pat O'Leary Drive, Kelso NSWE 2795 (02) 6339 8505
- Blaney Fire Station
  - 23 Church Street, Blaney NSW 2799 (02) 6339 8527

5.14.4 Bushfire Initiator Risk Management – Refer Table 15

Project Stage - Construction

- Bushfire risks during construction will be managed through the implementation of a comprehensive Construction Bushfire Management Sub-Plan (CBEMP), to be prepared by the successful Project Contractor and signed off by all appropriate authorities.
- The CBEMP will ensure adequate site access for RFS along with water supply resources (20,000 L) needed to supress any fire within the Project site.

Project Stage – Operational

- Bushfire risks once the facility is fully operational will be managed through the implementation of the BEMP as described above, to be prepared by the successful Project Operator and signed off by all appropriate authorities.

Project Stage – De-Commissioning

- The BEMP will detail De-Commissioning phase management strategies similar to those deployed for the Construction phase to address the similar risks expected during this last phase of the Project.

5.14.5 Other Management and Mitigation Aspects

In addition to the above measures, the BEMP will:

- Recommend a system for the continuous monitoring of the RFS website for bushfire alerts (especially during the bushfire season).
- Ensure that smoking is prohibited throughout the site and that all employees receive training and instruction on the relevant fire procedures as part of their induction training.

Alignment of the Overall BEMP, CBEMP and ERP

It is important that the Project overall BEMP and Sub-Plan CBEMP and Project site Emergency Response Plan are aligned so that there is no conflict between activities such as the risk control measures adopted for minimising electrical hazards for firefighters attending emergency situations on-site.

All plans will be provided to RFS with copies stored locally within an appropriate “emergency cabinet” securely located within the Project site.

5.15 Bushfire Hazard Risk Conclusion

This section has shown that:

- Bushfire risk issues can be adequately mitigated.
- Accordingly, the BESS facility will be adequately protected from the threat of a bushfire event.

On the basis of the Risk Matrix shown in **Table 6**, SLR considers the residual risk associated with Bushfire fire hazard to be **LOW**, and hence adequately mitigated.

6.0 BESS Hazards and Risk Management

The safety measures involved in BESS Facility design are addressed in this section of the report to demonstrate that the BESS will not increase the extent or severity of hazards identified in **Section 4** to surrounding property, community and environment.

6.1 General Background to BESS Hazard Mitigation and Control Measures

Fire is recognised as the main hazard associated with lithium-ion batteries.

Containerised BESS Unit modules have been designed so that the occurrence of a fire does not spread easily to adjacent containerised modules, when constructed and installed according to relevant standards and guidelines.

- Refer e-STORAGE, *"SolBank 3.0 Installation Manual"*, version 1.0, 2022.

The control measures, described below, are designed to maintain and contain the risks within the site boundary and reduce the risk to areas outside the site boundary. The technical and management safeguards required for BESS units are self-evident and readily implemented as part of plant safety engineering. Following these safeguards, including codes and standards, will ensure that the resulting risk level associated with the BESS units is wither ALARP or LOW and that the proposed Panorama BESS facility meets the principles of:

- the circumvention of all avoidable risks;
- the risk from a major hazard should be reduced wherever practicable, even where the likelihood of exposure is low;
- the effects of significant events should, wherever possible be contained within the site boundary; and
- where the risk from an existing installation is already high, further development should not pose any incremental risk.

Technical and management safeguards relevant to the Project include but are not limited to guidance set out in the following:

- AS1768:2020 Lightning Protection
- AS 5139 Electrical Installations - Safety of Battery Systems for Use with Power Conversion Equipment
- Ditch, Ben & Zeng, Dong. (2019). Development of Sprinkler Protection Guidance for Lithium Ion Based Energy Storage Systems (FM Global Research Technical Report)
- FM Global Property Loss Prevention Data Sheets 5-33, Electrical Energy Storage
- IEC 62485-1:2015 Safety requirements for secondary batteries and battery installations - Part 1: General safety information
- IEC 62485-2:2010 Safety requirements for secondary batteries and battery installations - Part 2: Stationary Batteries
- IEC 62619:2017 Secondary cells and batteries containing alkaline or other non-acid electrolytes - Safety requirements for secondary lithium cells and batteries, for use in industrial applications
- IEC 62897 Stationary Energy Storage Systems with Lithium Batteries - Safety Requirements

- IEC 62933:2018 Electrical Energy Storage (ESS) Systems
- NFPA 855: 2020 Standard for the Installation of Stationary Energy Storage Systems
- UL 9540 Standard for Energy Storage Systems and Equipment
- UL 9540A ANSI/CAN/UL Standard for Test Method for Evaluating Thermal Runaway Fire Propagation in Battery Energy Storage Systems

6.2 BESS Equipment of Interest

As noted in **Section 1**, improvements in battery energy storage technology since the submission of the EIS mean that the SolBank 3.0 system offers an increased capacity and enhanced energy density per battery container while reducing the BESS layout footprint by approximately 20% or 0.35 ha.

- The rated capacity of the SolBank 3.0 system is 4.7 MWh with an energy density of 339kWh/m^2.

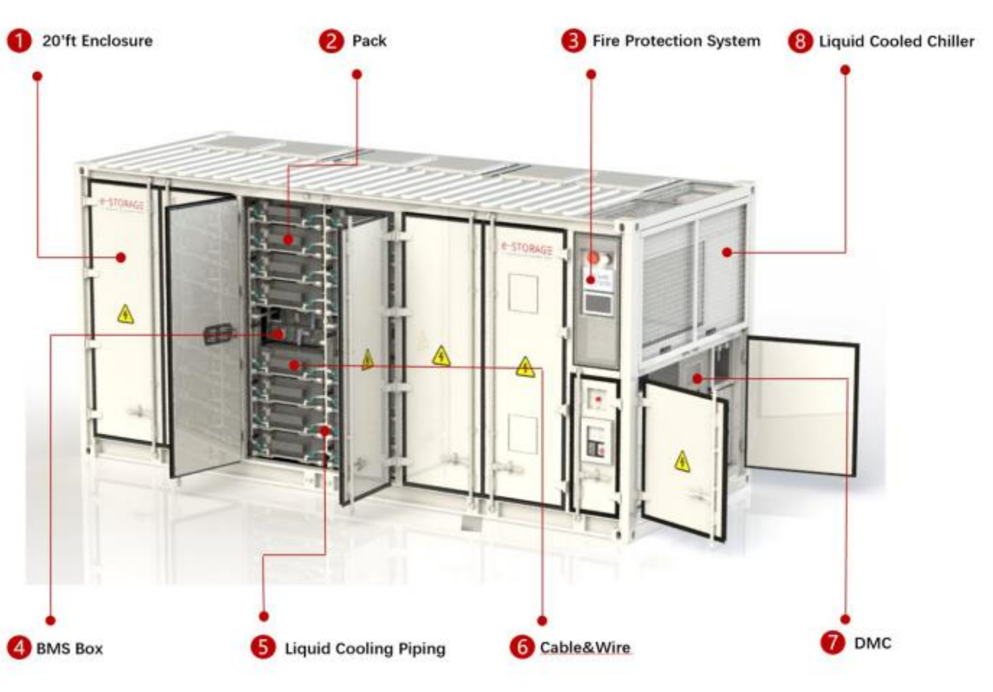
The SolBank 3.0 unit is shown in **Figure 17**.

The design upgrade of the Project will also involve the replacement of previous Twin Skid compact units with Single type compact units.

As a result, the amended Project will now comprise:

- 48 x Battery Storage Containers: SolBank 3.0
- 32 x MV Single Skid Compact Units comprising one invertor and one low voltage to high voltage transformer;
- 33 kV to 132 kV transformer; and
- Control Room Heating, Ventilation, and Air Conditioning (HVAC).

Figure 17 SolBank 3.0 Unit



6.3 BESS Related Fire Hazards

BESS-related fire hazards arise from the following two broad areas.

Risks Associated with Non-Battery Fire Events

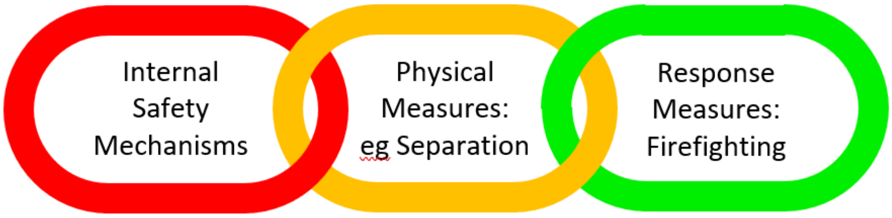
- Wiring Issues, eg short circuits.
- Electrical Safety System Failures, eg fuses, breakers, insulation, etc.
- Mechanical Interference, eg bugs, rodents, mishandling, etc.

Thermal Runaway

- Causes: manufacturer defect, overcharge, over-discharge, mechanical damage, environmental (too hot, too cold).
- Hazards Produced: heat, flame, off-gassing of mainly H2 and CO, off-gassing of other toxic gases, deflagration/explosion risk.

The key “links” in managing “internal” fire related risks within a BESS facility are illustrated in the “Fire Response Chain” shown in **Figure 18**.

Figure 18 Key Strategic Links in Managing BESS Fire-Related Risks – the Fire Response Chain



- **Link 1**: Globally manufactured, commercially available BESS units (battery packs, convertors, etc) come with a range of sophisticated in-built hazard reduction mechanisms to: firstly, avoid the onset of a fire event; secondly, detect a fire and “announce” it to relevant “stakeholders”, and thirdly, contain and suppress the fire until external firefighting resources can be brought to bear to shut the fire down, if it has not already been contained.
- This is the case with the proposed SolBank BESS Units and the MV Inverter Units
- **Link 2**: In between the Link 1 automatic fire-management systems and the Link 3 intervention of fire-fighting resources are a series of physical measures, eg BESS separation distances, APZ zones, etc, designed limit the spread of a fire event until firefighting resources arrive to shut down the fire, if it has not already been contained.
- **Link 3**: Appropriate access for firefighting vehicles, availability of an adequate water supply for firefighting, emergency response planning, etc, form the last link aimed at being able to shut a fire down before it spreads beyond the BESS perimeter and into the surrounding community.

In relation to **Figure 17:**

- A strong **Link 1** places less onus on **Links 2 and 3**, and
- Strong **Links 1 and 2** place less onus on **Link 3**.

6.4 Link 1

It is worth re-stating that grid-scale BESS units provided currently by global manufacturers (eg SolBank's BESS Unit) typically contain a hierarchy of fire management controls which create layers of protection:

- SolBank 3.0 features **LiFePO4 chemistry**:
  - LFP chemistry is preferred over NMC because of the higher onset temperature for Thermal Runaway (270°C for LFP versus 210°C for NMC).
  - LFP also has a significantly lower self-heating rate than NMC chemistry batteries.
- Compared to the previously proposed SolBank units, the updated SolBank 3.0 features:
  - Up to 20% faster detection of abnormal and automatic protection; and
  - Advanced pack thermal isolation, electrical redundancy protection, and multi-level fire protection, effectively minimize potential issues
- SolBank 3.0 units come with an advanced BMS (Battery Management System) which monitors a range of variables related to the onset or incidence of a fire event (temperatures, over and under-voltage, over-currents, etc).
- The BMS will then trigger alarms, instigate internal fire suppression equipment and automatically disconnect each BESS unit in the event of a fire.
- Electrical Protection is enabled via an IP67-rated pack design which features Current Interrupt Devices (CID) and Rack Level Fuse Protection.
- SolBank 3.0 also features its own CSI Intelligent Thermal Management System.
- SolBank's fire detection system includes Thermal and Smoke Detectors, Explosive Gas Sensing and H_2 Detection for Thermal Runaway.
- Mechanical protection is enabled via Pressure Relief Valves.
- Cabinet walls which are adjacent to other units are fire-rated to EI60 – this provides a 2-hour fire wall between adjacent units.
- Roof panels are designed for blast loading to minimise the impact of any potential deflagration/explosion, including roof panel rupture.
- SolBank 3.0 Fire Detection and Alarm comprises:
  - A fire alarm panel; heat and smoke detection; and alarm bell and strobe.
- SolBank 3.0 Explosion Prevention features:
  - Combustible gas detection with active ventilation
- SolBank 3.0 Power Back-up is enabled via:
  - Container Uninterrupted Power Supply for a 2-hour control system back-up; and
  - Dedicated fire safety Uninterrupted Power Supply for 24-hour fire alarm back-up.
- SolBank 3.0 Fire Suppression features:
  - Aerosol-based suppression; and
  - A dry pipe sprinkler system.

6.4.1 SolBank 3.0 – Certifications and Standards Compliance

Table 16 SolBank 3.0 Certifications / Standards Compliance

Aspect	Impact
Design	NEC – National Electrical Code® IEEE C84.1 – Standard Preferred Voltage Ratings for Alternating- Current Electrical Systems IEEE 693 – Recommended Practice for Seismic Design of Substations IEEE 1584-2018 – Guide for Performing Arc-Flash Hazard Calculations NFPA 855 – Installation of Energy Storage Systems NFPA 70E® – Standard for Electrical Safety in the Workplace® NFPA 72 – National Fire Alarm and Signalling Code IEC62933-5-2 – Safety requirements for grid-integrated EES systems - Electrochemical-based systems AS3000 - Electrical installations “Wiring Rules”
Product Certification	IEC 60529 – Degrees of protection provided by enclosure IEC62619 – Secondary cells and batteries containing alkaline or other non-acid electrolytes - Safety requirements for secondary lithium cells and batteries, for use in industrial applications IEC63056 – Secondary cells and batteries containing alkaline or other non-acid electrolytes - Safety requirements for secondary lithium cells and batteries for use in electrical energy storage systems IEC/EN 62477-1 – Safety requirements for power electronic converter systems and equipment - Part 1: General IEC/EN 61000 – Electromagnetic compatibility (EMC) UL 60730-1 – Standard for safety: Automatic Electrical Controls – Part 1:General Requirements UL9540A – Standard for Test Method for Evaluating Thermal Runaway Fire Propagation in Battery Energy Storage Systems UL1973 – Standard for safety: Batteries For Use In Stationary and Motive Auxiliary Power Applications UL9540 – Standard For safety: Energy Storage Systems and Equipment NFPA 69® – Standard on Explosion Prevention Systems NFPA 68® – Standard on Explosion Protection by Deflagration Venting UN38.3 – Recommendations on the Transport of Dangerous Goods: Manual of Tests and Criteria
Fire Protection and Safety	NFPA 2001 – Standard on Clean Agent Fire Extinguishing Systems NFPA 15 – Standard for Water Spray Fixed System for Fire Protection NFPA 2-2023 – Hydrogen technologies code BS 5839-1 – Fire detection and fire alarm systems for buildings BS 7273 -1 – Code of practice for the operation of fire protection measures BS EN 54 Pt1- 21 – series for equipment BS EN 15004-1:-2019 – Fixed firefighting systems. Gas extinguishing systems. Design, installation and maintenance. BS EN 15004-2:2020 – Fixed Firefighting Systems-Gas Extinguishing Systems FK-5-1-12

Aspect	Impact
	BS 6266:2011 – Fire protection for electronic equipment installations – Code of practice BS EN 12094-1:2003 – Fixed firefighting systems. Components for gas extinguishing systems Requirements and test methods for electrical automatic control and delay devices AS 4487-2013 – Condensed aerosol fire extinguishing systems – Requirements for system design, installation and commissioning and test methods for components AS 7240– Fire Detection and Alarm Systems AS1670 – Fire detection, warning, control and intercom systems – System design, installation and commissioning AS 1851-2012 – Routine service of fire protection systems and equipment

6.4.2 Link 1 – Case Study in BESS Safety Development

Traditionally, the safety of engineering systems (civil, mechanical, electrical, etc) has evolved through three main avenues:

- R&D: especially in the early stages of development of a new product or system;
- Standards: compliance with standards provides an avenue for underpinning safety; and
- “Lessons Learned”: typically, through failures, accidents, etc, where low probability failure mechanisms are discovered, and mitigation measures developed to prevent their occurrence in the future. An example of this latter avenue discussed below is the Victorian Big Battery Fire of July 2021.

Victorian Big Battery (VBB) Fire – 30 July 2021

Neoen’s VBB is a 300 MW/450MWh BESS facility located in Geelong, Victoria, fitted with 212 Tesla Megapacks, each measuring approximately: 7.2 m (length) x 1.6 m (width) x 2.5 m (height).

On Friday, 30 July 2021:

- A single Megapack (MP1) caught fire and spread to a neighbouring Megapack (MP2) during the installation and commissioning phase of the facility.
- At that time, approximately half of the Megapacks had been installed at the site and some were undergoing testing and commissioning.
- MP1 was NOT scheduled for testing that day and was shut down manually at around 7:20 am. When it was shut down, it was not displaying abnormal conditions to site personnel.
- At around 10:00 am, smoke was observed emitting from MP1 by site personnel, who then electrically isolated ALL the Megapacks on-site and called emergency services.
- Country Fire Authority (CFA) arrived shortly thereafter and set up a 25 m perimeter around MP1.
- They also began applying cooling water to nearby exposures (eg transformers) as recommended in Tesla’s Lithium-Ion Battery Emergency Response Guide (ERG).

- At around Noon, the fire spread to the neighbouring MP2, which was installed 15 cm behind MP1. Wind was the dominant contributory factor in this case. At the time of the fire, sustained winds of over 50 km/hr impacted the site from the north. These pushed the flames exiting out of the top of MP-1 towards the roof of MP-2 leading to direct flame impingement on the thermal roof of MP-2.
- The CFA permitted MP-1 and MP-2 to burn themselves out and did not directly apply water into or onto either Megapack, as recommended in Tesla's ERG.
- The fire did not spread beyond MP1 and MP2, which burned themselves out over the course of approximately six hours.
- There were no injuries to the general public, to site personnel or to emergency first responders as MP1 and MP2 failed "safely", ie they slowly burned themselves out with no explosions or deflagrations, as they are designed to do in the event of a fire, and as per the guidance in Tesla's ERG.
- By around 4:00 pm, visible fire had subdued and a fire watch was instituted.
- The CFA monitored the site for the next three days before deeming it under control on 2 August 2021, at which time, the CFA handed the site over for a formal fire investigation to begin.

Lessons Learned

The VBB fire exposed a number of unlikely factors that, when combined, contributed to the fire initiation as well as its propagation from unit MP1 to MP2. This collection of factors had never before been encountered during previous Megapack installations, operation and/or regulatory product testing.

Below is a summary of the lessons learned from the incident and the new safety mitigation measures since implemented.

Commissioning

- Key weaknesses identified: (i) limited supervision/monitoring of telemetry data during the first 24 hours of commissioning, and (ii) use of the keylock switch during commissioning and testing.
- These two factors prevented MP1 from transmitting telemetry data (internal temperatures, fault alarms, etc) to Tesla's control facility and placed critical electrical fault safety devices (such as the pyro disconnect) in a state of limited functionality, reducing the Megapack's ability to actively monitor and interrupt electrical fault conditions prior to them escalating into a fire event.
- Since the VBB fire, Tesla has modified their commissioning procedures to reduce the telemetry setup connection time from 24 hours to 1 hour and to avoid utilizing the Megapack's keylock switch unless the unit is actively being serviced.

Electrical Fault Protection Devices

- Key lessons learned covered the following: (i) coolant leak alarms not being active, (ii) the pyro disconnect being unable to interrupt fault currents when the Megapack is off via the keylock switch, and (iii) the pyro disconnect likely being disabled due to a power supply loss to the circuit that actuates it.
- These factors prevented MP1's pyro disconnect from actively monitoring and interrupting the electrical fault conditions before escalating into a fire event.

- Since the VBB fire, Tesla has implemented a number of firmware mitigations that keep all electrical safety protection devices active, regardless of keylock switch position or system state, and actively monitor and control the pyro disconnect's power supply circuit.
- Furthermore, Tesla has added additional alarms to better identify and respond (either manually or automatically) to coolant leaks. Additionally, although this fire event was almost certainly initiated by a coolant leak, potential unexpected failures of other internal components of the Megapack that could create similar damage to the battery modules have been explored.
- Accordingly, the new firmware mitigations do not ONLY address damage from a coolant leak. They also permit the Megapack to better identify, respond, contain and isolate issues within the battery modules due to failures of other internal components, should they occur in the future.

Fire Propagation

- Key lessons learned included: (i) the significant role external, environmental conditions (such as wind) can have on a Megapack fire, and (ii) the identification of a weakness in the thermal roof design (unprotected, plastic overpressure vents in the ceiling of the battery bays) that permitted Megapack-to-Megapack fire propagation.
- These two factors led to direct flame impingement on the plastic overpressure vents that seal the battery bay from the thermal roof. With a direct path for flames and hot gases to enter into the battery bays, the cells within the battery modules of MP2 failed and became involved in the fire.
- This weakness had not been identified previously during product or regulatory testing as the relevant UL9540A tests are undertaken with wind speeds reaching only up to 20 kph. The fire therefore did not invalidate the Megapack's UL9540A certification, as the fire occurred as result of an environmental condition that is not captured by the UL9540A test method.
- Since the VBB fire, Tesla has devised (and validated through extensive testing) a hardware mitigation that protects the overpressure vents from direct flame impingement or hot gas intrusion via the installation of new, thermally insulated, steel vent shields.
- The vent shields are placed on top of the overpressure vents and NOW COME STANDARD on all NEW Megapack installations.
- For EXISTING Megapacks, the vent shields can be easily RETROFITTED in the field.

Megapack Spacing

- Investigation of the VBB fire concluded that NO changes were required to the installation practices of the Megapack ONCE the vent shield mitigation (as described above) was in place.
- Based on an analysis of MP2's telemetry data during the VBB fire, a Megapack's thermal insulation provides significant thermal protection in the event of a fire within an adjacent Megapack installed 15 cm away. The internal cell temperatures of MP2 only increased by 1°C, from 40°C to 41°C, before communication was lost to the unit, presumably due to fire, around 11:57 am (approximately 2 hours into the fire event). Fire propagation was triggered by the weakness in the thermal roof, as described above, and NOT due to heat transfer via the 150 mm gap between Megapacks.

- With the new vent shield mitigation in place, the weakness has been addressed and since validated through unit level fire testing (ie tests involving the ignition of the Megapack's thermal roof).
- These tests have confirmed that, even with the thermal roof fully involved in a fire, the overpressure vents will not ignite and the battery modules remain relatively unaffected with internal cell temperatures rising less than 1°C.

Emergency Response

Lessons learned from the emergency response to the VBB fire:

- Effective pre-incident planning is invaluable and can reduce the likelihood of injuries;
- Coordination with "Subject Matter Experts" (SMEs), either on site or remotely, can provide critical expertise and system information for emergency responders to draw upon;
- The effectiveness of applying water directly to adjacent Megapacks appears to provide limited benefits. However, water application to other electrical equipment, with inherently less fire protection built into their designs (such as transformers), can be a useful tactic to protect that equipment;
- The fire protection design approach of the Megapack was shown to be very robust;
- Victoria's EPA indicated that there was "good" air quality two hours after the fire, demonstrating that no long-lasting air quality concerns arose from the fire event;
- Water samples indicated that the likelihood of the fire having a material impact on firefighting water was minimal; and
- Prior community engagement during the project planning stages proved to be invaluable as it enabled Neoen to quickly update the local community and address immediate questions and concerns. Early, factual and where possible, face-to-face engagement with the local community is essential when a fire event is unfolding to keep the general public informed.

Summary

- The VBB fire event proceeded in accordance with its fire protection design and pre-incident planning.
- It presented no unusual, unexpected, or surprising characteristics (ie explosions)
- It did NOT result in any injuries to site personnel, the general public or emergency responders.
- It was isolated to the units directly involved and had minimal environmental impact.
- It did not adversely impact the electrical grid and had appreciably short mission interruption.

Relevance to the SolBank BESS Units

SLR understands that key learnings from the VBB fire event, including monitoring and supervision procedures during commissioning and unit-to-unit wall/roof vent fire mitigation measures, have been considered in the latest SolBank BESS unit design.

6.5 Link 2

The key to **Link 2** (refer **Figure 3**) is to provide sufficient clearance between rows of adjacent BESS units (whether modular/cabinet type or containerised type) and between BESS units and the BESS enclosure perimeter.

- Typically, BESS battery packs have a minimum clearance distance to the nearest boundary of their enclosure of between 5 m to 6 m. This is based on the radiant heat flux from a theoretical BESS battery pack fire that might be experienced by site personnel.
- Rows of adjacent BESS battery pack units will also be separated by a minimum clearance which will vary in terms of the front and end walls and side walls. This is based on the radiant heat flux from a theoretical BESS battery pack fire that an adjacent BESS unit might experience in relation to its structural integrity.

BESS Unit Separation Distances via Regulatory Guidelines

Some information is available amongst international standards and guidelines regarding minimum separation distances between BESS packs and between BESS packs and surrounding personnel access areas.

For example, NFPA 855-2020 Standard for *the Installation of Stationary Energy Storage Systems*, (US) National Fire Protection Association (latest edition 2020) specifies:

- A minimum of 10 feet (3.05 m) separation to lot perimeters, public ways, buildings, stored combustible materials, hazardous materials, high-piled stock, and other exposure hazards not associated with the electrical grid.

AS/NZS 5139:2019 *Electrical Installations – Safety of Battery Systems for Use with Power Conversion Equipment* also provides guidance with respect to minimum separation distances from personnel and buildings and other equipment. The minimum separation distances (which range from 600 mm to 900 mm) do not apply in the present instance – the facility's BESS units will be located within their dedicated area, isolated from personnel by the facility's Perimeter Fence as shown in **Figure 2**.

BESS Unit Separation Distances via Quantitative Fire Modelling

SLR has reviewed the literature of credible fire scenarios for comparable containerised BESS systems.

Guidance for example in relation to a fire event relevant to BESS units can be found in:

- AS 1530.4:2014, *"Methods for fire tests on building materials, components and structures – Fire resistance tests for elements of construction".*

Other relevant international standards include:

- SFPE S.01, *Standard on Calculation Fire Exposures to Structures,* Society of Fire Protection Engineers; Gaitherburg MD, 2011.
- SFPE S.02, *Standard on Calculation Methods fo Predict the Thermal Performance of Structural and Fire Resistive Assemblies*, Society of Fire Protection Engineers; Gaitherburg MD, 2015.
- ISO 23932-1:2018, *Fire Safety Engineering – General Primciples – Part 1: General*.
- CIBSE Guide E, *Fire Engineering*, 3rd Edition, Chartered Institute of Building Services Engineers, UK, 2010.

The above standards provide parametric fire curves which can be used to estimate the upper bound of the likely fire temperatures relevant to a BESS unit.

These are typically in the range:

- 800-1,000°C at an “open” side of a containerised unit – a typical value found in the literature is 840°C, a standard upper limiting value used in fire simulations for fire spread between office buildings.
- 600°C at a “closed” side of a containerised unit – refer the SPFE and CIBSE Handbooks above, for a severe, fully developed fire in a containerised unit.
- 700-800°C for sides between an “open” and “closed” side.

Common assumptions made in the literature for BESS fire simulations include the following:

- BESS units are assumed to be a “black body” (worst-case from a fire spread point of view).
- Fire spread is via the Stefan-Boltzmann Law, with uniform heat loss.
- Emissivity factors in the range 0.9-1.0.

SLR’s literature search of worst-case BESS fire simulations based on the above assumptions indicate the following approximate minimum separation distances:

- 6 m = minimum distance from either the front, end or side walls of any BESS battery pack to the associated enclosure fence perimeter (based on the 4.7 kW/m2 criterion).
- 3 m = minimum distance between adjacent BESS battery pack side walls (based on the 12.6 kW/m2 criterion).
- 4 m = minimum distance between adjacent BESS battery pack front and end walls (based on the 12.6 kW/m2 criterion).

On the basis of the above, various possible configurations of BESS battery packs within a rectangular area can then be assessed for a given total area allocated to the facility.

BESS Unit Separation Distances via Certified Tests – UL9540A

The standard certification test for establishing (amongst a number of design parameters) the minimum fire-related clearances for commercially available BESS containerised units is UL9540A:

- UL 9540A ANSI/CAN/UL *Standard for Test Method for Evaluating Thermal Runaway Fire Propagation in Battery Energy Storage System*.

In fact, UL has established a database of its BESS container fire tests and provides free accesws to this database:

- Refer … https://www.ul.com

The proposed SolBank 3.0 BESS Units has been subject to fire testing under UL9540A.

- **Figure 19** shows the certified dimensions derived from this testing for the CSI SolBank PN CSES315A5 unit.
- **Figure 19** also shows some actual installations involving CSI SolBank BESS Units based on the unit-to-unit distances that have been subject to UL 9540A testing.

On the basis of the UL9540A certified unit-to-unit separation distances noted above, the space allocated for the 48 SolBank 3.0 BESS Units (~9,000 m2 – refer **Figure 2**) should be more than sufficient to accommodate the 100 MW/200 MWh BESS capacity proposed for the site.

Figure 19 Example CSI SolBank Installations

6.6 Link 3

Within this report, Section 5 separately addressed:

- **Asset Protection Zones, Landscaping and Construction Standards:** including non-combustible security fencing to be installed around BESS units and related infrastructure and the APZ around the external boundary fence, to be managed as an inner protection zone (IPA).
- **Access:** to the BESS facility with fire trail access around the BESS compound perimeter fence
- **Water Supply:** including a supply pipe from the proposed 20 kL static water tank, positioned close to the BESS compound to enable responding fire fighters to access this water supply.
- **Bushfire Emergency Management Plan:** to be developed post-approval.

6.7 BESS Fire Hazard Risk Conclusion

This section has shown that:

- BESS-related fire risk issues can be adequately mitigated. Accordingly, the BESS facility will not itself pose an additional fire hazard that has the potential to increase the extent or severity of a bushfire event on surrounding property, people and the environment, and
- The proposed BESS capacity can be comfortably accommodated within the site space provided.

On the basis of the Risk Matrix shown in **Table 6** SLR considers the residual risk associated with the BESS-initiated fire hazard to be **LOW**, and hence adequately mitigated.

7.0 EMF Hazards

SLR recognises the concerns amongst some communities regarding the potential for adverse health impacts associated with exposure to Electric and Magnetic Fields (EMFs) and the recent interest regarding the impacts associated with Magnetic Fields in particular.

Standards and guidelines covering the above have evolved over time, and include:

- Australian Radiation Protection and Nuclear Safety Agency (ARPANSA), 2002. *Maximum Exposure Levels to Radiofrequency Fields - 3 kHz to 300 GHz,* Radiation Protection Series; No.3.
- Australian Radiation Protection and Nuclear Safety Agency (ARPANSA), 2014. *Review of Radiofrequency Health Effects Research – Scientific Literature 2000–2012,* Technical Report Series; No.164.
- Australian Radiation Protection and Nuclear Safety Agency (ARPANSA), 2021. *Standard for Limiting Exposure to Radiofrequency Fields – 100 kHz to 300 kHz*, Radiation Protection Series S-1 (Rev.1).
- AS/NZS 2772.2:2016*, Radiofrequency fields Principles and methods of measurement and computation - 3 kHz to 300 GHz*, Standards Australia, 2016.
- International Commission on Non-Ionizing Radiation Protection (ICNIRP), 1998. *Guidelines for limiting exposure to time-varying electric, magnetic and electromagnetic fields (up to 300 GHz),* Health Physics, 74(4):494-522.
- International Commission on Non-Ionizing Radiation Protection (ICNIRP), 2009. *Guidelines on limits of exposure to static magnetic fields*, Health Physics, 96(4):504-514.
- International Commission on Non-Ionizing Radiation Protection (ICNIRP), 2010. *Guidelines for limiting exposure to time-varying electric and magnetic fields (1 HZ – 100 kHz),* Health Physics, 99(6):818-836.
- International Commission on *Non-Ionizing Radiation Protection (ICNIRP), 2020a. ICNIRP guidelines for limiting exposure to electromagnetic fields (100 KHz to 300 GHz)*, Health Physics, 118(5):483–524.
- International Commission on Non-Ionizing Radiation Protection (ICNIRP), 2020b. *ICNIRP Statement Principles for Non-ionizing Radiation Protection*, Health Physics, 118(5):477–482.

7.1 Electric and Magnetic Fields (EMFs) versus Electromagnetic Fields (EmFs)

EMFs

Electric and Magnetic Fields (EMFs) are part of the natural environment; they are present within the Earth's core and in the atmosphere. Whenever a power line (or household power cord) is energized, an Electric Field is created with a strength that depends directly on the voltage across the line creating it. A Magnetic Field is created whenever current flows through a power line (or household power cord), at any voltage.

EMFs associated with the generation, distribution and use of electricity power systems in Australia are classified by Energy Networks Australia (ENA) as being extremely low frequency (ELF). As a result, they do not normally radiate from their sources. **Table 17** illustrates the basic features of EMFs as applied to a typical household appliance.

Table 17 Comparison of Typical Household Appliance EMFs

Characteristic	Electric Field	Magnetic Field
Field is produced by …	Voltage	Current
Field is measured in units of …	Volts/metre (V/m) or kV/m	milli-Gauss (mG) or micro-Tesla (μT)
The field exists when the appliance is turned OFF …	YES	NO
Field strength decreases rapidly with distance from source …	YES	YES
Field strength decreases rapidly if shielded by intervening insulation, enclosures, trees, buildings, etc …	YES	NO

Source: (NIEHS 2002)

EmFs

At much higher frequencies, Electric Fields and Magnetic Fields exist in a mutual relationship known as an Electromagnetic Field (EmF) with a unique ability to radiate beams of energy from an antenna (hence their “electromagnetic radiation” property), thereby making communication systems possible. The hazards and risks assessed in this study however are restricted to the properties of the independent Electric and Magnetic Fields associated with BESS facility equipment, cabling and power lines (operating at a frequency of 50 Hz).

Confusion between EMFs and EmFs is understandable, but the distinction is important as the electromagnetic radiation properties of EmFs are in sharp contrast to BESS facility EMFs that do not create a radiating energy beam (hence the nomenclature of EMFs as a ”field” and not “radiation”).

7.2 Typical EMF Strengths

Typical examples of the strength of commonly encountered Magnetic Fields are shown in **Table 18**.

Table 18 Typical Magnetic Field Strength Examples

Example Domestic Source	Magnetic Field	Example Power Source	Magnetic Field
TVs, Fans	0.2 – 2 mG	Sub-Station (at perimeter fence)	1 - 8 mG
Toasters, Kettles	2 - 10 mG	Suburban transmission line: . Under the line . 10 m away	 2 - 30 mG 0.5 - 10 mG
PCs, Laptops	2 - 20 mG	High voltage transmission line: . Under the line . Edge of Easement	 10 - 200 mG 2 – 50 mG
Electric Stoves, Electric Blankets	2 - 30 mG	Underground Cables	5 - 200 mG

Source: (Transgrid 2016 & ARPANSA 2006)

Domestic Appliances

- The Electric Field close to typical domestic appliances is around 10 V/m. At the surface of an electric stove or electric blanket, Electric Field strength can reach 500 V/m.

Power Sources

- Directly under high voltage transmission lines, Electric Field strength can range up to 10 kV/m.
- Near power source underground cabling, Electric Field strength is typically negligible, due to the shielding attenuation of cable insulation and the intervening ground soil.

In the present instance, it is noted that the proposed BESS facility to Transgrid Sub-station is via an underground cable.

7.3 EMF Guidelines – Magnetic Field Exposure Limits

ARPANSA (the Australian Radiation Protection and Nuclear Safety Agency) advises that …

- *"On balance, the scientific evidence does not indicate that exposure to 50 Hz EMFs found around the home, the office or near power lines is a hazard to human health".*

  and

- *"The majority of scientists and Australian radiation health authorities in particular, do not regard chronic exposure to 50 Hz EMFs at the levels commonly found in the environment as a proven health risk. Moreover, the evidence we have is inconclusive and does not allow health authorities to decide whether there is a specific Magnetic Field level above which chronic exposure is dangerous or compromises human health".*

The broad consensus therefore amongst the Australian scientific community, and indeed internationally, is that adverse health impacts have not been established, but the possibility cannot be ruled out. The logical outcome of this situation is a cautionary approach, which will be adopted in the design of the proposal.

The scientific research surrounding the health impacts of EMFs was previously focussed on Electric Fields. Currently, most interest and research centres on the impacts of Magnetic Fields.

NHMRC (IRPA) & ARPANSA

In November 1989, the National Health and Medical Research Council (NHMRC) recommended the following daily exposure limits relevant to 50/60 Hz Electric and Magnetic Fields:

- 5,000 mG for Occupational Exposure and 1,000 mG for General Public exposure.

These limits were identical to the Interim Guidelines adopted earlier that year by the International Radiation Protection Association (IRPA). The above Australian Exposure limits have since been rescinded by the NHMRC and have been undergoing ongoing review by ARPANSA.

ARPANSA released a then new draft standard covering EMF exposure limits in December 2006.

ICNIRP & IEEE

In March 1998, the International Commission on Non-Ionizing Radiation Protection (ICNIRP) published revised guidelines (updated in 2010) for limiting exposure to EMF. These have been recognised by the World Health Organisation. The institute of Electrical and Electronics Engineers (IEEE) published their own set of EMF exposure limits in 2002.

Recent Standards/Guidelines

The most recent ARPANSA and ICNIRP publications providing exposure limits relevant to the proposed BESS are:

- Australian Radiation Protection and Nuclear Safety Agency (ARPANSA), 2021. *Standard for Limiting Exposure to Radiofrequency Fields – 100 kHz to 300 kHz*, Radiation Protection Series S-1 (Rev.1).
- International Commission on Non-Ionizing Radiation Protection (ICNIRP), 2020a. *ICNIRP guidelines for limiting exposure to electromagnetic fields* (100 KHz to 300 GHz), Health Physics, 118(5):483–524.
- International Commission on Non-Ionizing Radiation Protection (ICNIRP), 2020b. *ICNIRP Statement Principles for Non-ionizing Radiation Protection*, Health Physics, 118(5):477–482.

The exposure limits prescribed by the above guidelines have been provided in **Appendix B.** The relevant reference level quantities are expressed via the incident Electric Field strength, incident Magnetic Field strength, incident Power Density and incident Energy Density (Uinc). The exposure periods are 30 minutes for whole-body exposure and 6 minutes for local exposure.

Prior to the publication of the **Appendix B** exposure limits, which require analysis relevant to a specific assumed exposure period, a simplified set of peak limiting Magnetic Field strengths, expressed as units of mG, obtained from the standards have been reproduced in **Table 19**.

Table 19 Australian and International Magnetic Field Exposure Limits

Exposure Class	NHMRC	ARPANSA	ICNIRP	IEEE
Public Exposure				
Normal	na	1,000	9,040	1,000
Controlled Activity	na	3,000	na	na
Up to 24 hours	1,000	na	na	na
A few hours per day	10,000	na	na	na
Limbs	na	na	758,000	na
Occupational Worker Exposure				
Normal	na	5,000	27,100	5,000
Controlled Activity (head)	na	15,000	na	na
Controlled Activity (other)	na	18,000	na	na
Whole working day	5,000	na	na	na
2 hours per day	50,000	na	na	na
Limbs	250,000	na	758,000	na

7.4 Project EMF

It is a Project Commitment that the Project's electrical equipment will comply with relevant ARPANSA and ICNIRP Standards for exposure to electromagnetic radiation.

As a result, the magnitude of the EMFs from all equipment types, in particular their Magnetic Fields, will be highly localized and should remain well below the exposure limits found in the Australian and International guidelines shown in **Table 19**.

As a general observation, it is not expected that the SolBank units themselves would be associated with measurable EMFs. The principle of a Li-ion battery is the chemical reaction that occurs on the electrodes of the individual battery cells within the unit which is then converted to electricity. Such chemical reactions do not produce radiation, including EMF radiation. However, the battery cells are used to power the remaining equipment within the BESS facility (inverters, etc) which do have the potential to generate measurable, albeit small, amounts of EMNF radiation.

Reference is also made to the following US EPRI-funded study of EMFs in the frequency range 0 Hz and 3 GHz at two large-scale solar facilities operated by the Southern California Edison Company in Porterville, CA, and San Bernardino, CA. The study included inverters which are relevant to the proposed Panorama BESS facility

- Tell, R.A., Hooper, H.C, Sias, G.G, Mezei, G., Hung, P. and Kavet, R., *"Electromagnetic Fields Associated with Commercial Solar Photovoltaic Electric Power Generating Facilities"*, Journal of Occupational Environmental Hygiene, 2015 12(11) pp795-803.

The EPRI study included the measurement of static DC Magnetic Fields, power-frequency AC EMFs (up to 3 kHz), and radio-frequency EMFs (up to 3 GHz) and concluded the following:

- All measured DC Magnetic Fields were within the exposure limits established by IEEE and ICNIRP.
- The highest (DC) Magnetic Fields were measured adjacent to inverters and fuse boxes, with the EMF strength approaching 3,000 µT immediately adjacent to inverters, and 2,000 µT immediately adjacent to some fuse boxes.
- These levels attenuated quickly with distance – in fact they will attenuate with the cube of the distance from the source.
- None of the equipment surveyed exhibited significant power-frequency AC Electric Field levels, due to the housing and enclosures deployed in power generation facilities.
- The major sources of AC Magnetic Fields were AC power cables, inverters, transformers and switchgear, ranging up to a maximum of 100 µT adjacent to the relevant equipment.
- The principal sources of RF EMFs were the inverters, with the greatest magnetic flux density recorded at a single point on the surface of an inverter operating at near full output (40 µT).
- The greatest 5 kHz Electric Field strength was measured at the surface of the inverter (1.4 V/m).

On the basis of the above, the Magnetic Fields produced by all of the equipment within the proposed BESS facility Project should be comfortably below the exposure limits shown in **Table 19** even at close distances from the relevant equipment and certainly at "background" levels at the nearest relevant perimeter fence of the Project.

Inverter (Systems)

Modern grid-scale inverter systems are normally a dual component system comprising a large-scale inverter coupled with a step-up transformer. All such inverter systems contain high frequency switching electronics which emit electromagnetic radiation.

The proposed MV Project inverters have been designed to comply with the international standards and guidelines that ensure their conformance to performance criteria with respect to EMFs, including:

- UL 1741 and UL 1741 Sb, CSA 22.2 No.107.1-16, IEC 62109-1, IEC 62109-2, NEC 2020, IEEE 1547:2018. IEC 621165:2014.

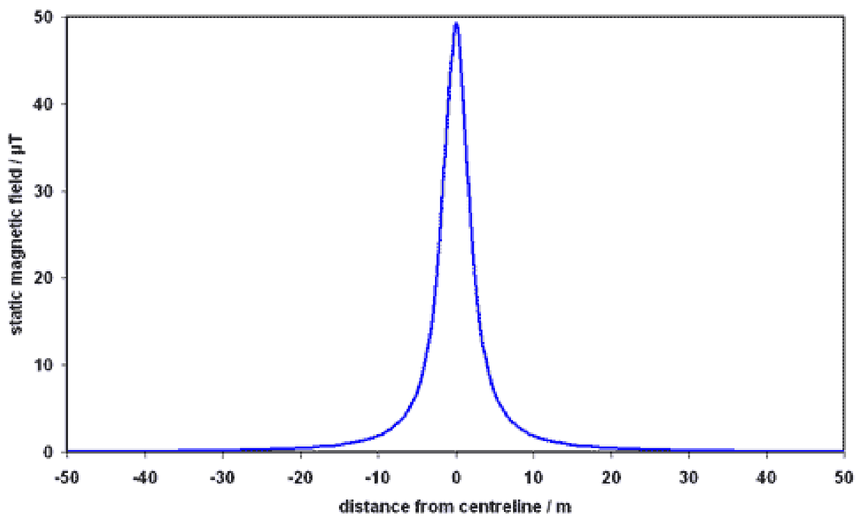
The step-up transformers within the inverters are essentially identical to those installed within residential distribution kiosks commonly found in public spaces. All of the inverter stations planned for the Project will be positioned at a sufficient distance from the external security fence such that no further assessment is necessary to confirm that the impact to the public will be negligible.

Underground Cabling

Underground cables always include a metal sheath which screens the Electric Field. Given the additional (Electric Field) shielding from the surrounding soil mass, an underground cable will only produce a discernible Magnetic Field.

A typical underground cable will produce a maximum Magnetic Field of about 50 µT at approximately 1 m above ground. As can be seen in **Figure 20** this falls rapidly to the sides of the cable. At distances beyond about 15 m, the Magnetic Field strength would be below 1 µT and indistinguishable from the earth's own Magnetic Field. The data is taken from PHE (Public Health England) Radiation Protection Division (formerly an amalgamation of the Health Protection Agency and National Radiological Protection Board).

Figure 20 Typical Underground Cable Magnetic Field Distance Attenuation



Substation (Transformers)

It is expected that the location of the Project substation along with its own security fencing will ensure that EMF exposure to the public is well below the limits found in the guidelines provided in **Table 19**.

The UK's National Grid Company conducted a 2004 substation survey for PHE involving measurements 0.5 m above ground level and one metre away from substation enclosures. Magnetic Field strength averaged 19 mG and became indistinguishable from background levels within 5 m.

Summary

As a consequence of the above considerations, the only measurable EMFs present outside the border of the Project site would almost entirely be from the existing transmission lines which run along the northeastern boundary of the proposal site.

Despite the above, and in line with the cautionary approach recommended in this study, in addition to compliance with the guidelines and standard shown in **Table 19**, the Project Applicant has made the following Project Commitment:

- The design of the facility will be developed in accordance with Energy Networks Association (ENA), *"ENA Policy Statement on Electric and Magnetic Fields",* adopted by the ESAA Board in 1991 and reconfirmed by the ENA EMF Committee, March 2006; and Nutall, K., Flanagan, P. and Melik, G., *"Prudent Avoidance Guidelines for Power Frequency Magnetic Fields"*, 23rd Annual Conference of the Australasian Radiation Protection Society, 1998; and
- The integrity of all Project site security fencing will be maintained through the lifetime of the Project to ensure adequate exposure separation for all members of the public.

Construction & De-Commissioning

During the Project construction phase, construction staff may be intermittently exposed to EMFs when working near selected equipment (eg inverters) once testing of the BESS facility begins. Potential EMF impacts are possible, in particular for sensitive workers (eg workers with implanted medical devices). They are however likely to be short term and negligible and will be managed according to the Project's Occupational Health & Safety Management Plan.

7.5 Electric Shock and Arc Flash

There is potential for the occurrence of electric shock to anyone entering any of the Project's electrical cabinets such as combiner boxes, disconnect switches, inverters, or transformers. This potential also exists for anyone coming in contact with voltages over 50 Volts.

A second source of electrical hazard is a so-called "arc flash", which is a sudden burst energy that can occur in a short circuit situation. Arc flashes cause both a flash of heat and a localised shockwave, both of which can cause serious injury.

Properly equipped on-site facility technicians will have received training to safely install, test and repair all relevant equipment, but there is always some risk of injury when hazardous voltages and/or currents are present.

The Engineering Operation and Maintenance Management Plan for the facility will include all measures aimed at managing these risks, including specific targeted measures detailed in the Project Emergency Response Plan:

- Adequate warning signs throughout the facility, based on the level of danger posed by the relevant voltages and current involved, especially focussed on first responders in an emergency situation, eg firefighters attending the site, hazmat attendees, etc;
- Instructions available to all authorised personnel (including firefighters, etc) regarding the level of personal protective clothing required to be worn, respiratory protection required, minimum evacuation zone distances, etc;
- Instructions covering safe shut-down and isolation procedures for all equipment to be readily available for emergency service personnel as well as on-site staff;
- Security fencing around individual equipment items as required (based on risk principles) and the entire site itself, properly maintained throughout the life of the Project, all with adequate hazard warning signs; and
- A safety protocol for the site which prevents untrained individuals from inspecting, testing or repairing any aspect of the facility's electrical equipment and systems.

7.6 BESS EMF Hazard Risk Conclusion

This section has shown that:

- EMF fire risk issues can be adequately mitigated, for both the public and site workers.

On the basis of the Risk Matrix shown in **Table 6** SLR considers the residual risk associated with the BESS-related EMF hazard to be **LOW**, and hence adequately mitigated.

8.0 Conclusions and Recommendations

Preliminary Risk Screening has found that the quantity (in terms of storage and transport) of dangerous goods and associated potential hazards comply with the screening requirements of the ADG (Australian Code for the Transport of Dangerous Goods by Road and Rail", Edition 7.7, 2020) Code.

The Preliminary Hazard Analysis in this report found that the hazards warranting detailed assessment were:

- Hazards associated with Bushfire.
- Hazards associated with lithium-ion batteries in the BESS, specifically overheating and fire.

Bushfire hazards have been addressed in **Section 5**.

BESS-related hazards have been addressed **Section 6**.

EMI-related hazards have been addressed **Section 7**.

Section 5 of this report dealt with Bushfire Risk.

- The Bushfire Risk Assessment concludes that bushfire risk issues can be adequately mitigated. Accordingly, the Project will be adequately protected from the threat of a bushfire event.
- In relation to the Risk Matrix shown in **Table 6**, SLR considers the residual risk associated with bushfire fire hazard to be **LOW**, and hence adequately mitigated.

Section 6 of this report dealt with BESS-Related Risks.

- **Section 6** showed that BESS-related and other equipment-related fire risk issues can be adequately mitigated.
- Accordingly, the facility will not it itself pose an additional fire hazard that has the potential to increase the extent or severity of a bushfire event on surrounding property, people and the environment.
- Finally, the proposed BESS capacity can be comfortably accommodated within the site space with separation distances that provide adequate protection to personnel and property.
- In relation to the Risk Matrix shown in **Table 6**, SLR considers the residual risk associated with the BESS-initiated or other equipment-related fire hazard to be **LOW**, and hence adequately mitigated.

Section 7 of this report dealt with EMF-related Risk.

- **Section 7** demonstrated that EMF hazard issues can be adequately mitigated, for both the public and site workers.
- On the basis of the Risk Matrix shown in **Table 6**, SLR considers the residual risk associated with the EMF hazard to be **LOW**, and hence adequately mitigated.

It is the overall conclusion of this Hazard Analysis Report that the risks associated with the proposed development would be adequately managed, with suitable engineering controls, operational controls and management controls in place.

It is expected that all of the above controls will be enabled by the post-approval development of comprehensive management plans covering the following:

- Bushfire Emergency Management Plan (BEMP)
- Fire Safety Study (FSS).
- Emergency Response Plan (ERP).

Appendix A Vegetation Descriptions from AS3959:2018

Updated Hazard and Risk Assessment

Panorama Battery Energy Storage System (BESS) – SSD 50587460

Panorama BESS SubCo Pty Ltd

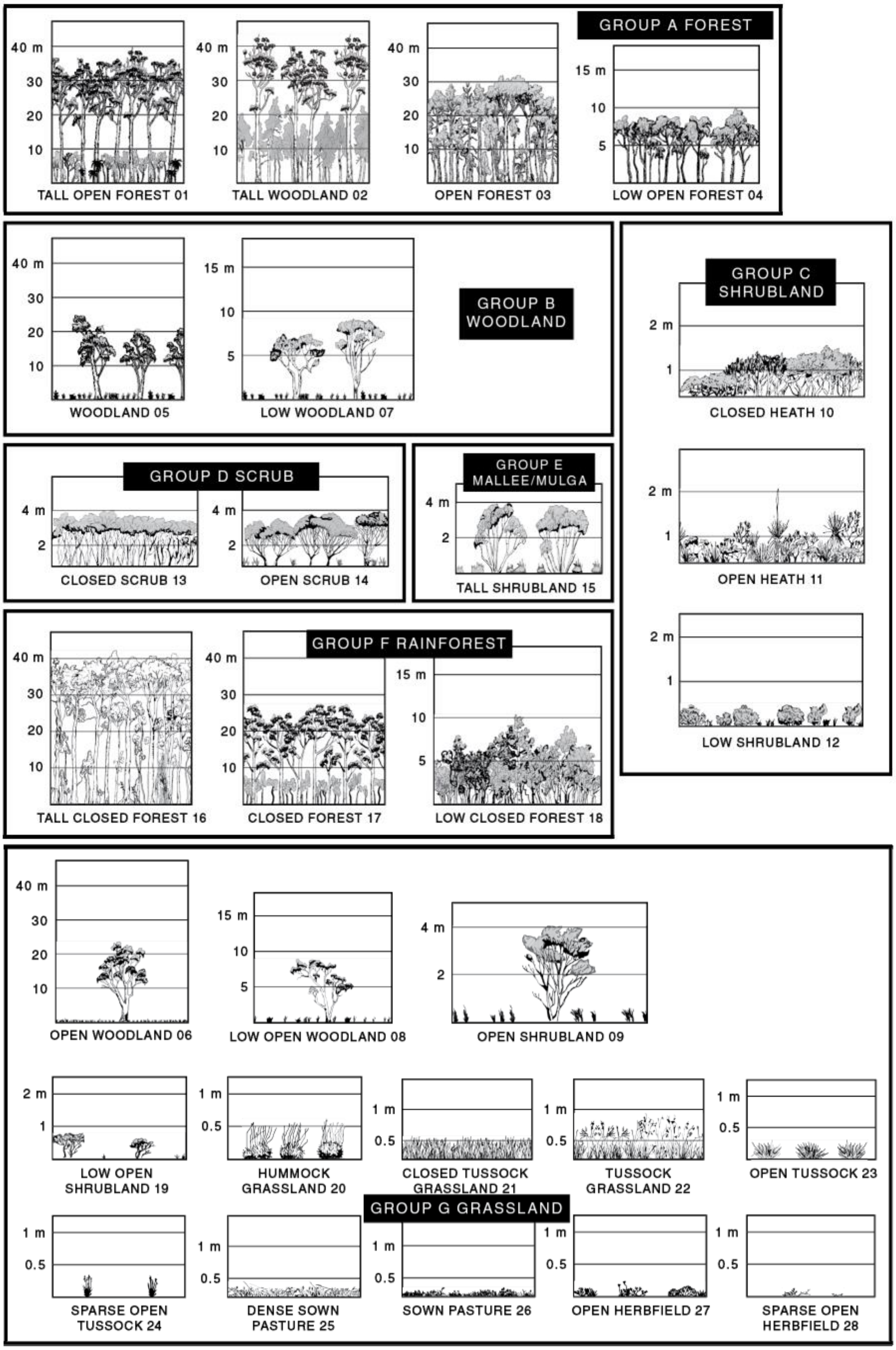
SLR Project No.: 660.30234.00007
Revision: R06-v1.1

13 May 2025

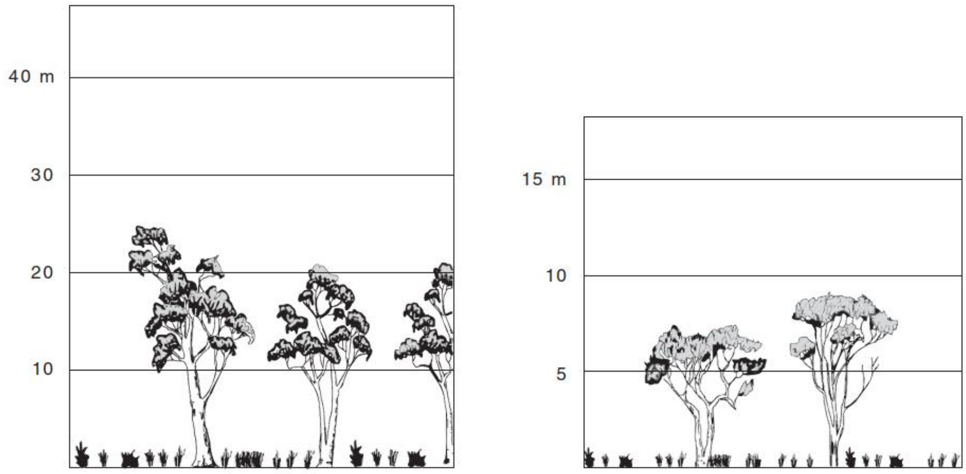
AS3959:2018 - Table 2.3 CLASSIFICATION OF VEGETATION

Vegetation classification	Vegetation type	Figure No. in Figures 2.4(A) to 2.4(H)	Typical characteristics
A Forest	Tall open forest Tall woodland	01 02	Trees over 30 m high; 30%–70% foliage cover (may include understorey ranging from rainforest species and tree ferns to low trees and tall shrubs). Found in areas of high reliable rainfall. Typically dominated by eucalypts with a sub-dominant tree layer.
	Open forest Low open forest	03 04	Trees up to 30 m high; 30%–70% foliage cover (may include understorey of sclerophyllous low trees or shrubs). Typically dominated by eucalypts, melaleuca or callistemon (may include riverine and wetland environments) and callitris. Includes eucalypt plantations.
	Pine plantation	Not shown	Trees 30 m in height at maturity, generally comprising Pinus species or other softwood species, planted as a single species for the production of timber.
B Woodland	Woodland Low woodland	05 07	Trees up to 30 m high; 10%–30% foliage cover dominated by eucalypts and/or callistris with a prominent grassy understorey. May contain isolated shrubs.
C Shrubland	Closed (low) heath Open heath	10 11	Found in wet areas and/or areas affected by poor soil fertility or shallow soils. Shrubs 1 m–2 m high. Wet heaths occur in sands adjoining dunes of the littoral (shore) zone. Montane heaths occur on shallow or water-logged soils.
	Low shrubland	12	Shrubs <2 m high; greater than 30% foliage cover. Understoreys may contain grasses. Acacia and Casuarina often dominant in the arid and semi-arid zones.
D Scrub	Closed scrub (Tall heaths)	13	Found in wet areas and/or areas affected by poor soil fertility or shallow soils; >30% foliage cover. Dry heaths occur in rocky or sandy areas. Shrubs >2 m high. Typical of coastal areas and tall heaths up to 6 metres in height. May be dominated by Banksia, Melaleuca or Leptospermum with heights of up to 6 metres.
	Open scrub	14	Shrubs greater than 2 m high; 10%–30% foliage cover with a mixed species composition.
E Mallee/Mulga	Tall shrubland	15	Vegetation dominated by low trees or tall shrubs (especially eucalypts and acacias) some with a multi-stemmed habit (mallee); usually greater than 2 m in height; <30% foliage cover. Understorey of widespread dense low shrubs or sparse grasses and generally found in the arid and semi-arid zones, but not within the rangelands.
F Rainforest	Tall closed forest Closed forest Low closed forest	16 17 18	Trees >90% foliage cover; understorey may contain a large number of species with a variety of heights. Not dominated by eucalypt species.
G Grassland	Open woodland Low open woodland Open shrubland Low open shrubland Hummock grassland Closed tussock grassland Tussock grassland Open tussock Sparse open tussock Dense sown pasture Sown pasture Open herbfield Sparse open herbfield	06 08 09 19 20 21 22 23 24 25 26 27 28	All forms (except tussock moorlands), including situations with shrubs and trees, if the overstorey foliage cover is less than 10%. Includes pasture and cropland. NOTE: Grassland managed in a minimal fuel condition and non-curing cropland is regarded as low threat vegetation for the purposes of Clause 2.2.3.2.
H Tussock Moorland	Tussock Moorland	Not shown	All forms of vegetation where the overstorey is dominated by the species Buttongrass (*Gymnoschoenus sphaerocephalus*). Only occurs as a significant vegetation type in Tasmania.

AS3959:2018 – Figure 2.4(A) Classification of Vegetation - SUMMARY



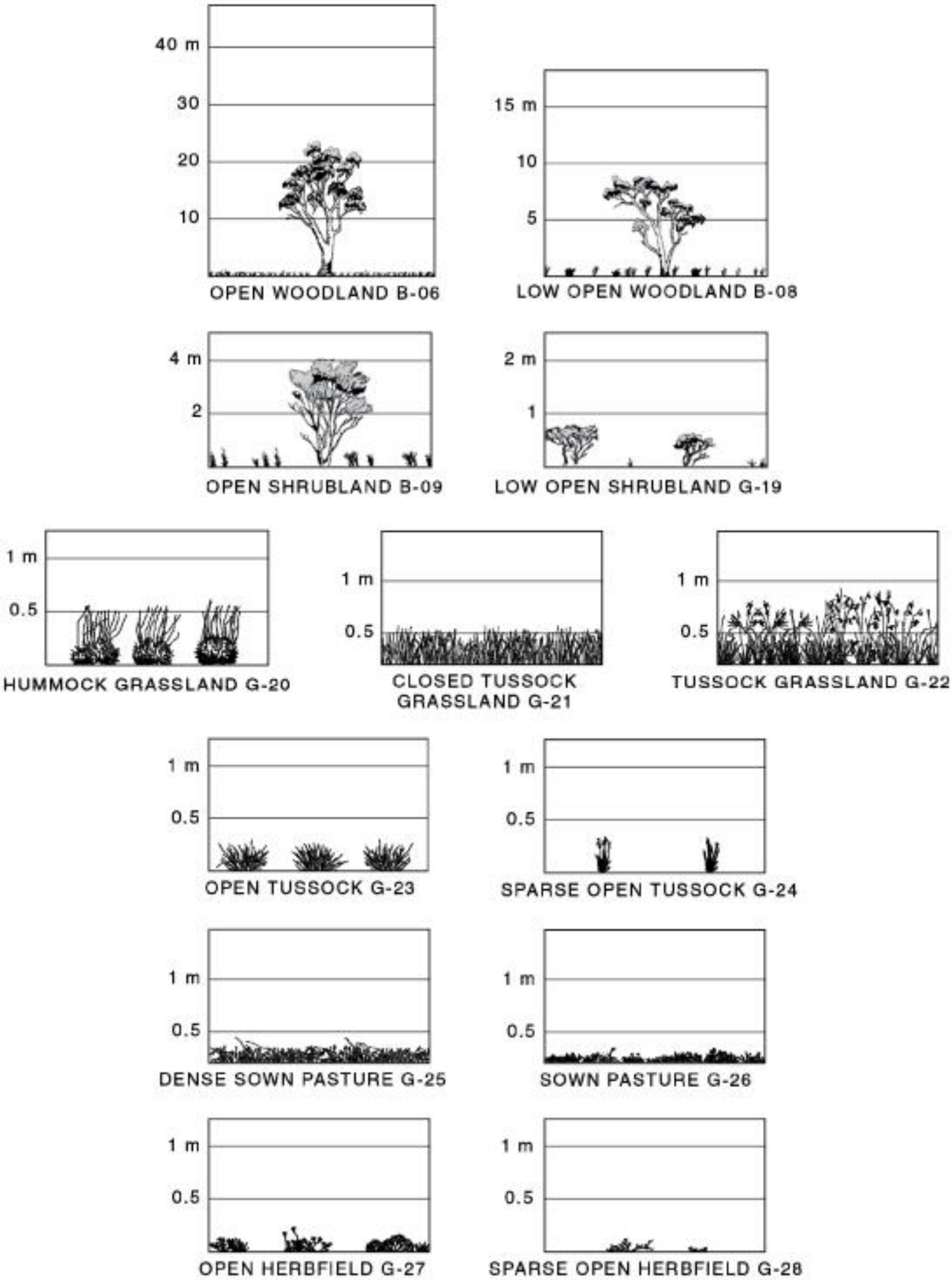
AS3959:2018 – Figure 2.4(C) Classification of Vegetation – WOODLAND (Group B)



WOODLAND B-05

LOW WOODLAND B-07

AS3959:2018 – Figure 2.4(H) Classification of Vegetation – GRASSLANDS (Unmanaged)



Appendix B ARPANSA EMF Exposure Limits

Updated Hazard and Risk Assessment

Panorama Battery Energy Storage System (BESS) – SSD 50587460

Panorama BESS SubCo Pty Ltd

SLR Project No.: 660.30234.00007

Revision: R06-v1.1

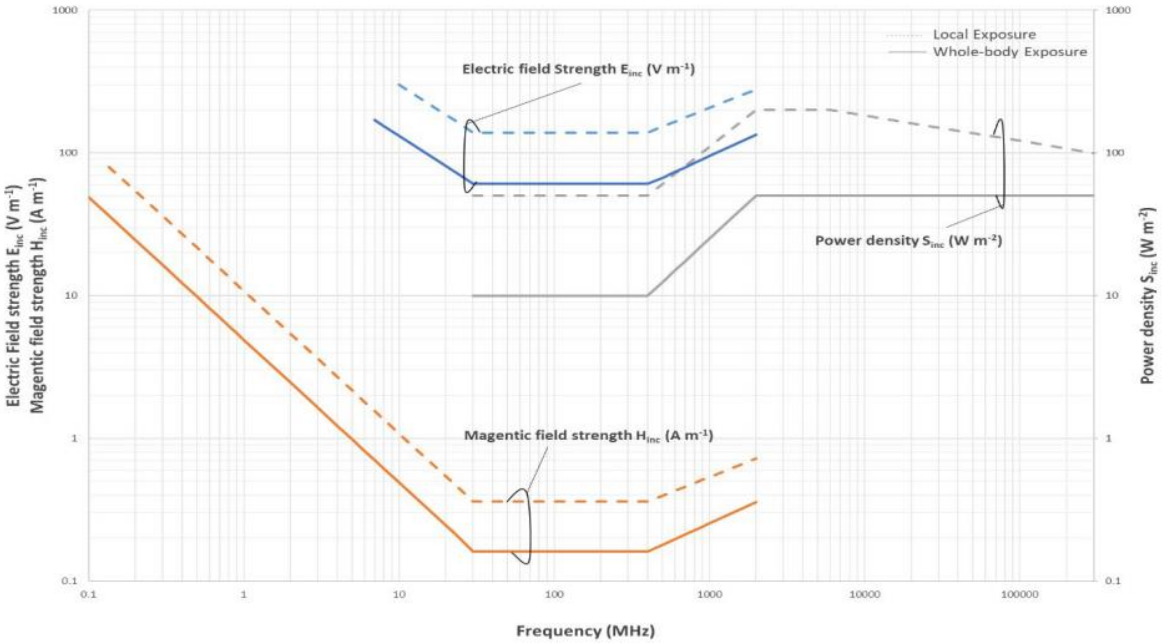
13 May 2025

Reference:

- Australian Radiation Protection and Nuclear Safety Agency (ARPANSA), 2021. *Standard for Limiting Exposure to Radiofrequency Fields – 100 kHz to 300 kHz*, Radiation Protection Series S-1 (Rev.1).

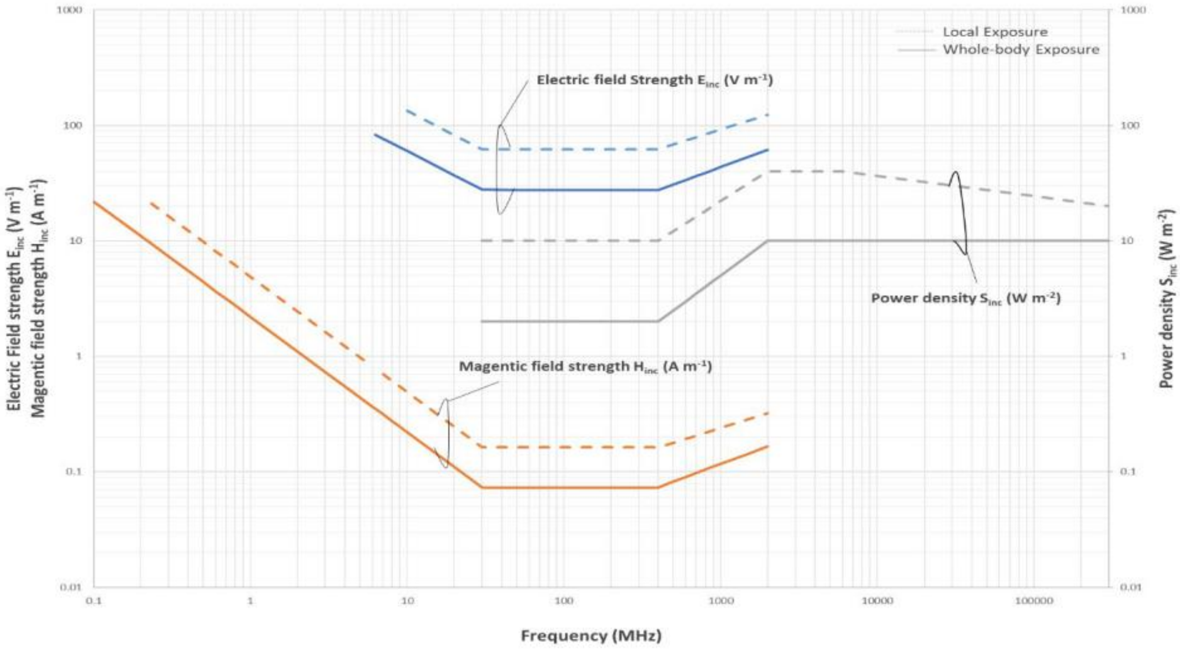
ARPANSA Radiation Protection Series S-1 (Rev.1)

Figure 2
Occupational reference levels for
whole body (averaged over 30 min) and local (averaged over 6 min) exposure
to incident electric and magnetic field strength (100 kHz - 2 GHz) and
incident power density (>30 MHz – 300 GHz) (unperturbed rms values)



ARPANSA Radiation Protection Series S-1 (Rev.1)

Figure 3
General public reference levels for
whole body (averaged over 30 min) and local (averaged over 6 min) exposure
to incident electric and magnetic field strength (100 kHz - 2 GHz) and
incident power density (>30 MHz – 300 GHz) (unperturbed rms values)



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