Preliminary Hazard Analysis

Blind Creek Solar Farm

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Acronyms and abbreviations

AC	alternating current
APZ	Asset Protection Zone
BESS	Battery Energy Storage System
CCTV	Closed-circuit television
DC	direct current
DPE	Department of Planning and Environment (NSW)
EIS	Environmental impact statement
EMFs	Electric and magnetic fields
EP&A Act	*Environmental Planning and Assessment Act 1979* (NSW)
EP&A Regulation	*Environmental Planning and Assessment Regulation 2000* (NSW)
FHA	Final Hazard Analysis
FRNSW	Fire and Rescue NSW
ha	hectares
km	kilometres
kV	kilovolts
LEP	Local Environment Plan
LGA	Local Government Area
m	metres
MW	Megawatt
MWh	Megawatt hours
O&M	Office and Maintenance
PCU	Power Conversion Unit
PHA	Preliminary Hazard Analysis
PPE	Personal protective equipment
RFS	(NSW) Rural Fire Service
SEARs	Secretary's Environmental Assessment Requirements
SEPP 33	*State Environmental Planning Policy No. 33 – Hazardous and Offensive Development and Applying*
SFARP	So Far As Reasonably Practicable
WHS	*Work Health and Safety*

1. Introduction

1.1 Background

The Blind Creek Solar Farm (the Project) is located along Tarago Road, approximately 8 kilometres (km) north of Bungendore, NSW, and 50km east of Canberra, Australian Capital Territory (ACT). The proposed Blind Creek Solar Farm (BCSF) involves the construction, operation and decommission of a photovoltaic (PV) solar array with a capacity to generate approximately 350-400MW that would supply electricity into the national electricity grid. When built, the solar farm will produce up to 735,000 Mega Watt hours (MWh) per year.

The Proponent, Blind Creek Solar Farm Pty Ltd , is a farmer-led consortium made up of local landholders and renewable energy experts with strong historical and ongoing personal connections to the Project site and local area.

Of the 1,026 hectares (ha) Project site, the development footprint would represent approximately 680-700ha which would be developed for the solar farm and associated infrastructure. The Project site is primarily zoned RU1 Primary Production and C3 Environmental Management under the *Palerang Local Environmental Plan 2014.*

NGH is preparing an Environmental Impact Statement (EIS) on behalf of the Proponent. The EIS is being prepared in accordance with Part 4 of the NSW *Environmental Planning and Assessment Act 1979* (EP&A Act) and Schedule 2 of the *Environmental Planning and Assessment Regulation 2000* (EP&A Regulation).

This Preliminary Hazard Analysis (PHA) has been prepared to address the Planning Secretary's Environmental Assessment Requirements (SEARs) for the Project, specifically:

> *A Preliminary Hazard Analysis (PHA) must be prepared in accordance with Hazard Industry Planning Advisory Paper No. 6 – Guidelines for Hazard Analysis (DoP, 2011) and Multi-Level Risk Assessment (DoP, 2011).*

The Project includes two options for the Battery Energy System Storage (BESS):

- Option 1: DC-coupled distributed batteries. In this option the batteries are placed next to the power conversion units (inverters) that are distributed across the site.
- Option 2: AC-coupled BESS Facility. In this option all energy storage infrastructure is located in its own facility adjacent to the onsite substation.

The BESS option will be selected during detailed design and based on economic considerations.

1.2 Objectives

The objective of this PHA is to develop a comprehensive understanding of the hazards and risks associated with the operation of the BESS for the BCSF and the adequacy of safeguards.

1.3 Scope

This PHA is to address the SEARs for Project and be in accordance with the *Hazard Industry Planning Advisory Paper No.6 – Guidelines for Hazard Analysis* (DoP, 2011) (HIPAP 6) and *Multi-Level Risk Assessment* (DoP, 2011) (MLRA). This PHA provides a basis for an informed judgment to be made on the acceptability of the Blind Creek Solar Farm BESS.

This PHA has assessed both options for the BESS, DC-coupled distributed batteries and AC-coupled Energy Storage Facility with the use of lithium-ion batteries.

1.4 Exclusion and limitations

This PHA is based on concept design, industry design standards and guidelines, and standard safety controls. Some information is limited as complete data on the design and precise controls is not available at the concept design stage.

The scope of this PHA does not include:

- A transport route analysis since the proposed development does not exceed transport volumes of dangerous goods exceeding the *State Environmental Planning Policy No. 33 – Hazardous and Offensive Development and Applying* (SEPP 33) guideline thresholds (see EIS Section 9.9).
- Assessment of other risks, including, but not limited to, aviation safety, health, landslide/subsidence, telecommunications, electromagnetic field and bushfire.
- Quantitative risk data as BESS technology is relatively new and data is not yet available.
- Updating the PHA to a Final Hazard Analysis (FHA) during the design stage.

It is noted that safety controls, including fire suppression systems, will develop as the industry evolves and in response to safety incidents such as the recent battery fire in Victoria. At the time of preparing this report, there was no available information relating to the Victorian battery fire incident and recommended improvements to safety controls.

2. Site location and description

2.1 Site location

The BCSF is located approximately 8km north of Bungendore, within the Queanbeyan-Palerang Local Government Area (LGA). The Project will use the Blind Creek track, a private road currently used by heavy vehicles for the Paragalli Sands quarrying operations. Tarago Road is a sealed public road, presently being upgraded to better cope with existing heavy vehicles, linking Bungendore Road and Braidwood Road. The main site access will be via the Tarago Road at an existing entrance on Lot 1 DP1154765, hereafter called the Blind Creek Entrance. The Blind Creek track will connect to the internal access track within the Project site.

The Project's development site is the land that would be used for the construction and operation of the solar farm and has a total approximate area of 645ha. This comprises the land required to construct the facility connection substation, the solar array, BESS, proposed internal access tracks and other onsite ancillary infrastructure. The intersection of the access point and Currandooley Road is proposed to be upgraded to facilitate construction vehicle movements.

2.2 Surrounds

Queanbeyan is the closest major regional centre to the Project site. According to the 2016 Census (ABS, 2016), Queanbeyan accommodated 57,331 people and has a number of facilities, including hospitals, banks, a church, and primary and secondary education institutions.

The nearby town of Bungendore has a population of 4,178 (ABS, 2016). The Project site is located on the edge of the Lake George, and within the Lake George locality, which had a population of 98 people in 2016 (ABS, 2016). Lake George is the most significant natural feature in the locality.

2.3 Sensitive receivers

There are five involved sensitive receivers and 22 potential non-involved sensitive receivers within 2km of the Project site (of these six are within 2km of the development footprint). The closest non-involved residential receiver is 812m south of the entrance to the Project site. The closest non involved industrial sensitive receiver is approximately 528m from the nearest boundary of the Project site. This receiver is also closest to the BESS Facility.

3. Project description

3.1 Overview

The proposed BCSF involves the construction, operation and decommissioning of a 350MW AC solar farm and associated infrastructure. Of the 1,026ha Project site, the development footprint would represent approximately 680-700ha which would be developed for the solar farm and associated infrastructure. An existing TransGrid 330Kv transmission line traverses the far southern portion of the Project site and would be used to connect the solar farm to the national electricity grid. The Project site will be accessed off Tarago during construction and operation.

The Project layout is present in Figure 3-1 and includes:

- Up to 850,000 PV solar modules mounted on a single axis tracking system.
- Up to 85 inverters and transformers, containerised in modified shipping containers, also known as Power Conversion Units ('PCUs').
- Steel mounting frames for the tracking system most likely with pile-driven foundations. Screw pile foundations are possible but less likely. Some piles may require pre-drilling and grouting if bedrock is encountered (not expected at this site).
- An onsite 330kV substation containing up to four transformers and associated switchgear to facilitate connection to the national electricity grid. This will cut into the existing 330kV transmission line that passes through the site.
- Energy storage devices and equipment, including up to 300MW of lithium-ion batteries, with inverters (PCUs). The batteries may be configured in either a DC-coupled format by distributing batteries through the site, or in an AC-coupled layout by placing all batteries in a purpose-built facility.
- Underground power cabling to connect solar modules, combiner boxes, PCUs and batteries.
- Underground auxiliary cabling for power supplies, data services and communications.
- Buildings to accommodate a site office, switchgear, protection and control facilities, maintenance facilities, and staff amenities.
- Internal access tracks for construction, operation, and maintenance activities.
- Perimeter security fencing.
- Native vegetation planting to provide visual screening for specific receivers if any are required.

The construction phase of the Project would take about 12 – 18 months. The peak construction period would be about 6 to 9 months. Approximately 300 workers would be required during peak construction.

The solar farm is anticipated to be operational for about 30 years. Around five fulltime equivalent operations and maintenance staff and service contractors would operate the facility.

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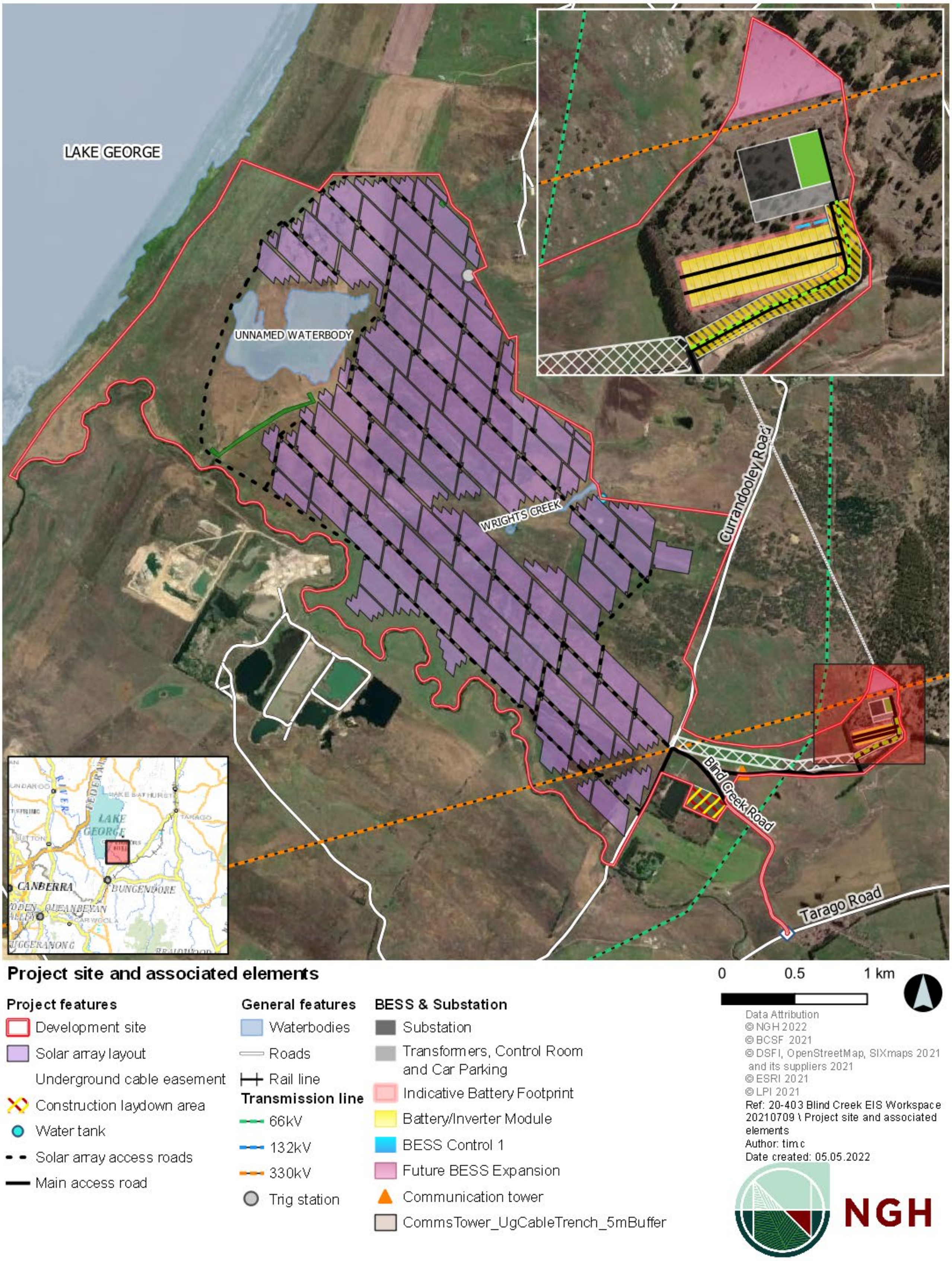

Figure 3-1 Project layout

3.2 Battery storage

The BCSF Project includes an allowance for energy storage options to firm the generating capacity. Large batteries will be used for this purpose that will enable storage and release of energy that is generated onsite, traded in accordance with energy market trends.

The batteries may be actively cooled by internal systems. They would be temperature monitored, and the automated control system would stop their operation if required. Depending on the technology, suppression systems may be built in to mitigate the risk of extreme overheating. Further still, this equipment would be surrounded by an Asset Protection Zone (APZ) including gravel surfacing to minimise the risk of fire escaping from the project and the risk of external fire affecting the site.

Subject to detailed design and economic considerations, the project is seeking approval for up to 300 MW with between 2 and 9 hours of full export capacity. This will be realised through the use of Lithium-ion batteries.

The physical layout of the batteries on the site will be specified during the detailed design phase, but two plausible configurations have been identified. As outlined below.

3.2.1 DC-coupled Distributed Batteries

In this format, the Project will make use of 'DC-DC converters' . These are devices that allow the batteries and solar panels to share a common inverter. Hence, the batteries would be placed beside the PCU in each sub-array. The number of batteries would be selected to match the specifications of the converters, and the inverter devices in the PCUs.

The batteries have similar dimensions to a half-sized shipping container. BCSF would include up to four batteries in each sub-array, or up to 200 batteries across the entire site. To facilitate this, up to 12 DC-DC converters would be included per sub-array, or up to 600 converters across the site. The converters would only occupy a small area; less than a half-sized shipping container (i.e - 20ft long) per sub-array.

In all, the impact of incorporating energy storage in this format would be equivalent to including an additional 2.5 full-sized containers per sub-array, or up to 125 full-sized containers across the entire solar array. Figure 3-2 shows an example of what the sub-array might look like if this option is pursued.

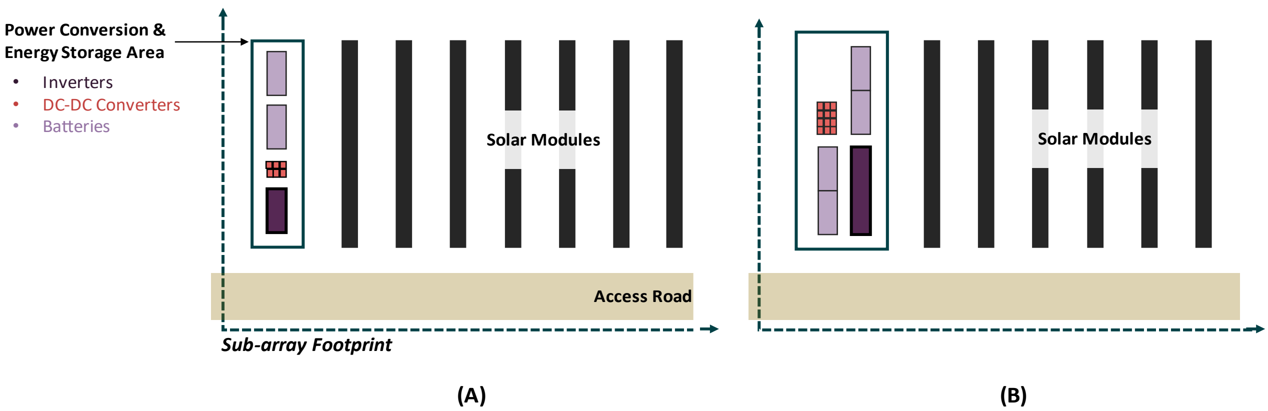

Figure 3-2 Indicative placement of all power conversion components and battery storage within the sub-arrays at Blind Creek Solar Farm, for a DC-coupled configuration. (A) shows the layout if single-inverter PCUs are used and (B) is the case where pairs of inverters are containerised.

3.2.2 AC-coupled Energy Storage Facility

An alternative for the use of DC-DC converters and the distribution of batteries through the array, is that all energy storage infrastructure be co-located in its own facility. This would be built nearby to the onsite substation, within a substantial APZ. In this space, groups of batteries would be paired with a PCU. Typically, the ratio would be 2 battery containers per PCU-container (equal size). The facility for this Project would hold up to 300 MW and up to 2 hours of full export capacity (600MWh). At two hours of duration, the facility would hold the equivalent of 60 units (each unit including a transformer, multiple inverters, multiple batteries, and medium voltage switchgear) and would have a footprint of up to 3ha. Figure 3-3 shows the indicative placement of this facility, if this approach is pursued. Figure 3-4 shows an example of an AC-couple storage facility.

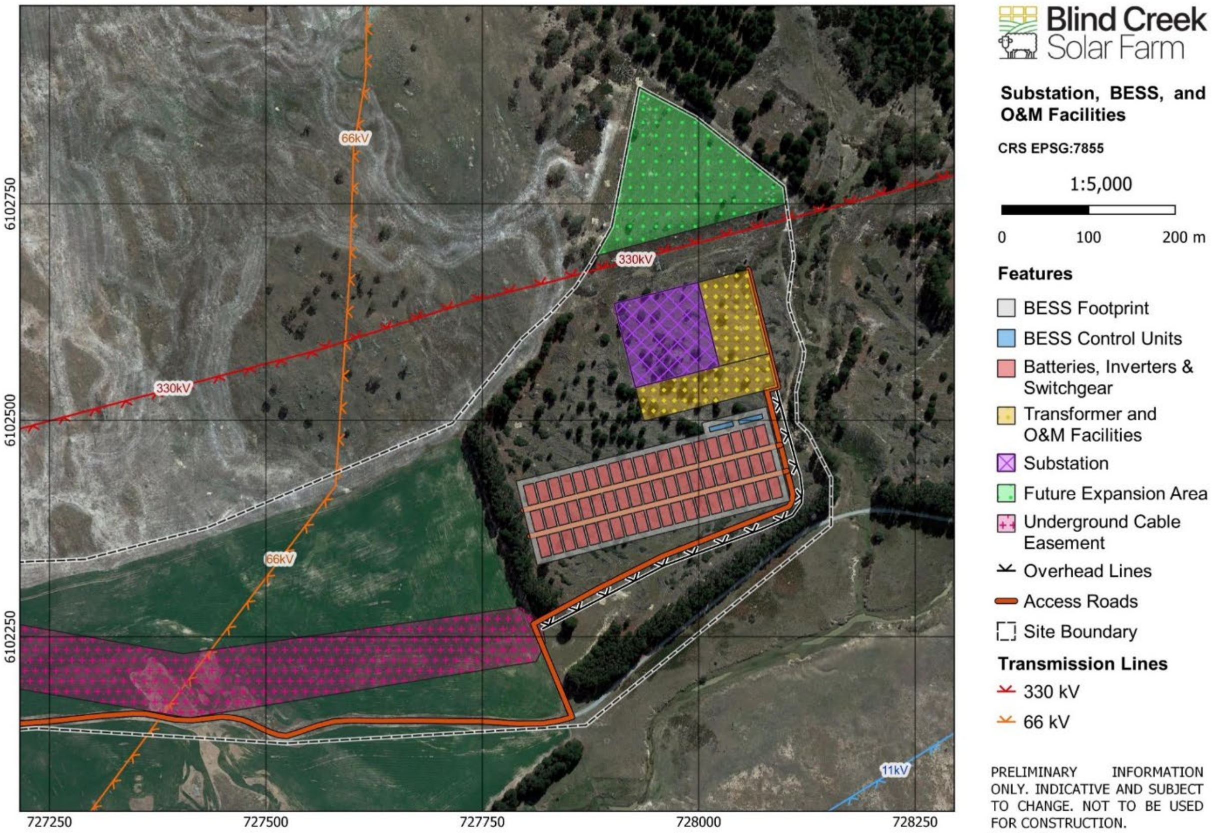

Figure 3-3 Indicative placement of the battery storage facility nearby to the onsite substation at Blind Creek Solar Farm, for an AC-coupled configuration. Precise layout is subject to detailed design.

Figure 3-4 Example of an AC-coupled energy storage facility. The Hornsdale Power Reserve is 100MW / 129MWh and has a footprint of less than one hectare (Source Hornsdale Power Reserve).

4. Preliminary hazard analysis

4.1 PHA methodology

The methodology undertaken to prepare this PHA includes:

- Identification of the nature and scale of all hazards at the Project, and the selection of representative incident scenarios.
- Analysis of the consequences of these incidents on people, property, and the biophysical environment.
- Evaluation of the likelihood of such events occurring and the adequacy of safeguards.
- Calculation of the resulting risk levels of the facility.
- Comparison of these risk levels with established risk criteria and identification of opportunities for risk reduction.

A schematic of the hazard analysis process is included below in Figure 4-1.

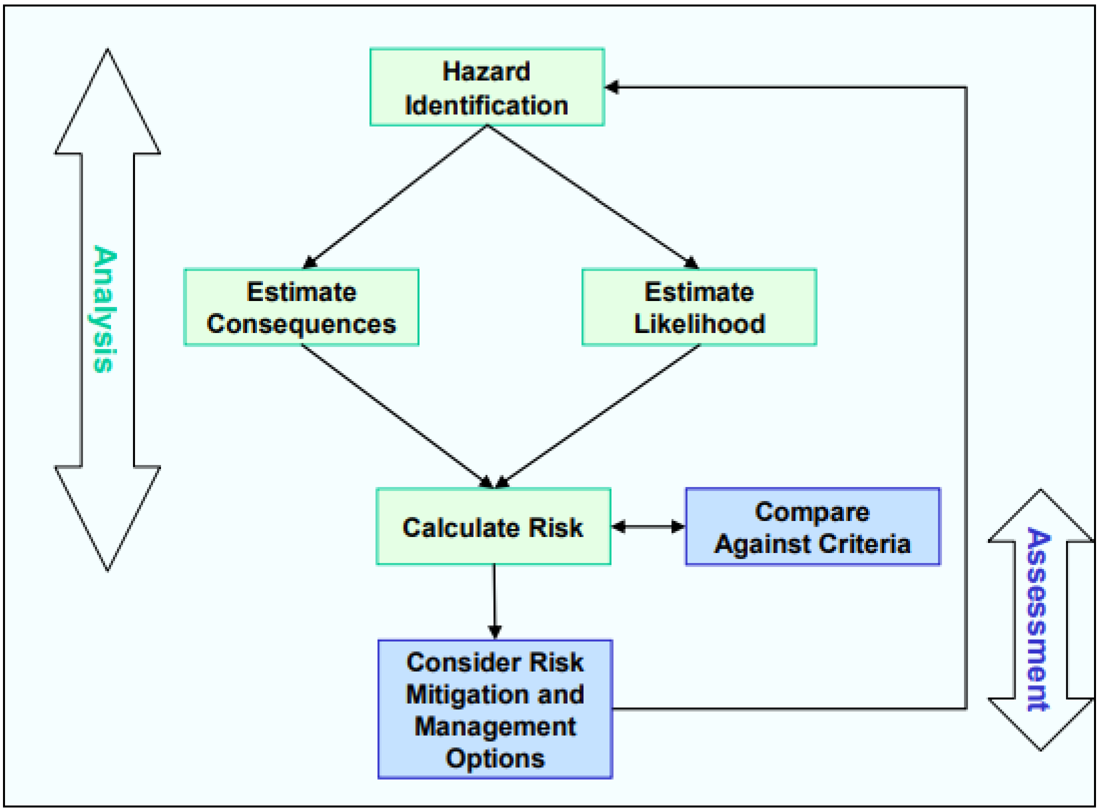

Figure 4-1 Basic methodology for hazard analysis (Source: HIPAP 6)

4.2 Hazard identification

Hazard identification includes the systematic identification of possible hazards, both on-site and off-site including:

- BESS activities and infrastructure
- Type of equipment
- Hazardous materials present
- Natural events such as floods, cyclones, earthquakes, or lightning strikes
- Hazardous events on neighbouring sites.

The identified BESS hazards and events are presented in Table 4-1.

Table 4-1 Identified hazards and events

Hazard	Event
Electrical	Exposure to voltage
Arc flash	Release of energy
Electric and Magnetic Fields (EMF)	Exposure to EMF
Fire	Infrastructure fire
Chemical	Release of hazardous materials
Reaction	Battery thermal runaway
External factors	Vandalism, flooding

4.3 Consequence analysis

Consequence

For each identified event, the resulting consequence was qualitatively described. These include impacts to personnel (e.g., fatality/injury), environment and/or assets.

Likelihood

Using a qualitative approach, the likelihood of an event was estimated using the category scale shown in Table 4-2. The likelihood ratings were assigned based on quantitative knowledge of historical incidents in the industry. The likelihood ratings were assigned accounting for the initiating causes, resulting consequences with controls (prevention and mitigation) in place.

Table 4-2 Likelihood category

Category	Description
1. Extremely Unlikely	Never heard of in the industry, not realistically expected to occur
2. Very Unlikely	Heard of in the industry, but not expected to occur
3. Unlikely	Could occur in the next 10 years
4. Likely	Could occur in the next year

4.4 Hazard register

The identified hazards, events, applicable infrastructure and the relationships with causes, consequences, controls, and likelihood ratings are summarised in the hazard register. Information contained in the hazard register is provided in Table 4-3.

The hazard register for the BESS units is presented in Table 4-4. Both options for BESS including DC coupled distributed batteries and AC-coupled Energy Storage Facility has been considered in the hazard register. If any hazards or measures are specific to an option, it has been stated.

Table 4-3 Information used in hazard register

Column Heading	Description
Hazard	Description of the source of potential harm
Event	Description of mechanism by which the hazard potential is realised
Cause	Description of the potential ways in which the event could arise
Consequence	Description of consequences of the event and potential impact to people, environment and/or asset
Controls	Any existing aspects of the design which prevent and/or mitigate against the event and resulting consequences
Likelihood Rating	Likelihood rating assigned for the event accounting for the initiating causes, resulting consequences with controls in place

Table 4-4 BESS hazard register

ID	Hazard	Event	Cause	Consequence	Controls	Likelihood Rating
1	Electrical	Exposure to voltage	Short circuit/electrical connection failure • Faulty equipment • Incorrect installation • Incorrect maintenance • Human error during maintenance • Safety device/circuit compromised • Battery casing/enclosure damage	• Electrocution • Injury and/or fatality • Fire	• Equipment and systems will be designed and tested to comply with industry standards and guidelines • Engagement of reputable engineering and construction designers/contractors • Installation and maintenance will be done by suitably qualified and experienced personnel • Electrical lockout/tagout • Temperature monitoring and automated shutoff • Fire suppression system • Warning signs (electrical hazards, arc flash) • Emergency Response Plan • Fire Safety Plan • External assistance for firefighting (Fire and Rescue NSW; FRNSW & Rural Fire Service; RFS) • Use of appropriate Personal Protective Equipment (PPE) • Rescue kits (i.e. insulated rescue hooks) • Bury cables and pipe (if practicable), specific to DC option	Very Unlikely
2	Arc flash	Arc flash	• Incorrect procedure (i.e. installation/ maintenance) • Faulty equipment (e.g. corrosion on conductors) • Faulty design (e.g. equipment too close to each other) • Insulation damage • Human error during maintenance	• Burns • Injury and/or fatality • Exposure to intense light and noise • Arc blasts and resulting heat, may result in fires and pressure waves	• Equipment and systems will be designed and tested to comply with industry standards and guidelines • Engagement of reputable engineering and construction designers/contractors • Installation and maintenance will be done by suitably qualified and experienced personnel • Maintenance procedure (e.g. deenergize equipment; electrical lockout/tagout) • Preventative maintenance • Emergency Response Plan • Fire Safety Plan • External assistance for firefighting (FRNSW & RFS) • Warning signs (arc flash boundary) • Use of appropriate PPE for flash hazard	Very Unlikely

ID	Hazard	Event	Cause	Consequence	Controls	Likelihood Rating
3	EMF	Exposure to electric and magnetic fields	• Operations of power generation equipment	• High level exposure (i.e. exceeding the reference limits) may affect function of the nervous system (i.e. direct stimulation of nerve and muscle tissue and the induction of retinal phosphenes) • Personnel injury	• Location siting and selection (incl. separation distance) • Optimising equipment layout and orientation • Reducing conductor spacing • Incidental shielding • Balancing phases and minimising residual current • Equipment and systems will be designed and tested to comply with industry standards and guidelines • Exposure to personnel is short duration in nature (transient) • Physical warning signs (e.g. danger or restricted access)	Extremely Unlikely
4	Fire	Fire	• Escalated event from facility/facilities fire • Faulty equipment • Arc flash • External fire (e.g. bushfire, adjacent infrastructure)	• Injury/fatality • Asset damage	• Equipment and systems will be designed and tested to comply with the relevant international standards and guidelines, refer to measures listed in the Bushfire assessment of the EIS • Installation, operations and maintenance by trained personnel (e.g. reputable third party) in accordance with relevant procedures • Preventative maintenance (e.g. insulation, replacement of faulty equipment) • Installation of a reliable integrated fire detection and fire suppression systems (inert gas). • Design appropriate separation and isolation between battery containers and between batteries and other infrastructure, including gravel surfacing around the facility for a minimum 10 m in accordance with asset protection zone standards • Battery Fire Response Plan as part of the Fire Management Plan • Cooling water supply on-site • Defendable boundary for firefighting will be established (i.e. APZ) • Emergency Response Plan	Very Unlikely

ID	Hazard	Event	Cause	Consequence	Controls	Likelihood Rating
					• Fire Safety Plan • External assistance for firefighting (FRNSW & RFS) • Facilitation of first responder training in the management of Lithium-ion battery fires at the site for local brigades. • Use of appropriate PPE • Vegetation management on site to limit fire fuel loads	
5	Reaction	Thermal runaway in battery	<u>Elevated temperature</u> • Bushfire • External fire (e.g. substation, transformer, adjacent) <u>Electrical failure</u> • Short circuit • Excessive current/voltage • Imbalance charge across cells <u>Mechanical failure</u> • Internal cell defect • Damage (crush/penetration/puncture) <u>Systems failure</u> • Battery Management System (BMS) failure • HVAC failure	• Fire in the battery cell • Injury/fatality • Escalation to the enclosure/ building • Escalation to the entire solar farm or BESS facility	• Equipment and systems will be designed and tested to comply with the relevant industry standards and guidelines including any changes as a result of the recent Victorian incident (when available) • Equipment will be procured from reputable supplier • Engagement of reputable engineering and construction designers/contractors • Installation and maintenance will be done by suitably qualified and experienced personnel • Voltage control • Charge-discharge current control • Temperature monitoring and automated shutoff • HVAC system (i.e. air conditioning) • Cell chemistry selection (minimise runaway) • Battery cell/pack design • BESS is housed in dedicated units • BESS fire protection system (enclosure/building) • Activation of emergency shutdown (ESD button; outside of BESS or remotely from the O&M building) • Fire Management Plan • Emergency Response Plan • Fire Safety Plan • External assistance for firefighting (FRNSW & RFS)	Very Unlikely

ID	Hazard	Event	Cause	Consequence	Controls	Likelihood Rating
6	Chemical	Release of electrolyte (liquid/ vented gas) from the battery cell	Mechanical failure/damage • Dropped impact (installation/maintenance) • Damage (crush/penetration/puncture) Abnormal heating/elevated temperature • Thermal runaway • Bushfire • External fire (e.g. substation, transformer, another BESS unit)	• Release of flammable liquid electrolyte • Vapourisation of liquid electrolyte • Release of vented gas from cells • Fire and/or explosion in battery enclosure/building • Release of toxic combustion products • Injury/fatality	• Equipment and systems will be designed and tested to comply with the relevant industry standards and guidelines • Equipment will be procured from reputable supplier • Engagement of reputable engineering and construction designers/contractors • Installation and maintenance will be done by suitably qualified and experienced personnel • BESS unit design and materials used • Spill cleanup using dry absorbent material • Fault detection and shut-off function • HVAC system (i.e. air conditioning) • BESS fire suppression/protection system (enclosure/building)	Very Unlikely
7	Chemical	Coolant leak	• Mechanical failure/damage • Incorrect maintenance	• Irritation/injury for personnel on exposure (inhalation)	• Equipment and systems will be designed and tested to comply with the relevant industry standards and guidelines • Equipment will be procured from reputable supplier • Engagement of reputable engineering and construction designers/contractors • Installation and maintenance will be done by suitably qualified and experienced personnel • BESS unit design and materials used • Spill cleanup using dry absorbent material • Fault detection and shut-off function • PPE	Very Unlikely

ID	Hazard	Event	Cause	Consequence	Controls	Likelihood Rating
8	Chemical	Refrigerant leak	• Mechanical failure/damage • Incorrect maintenance	• Irritation/injury for personnel on exposure (skin contact)	• Equipment and systems will be designed and tested to comply with the relevant industry standards and guidelines • Equipment will be procured from reputable supplier • Engagement of reputable engineering and construction designers/contractors • Installation and maintenance will be done by suitably qualified and experienced personnel • BESS unit design and materials used • Fault detection and shut-off function • Air conditioner unit separation distance to other equipment • PPE	Very Unlikely
9	External factors	Fire	• Water ingress (e.g. rain, flood)	• Electrical fault/short circuit • Fire • Injury/fatality	• Location siting (i.e. outside of flood prone area) and 40m from waterways • Drainage system • Preventative maintenance (check for leaks)	Extremely Unlikely
10	External factors	Vandalism	• Unauthorised personnel access	• Asset damage • Potential hazard to unauthorized person (e.g. electrocution)	• Project infrastructures are located in secure fenced area • Onsite security protocol • Warning signs • CCTV and security lighting (motion detectors) • During construction, the area will be patrolled, and fence will be installed	Unlikely

5. Risk assessment

Risk is the likelihood of a defined adverse outcome. To calculate risk, it is necessary to consider the likelihood and the consequences of each of the hazardous scenarios identified.

Using a qualitative approach, the risk of an event was estimated using the study risk matrix shown in Figure 5-1.

For each identified hazard and associated event, the resulting consequences and likelihood pair was determined from the hazard register. The consequence and likelihood of the identified events are presented in Table 5-1.

			Likelihood			
			1 Extremely Unlikely	2 Very Unlikely	3 Unlikely	4 Likely
			Never heard of in the industry, not realistically expected to occur	Heard of in the industry, but not expected to occur	Could occur in the next 10 years	Could occur in the next year
Severity	4 Major	Fatality / Permanent Injury	Medium	Medium	High	High
	3 Moderate	Severe injury / Lost time	Low	Medium	Medium	High
	2 Minor	Minor Injury / Visit to Doctor	Low	Low	Medium	Medium
	1 Insignificant	Slight injury / First aid	Low	Low	Low	Medium

Risk Acceptance Criteria

High	Unlikely to be tolerable - review if activity should proceed.
Medium	Tolerable, if so far as reasonably practicable
Low	Broadly acceptable

Figure 5-1 Qualitative risk matrix

Table 5-1 Risk assessment

Hazard	Event	Consequence (Impact to People)	Likelihood	Risk
Electrical	Exposure to voltage	Major	Very Unlikely	Medium
Arc flash	Arc flash	Major	Very Unlikely	Medium
EMF	Exposure to EMF	Insignificant	Extremely Unlikely	Low
Fire	Bushfire	Major	Very Unlikely	Medium
Reaction	Thermal runaway in battery	Major	Unlikely	High
Chemical	Release of electrolyte from the battery cell (liquid/vented gas) resulting in fire and/or explosion	Major	Very Unlikely	Medium
	Battery coolant leak	Minor	Very Unlikely	Low
	Refrigerant leak	Minor	Very Unlikely	Low
External factors	Water ingress resulting in fire	Major	Extremely Unlikely	Medium
	Vandalism due to unauthorised personnel access	Moderate	Unlikely	Medium

In regards to risks between the two proposed options for BESS including DC coupled distributed batteries and AC-coupled Energy Storage Facility, both options use similar equipment therefore resulting in similar risk. The key difference is their location within the Project site, DC includes smaller batteries distributed across the site, while the AC includes all the batteries at one location.

In the event of a battery fire, it is likely that the DC option may have a higher likelihood and a lower consequence. Whereas the AC option may have a lower likelihood and a higher consequence. The risk of battery fire is expected to be similar for both options.

6. Risk assessment results

6.1 Consequence

The risk assessment indicates that the worst-case consequence is a fire from a variety of causes (e.g. release of flammable materials, battery thermal runaway, infrastructure fire). These fires may have the potential to initiate bushfire to surrounding grasslands but is limited with appropriate control listed herein.

6.2 Likelihood

The risk assessment indicates that the highest likelihood rating for the identified events is unlikely (i.e. could occur in the next 10 years). This relates to thermal runaway in the battery and unauthorised personnel access to the BESS resulting in vandalism/asset damage to the project infrastructure.

6.3 Risk assessment

A total of 10 risk events were identified. The breakdown of these events according to their risk ratings are as follows:

- 1 high risk event
- 6 medium risk events
- 3 low risk events.

Based on the risk acceptance criteria used for the study, the risk profile for the project is considered to be tolerable if So Far As Reasonably Practicable (SFARP).

One high risk event was identified, and this is due to a recent fire within a battery facility being constructed within Victoria. It is understood that the fire commenced from thermal runaway during setting up of the facility and was contained to the site. This incident has not been considered in this assessment. Once it becomes available, this project will consider the findings and recommendations of the investigation into the fire by the owner and agencies involved. This study identified proposed prevention controls to reduce the likelihood of thermal runaway and mitigation controls to contain any fires to minimise potential for escalated events.

The majority of the medium risk events relate to fire events resulting from a variety of causes (e.g. release of flammable materials, battery thermal runaway, infrastructure fire, bushfire, etc). The study identified proposed prevention controls to reduce the likelihood of these fire events and mitigation controls to contain the fires to minimise potential for escalated events (e.g. fire management plan, APZs, vegetation management etc.). Based on the identified controls, the highest likelihood for these events were rated as very unlikely (i.e. heard of in the industry, but not expected to occur).

Based on the size of the development footprint, proposed location for project infrastructure within the Project site, proposed controls and distance to neighbouring land uses (including neighbouring properties and agricultural operations), the exposure to fire events will primarily be to the project’s construction and operations workforce. Offsite impacts would be expected to be minimal.

The risk assessment concluded that there is no potential for offsite fatality or injury. Therefore, the project meets the land use planning criteria. Risk events identified are onsite impacts and assessed against *Work Health and Safety* (WHS) *Act* requirements to reduce risk to SFARP. Risks were assessed by the project as tolerable if SFARP.

7. Conclusion

This PHA has been undertaken to respond to request from DPIE by demonstrating that BESS risk levels do not preclude approval for either option. This PHA did not identify any major offsite consequences or societal risk. Therefore, a qualitative analysis is suitable.

This PHA has:

- Identified all hazards at the BESS (either distributed around the site or at one facility), analysed the possible incident scenarios that could result from a hazardous incident and the consequences of these to people, property, and the biophysical environment.
- Estimated the likelihood of hazardous incidents that have the potential to result in significant consequences.
- Recommended controls to limit the consequences and likelihood of potentially hazardous incidents.

The risk assessment determined that the risk profile for the project is considered to be tolerable if SFARP. The majority of the medium risk events relate to fire events. The exposure to fire events will primarily be to the project's construction and operations workforce. Offsite impacts will be minimal. The risk assessment concluded that there is no potential for offsite fatality or injury identified and therefore the project meets the land use planning criteria.

8. Recommendations

It is recommended that the results of this PHA should be used as inputs into other safety studies required including:

- Fire Management Plan
- Emergency Response Plan
- Fire Safety Plan

9. References

DoP. (2011). *Hazardous and Offensive Development Application Guidelines: Applying SEPP 33*. Retrieved from Department of Planning, Industry and Environment: https://www.planning.nsw.gov.au/-/media/Files/DPE/Guidelines/hazardous-and-offensive-development-application-guidelines-applying-sepp-33-2011-01.ashx?la=en

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