# PRELIMINARY HAZARD ANALYSIS

## Glanmire Solar Farm

October 2022

**Project Number: 21-785**

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# Document verification

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**W.** www.nghconsulting.com.au

**E.** ngh@nghconsulting.com.au

**BEGA - ACT & SOUTH EAST NSW**
Suite 11, 89-91 Auckland Street
(PO Box 470) Bega NSW 2550
**T.** (02) 6492 8333

**BRISBANE**
T3, Level 7, 348 Edward Street
Brisbane QLD 4000
**T.** (07) 3129 7633

**CANBERRA - NSW SE & ACT**
Unit 8, 27 Yallourn Street
(PO Box 62) Fyshwick ACT 2609
**T.** (02) 6280 5053

**GOLD COAST**
19a Philippine Parade
Palm Beach QLD 4221
(PO Box 466 Tugun QLD 4224)
**T.** (07) 3129 7633

**NEWCASTLE - HUNTER & NORTH COAST**
Unit 2, 54 Hudson Street
Hamilton NSW 2303
**T.** (02) 4929 2301

**SYDNEY REGION**
Unit 17, 21 Mary Street
Surry Hills NSW 2010
**T.** (02) 8202 8333

**WAGGA WAGGA - RIVERINA & WESTERN NSW**
35 Kincaid Street (PO Box 5464)
Wagga Wagga NSW 2650
**T.** (02) 6971 9696

**WODONGA**
Unit 2, 83 Hume Street
(PO Box 506) Wodonga VIC 3690
**T.** (02) 6067 2533

**NSW • ACT • QLD • VIC**
**W.** www.nghconsulting.com.au
ABN 31 124 444 622 ACN 124 444 622

# Table of contents

## Figures



## Tables

# Acronyms and abbreviations

| | |
|---|---|
| AC | Alternating Current |
| APZ | Asset Protection Zone |
| BCP | Battery Control Panel |
| 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 |
| 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

The Glanmire Solar Farm (the Project) is proposed to be located on Lot 141 DP1144786, in Glanmire, NSW, in the Bathurst Regional Local Government Area of NSW. The Project proposed includes the construction, operation and eventual decommissioning of a solar farm that would be connected into the electricity grid. During its operational life of approximately 35 years, it would provide electricity generation and storage, assisting the grid's transition to renewable energy sources, as fossil fuel electricity generation is reduced.

The Project includes:

- The construction and operation of a solar photovoltaic (PV) energy generation facility with an estimated capacity of up to 60 MW
- Associated infrastructure, including grid connection and a Battery Energy Storage System (BESS) of up to approximately 60 MW / 60 MWh.

The proposed Glanmire Solar Farm is located approximately 10km east of the centre of Bathurst, Central Tablelands, New South Wales. Bathurst is about 200 kilometres west-northwest of Sydney. The site is zoned for Rural use and surrounding land uses are predominantly agricultural however, they also include appropriate rural businesses, smaller land parcels and rural residential development. The Development site is bounded by the Great Western Highway to the north which is the eastern 'gateway' to Bathurst.

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 2021* (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 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*

## 1.1 Objectives

The objective of this PHA is to develop a comprehensive understanding of the hazards and risks associated with the operation of the Glanmire Solar Farm and the adequacy of safeguards.

## 1.2 Scope

This PHA is to address the SEARs for the Project and has been prepared in accordance with, or consideration to:

- *Hazard Industry Planning Advisory Paper No.6 – Guidelines for Hazard Analysis* (DoP, 2011) (HIPAP 6)
- *Multi-Level Risk Assessment* (DoP, 2011) (MLRA)

- *Hazardous Industry Advisory Paper No. 4, Risk Criteria for Land Use Safety Planning* (DoP, 2011) (HIPAP 4)
- *Victorian Big Battery Fire Statement of Technical Findings* (*Energy Safe Victoria*, 2021).

This PHA provides a basis for an informed judgment to be made on the acceptability of the Glanmire Solar Farm.

## 1.3 Exclusion and limitations

**This PHA is based on an example BESS only. The Proponent has not selected a BESS Original Equipment Manufacturer (OEM).** The controls listed in the hazard register in Table 5-4 and the recommendations and mitigation measures in section 9 will be implemented regardless of the OEM selected.

It is anticipated that a BESS OEM will be selected and the detailed design complete after approval has been granted.

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 7.7).
- Assessment of other risks, including, but not limited to, aviation safety, health, landslide/subsidence and telecommunications.
- 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.

# 2. Site location and description

## 2.1 Site location

The proposed Glanmire Solar Farm is located approximately 10km east of the centre of Bathurst, Central Tablelands, New South Wales. Bathurst is about 200 kilometres west-northwest of Sydney.

The Subject land has a gently undulating terrain, forming a series of small valleys and dams. The site is currently occupied by open grazing pastures and sown paddocks with some scattered trees in central parts of the site, and a dense corridor of trees to the north east of the site, adjacent to an existing dwelling, 'Woodside' (formerly Woodside Inn).

## 2.2 Surrounds

Surrounding land uses are mixed, although predominantly agricultural. On the northern side of the Highway there is a transport business and animal boarding kennels, with smaller land parcels dominating. On the southern side of the Highway land use is agriculture, including grazing, improved pasture and farming (fodder, cereals and oilseed).

## 2.3 Sensitive receivers

The site is bounded by residential properties. As presented in Table 2-1, there are 7 residential properties (excluding possible future residences) within 1 kilometre of the proposed Glanmire Solar Farm.

Table 2-1 Sensitive receivers

| ID | Address | Description |
|---|---|---|
| R1 | 4824 Great Western Highway, Glanmire | Residential property located approximately 1,285m north of the development area |
| R2 | 23 Glanmire Lane, Glanmire | Residential property located approximately 400m north-east of the development area |
| R3 | 16 Glanmire Lane, Glanmire | Residential property located approximately 400m north-east of the development area |
| R4 | 264 Brewongle Lane, Brewongle | Residential property located approximately 190m south of the development area |
| R5 | 244 Brewongle Lane, Brewongle Dwelling 1 | Residential property located approximately 255m south of the development area |
| R6 | 244 Brewongle Lane, Brewongle Dwelling 2 | Residential property located approximately 620m south of the development area |

| ID | Address | Description |
|---|---|---|
| R7 | 4887 Great Western Highway, Glanmire | Residential property located approximately 885 m west of the development area |
| R8 | 4940 Great Western Highway, Glanmire | Residential property located approximately 1,700 m north-west of the development area |
| R14 | 44 Mersing Road, Glanmire | Residential property located approximately 880 m north-east of the development area |
| R44a | Possible future residence | Residential property located approximately 765 m east of the development area |
| R44b | Possible future residence | Residential property located approximately 290 m east of the development area |
| R44c | Possible future residence | Residential property located approximately 300 m west of the development area |

# 3. Project description

The Glanmire Solar Farm would consist of the solar panels, mounted within an array area and ancillary infrastructure. Ancillary infrastructure is taken to include all supporting inverters, transformers, BESS, substation and switching station, electrical connections and cabling, onsite buildings, access roads and parking, fencing and lighting. In addition, road upgrades will be required to access the site from public roads.

The Project would incorporate a ground mounted solar photovoltaic (PV) panels single-axis tracking system. Ancillary infrastructure would include:

- Inverters and voltage step-up transformers positioned throughout the solar arrays
- Underground and aboveground cabling to connect the arrays to the inverters/transformers
- A Battery Energy Storage System (BESS) with a power rating up to approximately 60 MW AC/DC coupled (approximately 65 MW hours)
- A switchyard and on-site substation
- National Energy Market (NEM) compliant metering
- Internal access tracks to enable site maintenance
- Security fencing around the perimeter with CCTV
- An operations and maintenance (O&M) building
- Site access off Brewongle Lane.

## 3.1 Solar arrays

The Project will utilise ground mounted solar photovoltaic (PV) panels. A single portrait solar array will be used on a single-axis tracking system. This will include:

- Approximately 128,000 solar modules.
- Row spacing between modules: 6m or greater.
- Clear space between panels: Approximately 3m or greater.
- Height: which means they will limit the maximum height to 3.5 metres above maximum ground level.
- Approximately 18 inverters installed within the solar array.

Steel piles would be used to support the solar modules and the mounting system.

## 3.2 Inverters and transformers

The purpose of the inverters and transformers is to convert direct current (DC) electricity, generated by the solar panels, to AC which is used by the national electricity grid. Inverters and transformers will be collocated with the containerised battery module and distributed throughout the array area for power conversion. This will include:

- Approximately 18 inverter / transformer stations distributed throughout the solar areas
- Approximately 17 inverter / transformer stations co-located with the BESS.

## 3.3 Battery Energy Storage System (BESS)

A BESS is proposed to store power generated by the Project, providing a more reliable release of energy to the grid. The Proponent has not selected a BESS OEM yet and is likely to after approval has been granted.

It is likely that the Proponent will select a BESS similar to the SolBank containerised battery module manufactured by CSI Energy Storage Technologies. It is expected that the selected BESS OEM will use a lithium iron phosphate technology.

The Project may include up to 40 containerised BESS modules. An additional 10 modules may be added at year 1, 4 modules at year 11 and 3 modules at year 16. The concept BESS layout is presented in Figure 3-3.

The concept design includes 17 battery module strings with up to 4 battery modules per string (subject to installation of additional modules described above).

The BESS would also include fire alarms and a fire suppression system such as the system presented in Figure 3-1 and Figure 3-2.

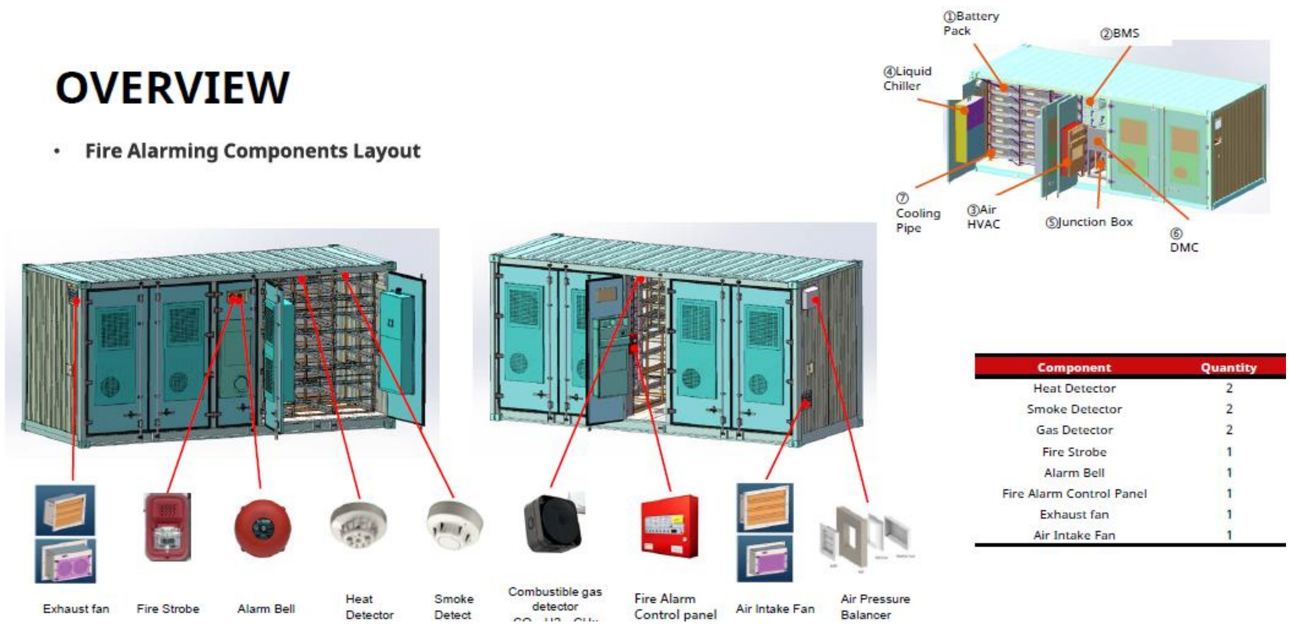


Figure 3-1 Example BESS aerosol based fire suppression system – fire alarming components

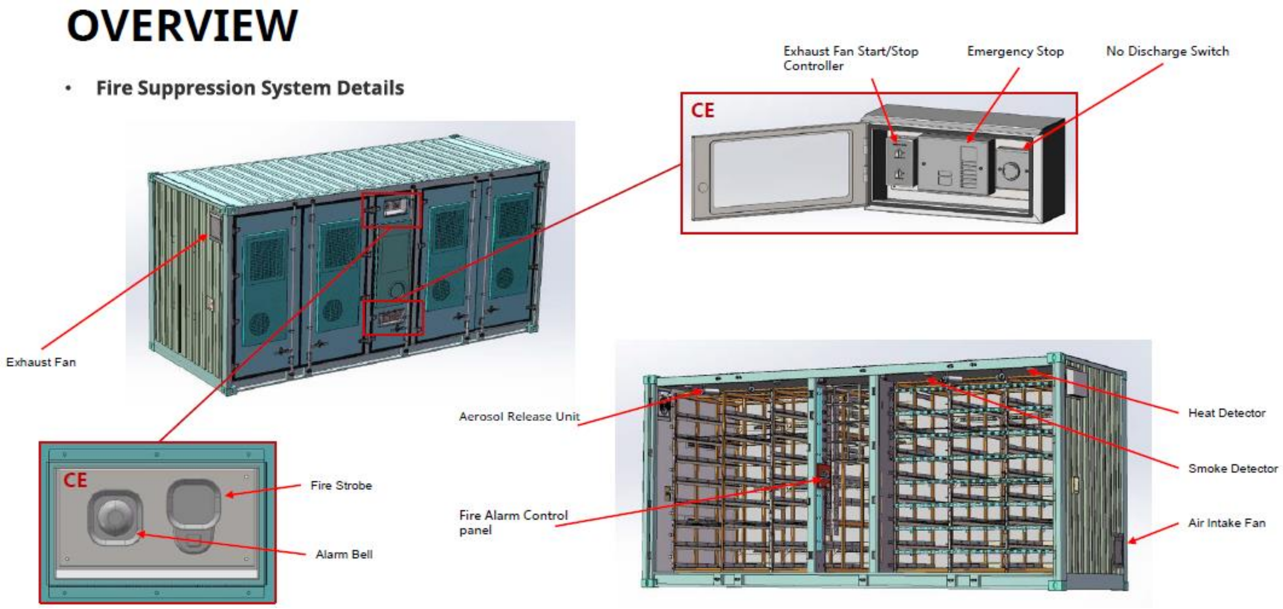


Figure 3-2 Example BESS aerosol based fire suppression system – fire suppression system details

The BESS units would also 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 Project.

### 3.3.1 BESS detailed design standards

The detailed design of the BESS will be in accordance with standards provided in Table 3-1. The detailed design will also include suitable low combustion materials and separation distances between battery sub-units to ensure that a fire does not propagate between the individual battery sub-units.

Table 3-1 Consideration of standards and codes in BESS design

| Standard / code | Consideration |
|---|---|
| AS 2067 | Substations and high voltage installations exceeding 1.0kVAC considering electrical, operation and safety separation |
| IEC 61000-6 | Electromagnetic compatibility (EMC) |
| IEC 62477-1 | Safety requirements for power electronic converter systems and equipment |
| IEC 62619 | Safety requirements for secondary lithium cells and batteries, for use in industrial applications |
| IEC 62897 | Stationary Energy Storage Systems with Lithium Batteries - Safety Requirements |
| UL 1973 | Standard for Safety Batteries for Use in Stationary and Motive Auxiliary Power Applications |
| UL 9540 | Standard for Energy Storage Systems and Equipment |
| UL 9540A | Test Method Brings Clarity to Insurance and Fire Mitigation Professionals especially for battery rack system |
| UN 38.3 | Transportation Testing for Lithium Batteries and Cells |
| NFPA 855 | Standard for the Installation of Stationary Energy Storage Systems |
| AS/NZ 5139:2019 | Electrical installations - Safety of battery systems for use with power conversion equipment |
| FM Global DS 5-33 | Property Loss Prevention Data Sheets |
| FM Global | Development of Sprinkler Protection Guidance for Lithium Ion Based Energy Storage Systems |

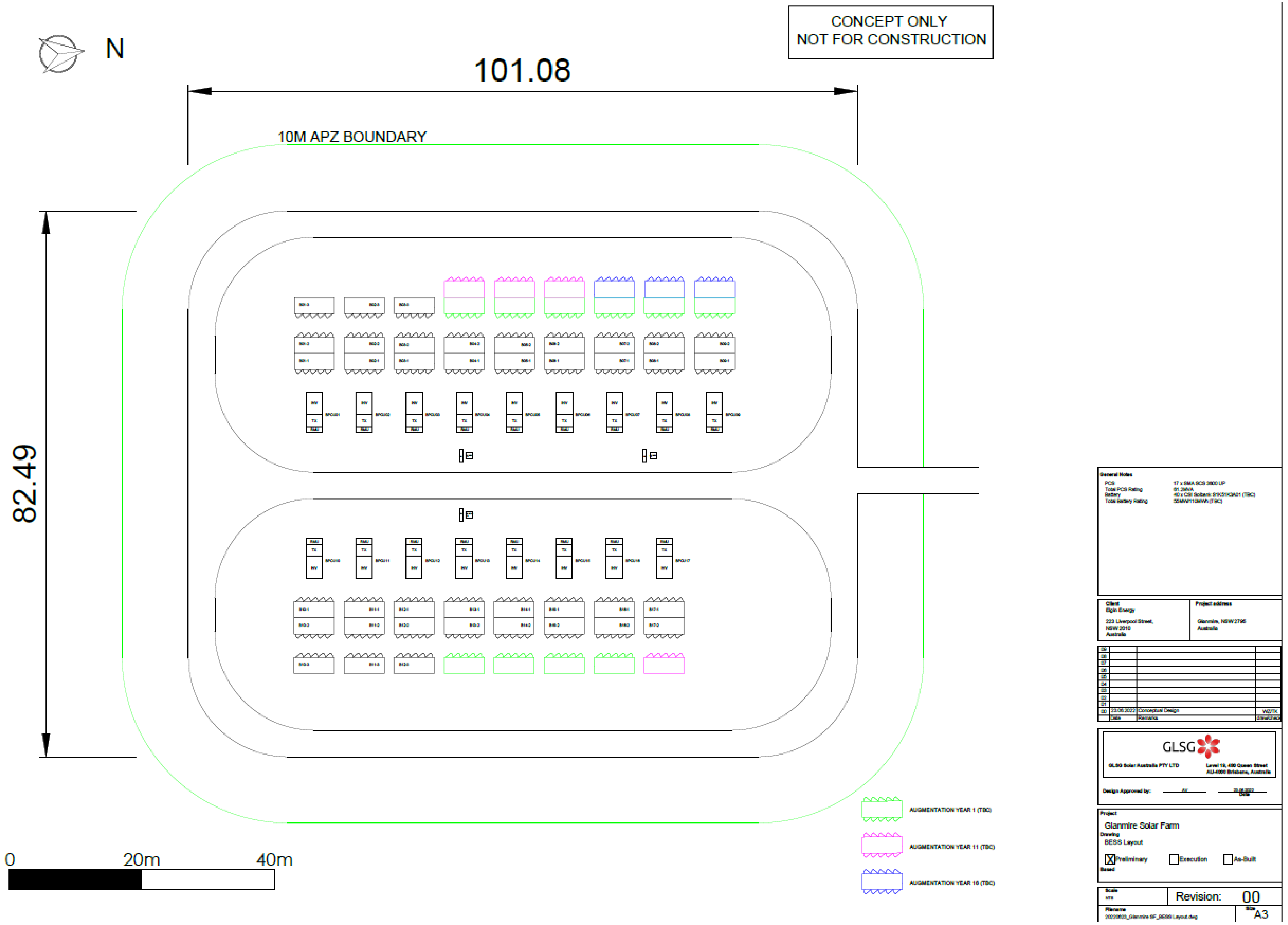


Figure 3-3 Concept BESS layout

## 3.4 Onsite substation and switching station

To connect the Project to the national electricity grid, the Project will require a substation. The substation would have a nominal transfer capacity of approximately 65 MVA and host up to 2 transformers. It would require approximately 0.20ha for the 33/66kV switchyard. The Project's dedicated assets would be adjacent, including transformers and switching equipment, O&M building, car parking and storage facility.

The switching station would contain a power transformer (66/33kV 70MVA), high voltage switchgear and other equipment to achieve a transfer capacity of approximately 65 MVA. It would be built on the eastern edge of the Development footprint and cover approximately 0.2 ha. It would connect to the 66kV lines at the front of the site via an underground or overhead powerline.

The National Energy Market metering equipment will be on-site within the substation compound.

## 3.5 Electrical connections

### Connection to the grid

There are existing transmission lines north of the Development site. The Project would connect to the Essential Energy 66Kv line (currently energised at 11kV) which runs past the site.

The Project may refurbish/augmentation existing Essential Energy transmission lines built for 66 kV capacity within existing easements, with the possibility of relocation of a short section of 11 kV line to enable this to proceed.

### Underground cabling

Underground cabling on the Development site would be required including both AC and DC cables.

## 3.6 Onsite buildings

### Operations and maintenance building

This facility would be a single storey building, up to approximately 18m x 7m X 4m (L x W x H). It would contain an office and amenities for staff (toilet, kitchen, first aid, potable water supply, etc.) as required for the safe operation of the site.

The control room and site office facility would include water supply as required for the services installed (including a septic system).

Permanent parking facilities will be provided adjacent to the control building to facilitate up to four cars and light vehicles on site.

### Switch room

A building footprint of approximately 14m x 4.2m and approximately 4m high would be constructed for the HV switch room, with services, protection and control facilities.

### Storage shed

A storage shed with footprint of approximately 14m x 12m and approximately 7m high would be constructed. Guttering and a water tank would be installed to collect rainwater.

## 3.7 Fencing

### Fencing the solar panel array area

The solar array would be located on private land with no public right of access. For this reason, it is intended to fence the solar panel array area with typical livestock fencing and not include more robust 'security' fencing. It is hoped that this option would provide sufficient security, whilst having the least impact on visual amenity. However, if security breaches or vandalism occur, then the Project would retain the right to install more robust 'security' fencing if it deems it necessary.

At the entrance points to the site, signage would be installed indicating "no entry without authorisation". Entry to the site would be by invitation from authorised personnel only (and would be given for several residents who use the entrance for access to their property). Contact details for the site office would be provided on the signage.

### Fencing the substation / battery area

The substation area would be enclosed by a security fence in accordance with TransGrid's requirements. This is expected to be a steel security fence approximately two m high with barbed wire topping, or similar.

## 3.8 Lighting and monitoring

### Closed Circuit Television (CCTV)

CCTV cameras would be installed at each entrance and throughout the solar array area for continuous monitoring by site staff. A security company would be contracted for monitoring outside of business hours. The CCTV cameras would be solar/battery powered with a wireless communication connection and would be mounted on up to 5 m poles complete with sensors or infrared security lighting. The number of cameras installed would be sufficient for coverage of site entrances, access roads and building areas.

### Lighting

There would be no permanently lit night lighting within the solar array. Lighting would be included in each PCU for night-time maintenance or emergency purposes only. Lighting would be installed around the substation, battery storage facility and O&M facilities to be used in case of night works or an emergency only.

Motion sensor or infrared security lighting (and CCTV cameras) would be installed at sensitive boundary locations and around the substation, battery storage facility, O&M facilities, and office areas.

All external operational lighting would be designed to reduce disturbance to neighbouring properties, as such it would be low intensity lighting (except where required for safety or emergency purposes) and would not shine above the horizontal. The external operational lighting would be used only when there are staff on site, as part of night works (where required), site security or during emergency situations including through remote operation to allow improved camera visibility.

# 4. Recommendations following the Victorian Big Battery Fire

Recommendations were provided in the _Victorian Big Battery Fire Statement of Technical Findings_ – Victorian Government 2021 following an investigation into the Victorian Big Battery Fire. Elgin Energy Pty Ltd (Elgin Energy) commits to the following as a result of these recommendations. Elgin Energy's response is provided in Table 4-1.

Table 4-1 Elgin Energy's response to recommendations of the Victorian Big Battery Fire

| **_Victorian Big Battery Fire Statement of Technical Findings - lessons learned and preventing a recurrence_** | **Elgin Energy's commitment** |
|---|---|
| _Each Megapack cooling system is to be fully functionally and pressure tested when installed on site and before it is put into service_ | Elgin Energy do not propose to use the Tesla Megapack.<br>Following installation of the modules Elgin Energy will commission any liquid chillers and cooling pipes to check they are fully functional and undertake pressure tests. |
| _Each Megapack cooling system in its entirety is to be physically inspected for leaks after it has been functionally and pressure tested on site_ | Elgin Energy will undertake inspections of any liquid chillers following commissioning and pressure testing. |
| _The Supervisory Control And Data Acquisition (SCADA) system has been modified such that it now 'maps' in one hour and this is to be verified before power flow is enabled to ensure real-time data is available to operators_ | Elgin Energy do not propose to use the Tesla Megapack. |
| _A new 'battery module isolation loss' alarm has been added to the firmware; this modification also automatically removes the battery module from service until the alarm is investigated_ | Elgin Energy do not propose to use the Tesla Megapack.<br>The selected containerised battery modules isolate the module automatically and removes the battery module from service until the alarm is investigated |
| _Changes have been made to the procedure for the usage of the key lock for Megapacks during commissioning and operation to ensure the telemetry system is operational_ | |
| _The high voltage controller (HVC) that operates the pyrotechnic fuse remains in service when the key lock is isolated_ | DC fuses remain in service for protection purpose no matter if the key lock is isolated or not. |

# 5. Preliminary hazard analysis

## 5.1 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 5-1.

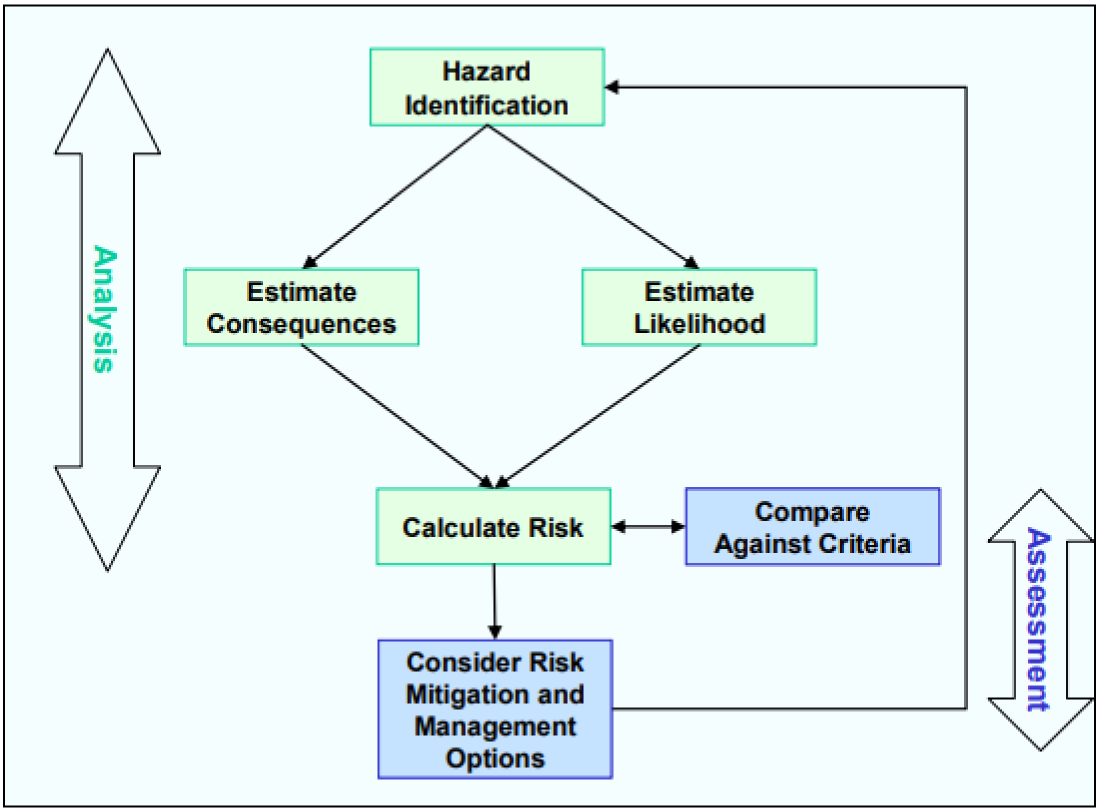


Figure 5-1 Basic methodology for hazard analysis (Source: HIPAP 6)

## 5.2 Hazard identification

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

- 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 5-1.

Table 5-1 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 |
| **Weather** | Flooding, bushfire |
| **Vandalism** | Vandalism |

## 5.3 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 5-2. 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 5-2 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 |

## 5.4 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 5-3.

The hazard register for the BESS units is presented in Table 5-4.

Table 5-3 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 5-4 BESS units hazard register

| ID | Hazard | Infrastructure impacted | Event | Cause | Consequence | Controls | Likelihood Rating |
|---|---|---|---|---|---|---|---|
| 1 | Electrical | • Solar arrays<br>• Inverter/transformers<br>• Overhead and underground cabling<br>• Substation<br>• BESS<br>• Onsite buildings | Exposure to voltage | <u>Short circuit/electrical connection failure</u><br>• Faulty equipment<br>• Incorrect installation<br>• Incorrect maintenance<br>• Human error during maintenance<br>• Safety device/circuit compromised<br>• Battery casing/enclosure damage | • Electrocution<br>• Injury and/or fatality<br>• Fire | • Equipment and systems will be designed and tested to comply with industry standards and guidelines (refer to Table 3-1)<br>• Engagement of reputable engineering and construction designers/contractors<br>• Installation and maintenance will be done by suitably qualified and experienced personnel<br>• Electrical lockout/tagout<br>• Temperature monitoring and automated shutoff<br>• Fire suppression system<br>• Warning signs (electrical hazards, arc flash)<br>• Emergency Response Plan<br>• Fire Safety Plan<br>• External assistance for firefighting (Fire and Rescue NSW; FRNSW & Rural Fire Service; RFS)<br>• Use of appropriate Personal Protective Equipment (PPE)<br>• Rescue kits (i.e. insulated rescue hooks)<br>• Underground cabling would be designed in accordance with Australian and International standards with the goal of minimising ground disturbance.<br>• AC underground cabling at the reticulation voltage would be installed at a depth of at least 500mm with the electrical reticulation typically buried to either 600mm (low voltage) or 800mm (high voltage) depth, following the relevant Australian Standard.<br>• Once underground cables are installed another layer of sand may be placed above the cable prior to covers and markers being installed.<br>• Cables would be protected in accordance with Australian Standard (AS) 3000:2007 Electrical Installations.<br>• External lighting would be installed to comply with Australian/New Zealand Standard AS/NZS 4282:2019 – Control of Obtrusive Effects of Outdoor Lighting, or its latest version. | Very Unlikely |
| 2 | Arc flash | • Solar arrays<br>• Inverter/transformers<br>• Overhead and underground cabling<br>• Substation<br>• BESS | Arc flash | • Incorrect procedure (i.e. installation/ maintenance)<br>• Faulty equipment (e.g. corrosion on conductors)<br>• Faulty design (e.g. equipment too close to each other)<br>• Insulation damage<br>• Human error during maintenance | • Burns<br>• Injury and/or fatality<br>• Exposure to intense light and noise<br>• 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 (refer to Table 3-1)<br>• Engagement of reputable engineering and construction designers/contractors<br>• Installation and maintenance will be done by suitably qualified and experienced personnel<br>• Maintenance procedure (e.g. deenergize equipment; electrical lockout/tagout)<br>• Preventative maintenance<br>• Emergency Response Plan<br>• Fire Safety Plan<br>• External assistance for firefighting (FRNSW & RFS)<br>• Warning signs (arc flash boundary)<br>• Use of appropriate PPE for flash hazard | Very Unlikely |
| 3 | EMF | • Solar arrays<br>• Inverter/transformers<br>• Overhead and underground cabling<br>• Substation<br>• BESS | 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)<br>• Personnel injury | • Equipment and systems will be designed and tested to comply with industry standards and guidelines (refer to Table 3-1)<br>• Location siting and selection (incl. separation distance)<br>• Optimising equipment layout and orientation<br>• Reducing conductor spacing<br>• Incidental shielding<br>• Balancing phases and minimising residual current<br>• Exposure to personnel is short duration in nature (transient)<br>• Physical warning signs (e.g. danger or restricted access) | Extremely Unlikely |
| 4 | Fire | • Solar arrays | Fire | • Escalated event from facility fire | • Injury/fatality<br>• Asset damage | • Equipment and systems will be designed and tested to comply with the relevant international standards and guidelines (refer to Table 3-1) | Very Unlikely |

| ID | Hazard | Infrastructure impacted | Event | Cause | Consequence | Controls | Likelihood Rating |
|---|---|---|---|---|---|---|---|
| | | • Inverter/transformers<br>• Overhead cabling<br>• Substation<br>• BESS<br>• Onsite buildings | | • Faulty equipment<br>• Arc flash<br>• External fire (e.g. bushfire, adjacent infrastructure) | | • Installation, operations and maintenance by trained personnel (e.g. reputable third party) in accordance with relevant procedures<br>• Preventative maintenance (e.g. insulation, replacement of faulty equipment)<br>• Installation of a reliable integrated fire detection and fire suppression systems within modules and onsite buildings.<br>• The battery and power conversion systems would be in containerised design, manufactured of low combustible external materials.<br>• A safety valve would automatically trigger safety mode, in case the battery cell is exposed in an over-heat environment.<br>• Design appropriate separation and isolation between battery cabinets and between batteries and other infrastructure, including gravel surfacing around the facility for a minimum 10 m in accordance with asset protection zone standards<br>• Battery Fire Response Plan as part of the Fire Management Plan<br>• Cooling water supply on-site<br>• Defendable boundary for firefighting will be established (i.e. APZ) including:<br>    o All proposed critical infrastructure (i.e. BESS, inverters, switching station, access and water supply) would be managed for a minimum distance/radius of 10 m<br>    o The substation and transformer would be provided with an increased 20m wide APZ<br>• Bush fire Emergency Management and Operations Plan<br>• Fire Safety Plan<br>• External assistance for firefighting (FRNSW & RFS)<br>• Facilitation of first responder training in the management of lithium iron phosphate battery fires at the site for local brigades.<br>• Use of appropriate PPE<br>• Vegetation management on site to limit fire fuel loads<br>• A function test for each individual battery module and cabinet during installation and commissioning | |
| **5** | Reaction | • BESS | Thermal runaway in battery | <u>Elevated temperature</u><br>• Bushfire<br>• External fire (e.g. substation, transformer)<br><br><u>Electrical failure</u><br>• Short circuit<br>• Excessive current/voltage<br>• Imbalance charge across cells<br><br><u>Mechanical failure</u><br>• Internal cell defect<br>• Damage (crush/penetration/puncture)<br><br><u>Systems failure</u><br>• Battery Management System (BMS) failure<br>• HVAC failure | • Fire in the battery cell<br>• Injury/fatality<br>• Escalation to the enclosure/ building<br>• Escalation to the entire BESS | • Equipment and systems will be designed and tested to comply with the relevant industry standards and guidelines (refer to Table 3-1)<br>• Equipment will be procured from reputable supplier<br>• Engagement of reputable engineering and construction designers/contractors<br>• Installation and maintenance will be done by suitably qualified and experienced personnel<br>• Voltage control<br>• Charge-discharge current control<br>• Temperature monitoring and automated shutoff<br>• HVAC system (i.e. air conditioning)<br>• Cell chemistry selection (minimise runaway)<br>• Battery cell/pack design<br>• BESS is housed in dedicated units<br>• BESS is located in designated area<br>• BESS fire protection system integrated in module<br>• Activation of emergency shutdown (ESD button; outside of BESS or remotely from the O&M building)<br>• Fire suppression system that has enough suppression for a couple of days<br>• Fire Management Plan<br>• Emergency Response Plan<br>• Fire Safety Plan<br>• External assistance for firefighting (FRNSW & RFS) | Very unlikely |

| ID | Hazard | Infrastructure impacted | Event | Cause | Consequence | Controls | Likelihood Rating |
|---|---|---|---|---|---|---|---|
| **6** | Chemical | • BESS | Release of electrolyte (liquid/ vented gas) from the battery cell | Mechanical failure/damage<br>• Dropped impact (installation/maintenance)<br>• Damage (crush/penetration/puncture)<br><br>Abnormal heating/elevated temperature<br>• Thermal runaway<br>• Bushfire<br>• External fire (e.g. substation, transformer) | • Release of flammable liquid electrolyte<br>• Vapourisation of liquid electrolyte<br>• Release of vented gas from cells<br>• Fire and/or explosion in battery enclosure/building<br>• Release of toxic combustion products<br>• Injury/fatality | • Equipment and systems will be designed and tested to comply with the relevant industry standards and guidelines (refer to Table 3-1)<br>• Equipment will be procured from reputable supplier<br>• Engagement of reputable engineering and construction designers/contractors<br>• Installation and maintenance will be done by suitably qualified and experienced personnel<br>• BESS unit design and materials used<br>• Spill cleanup using dry absorbent material<br>• Fault detection and shut-off function<br>• HVAC system (i.e. air conditioning)<br>• BESS fire suppression/protection system (enclosure/building) | Very Unlikely |
| **7** | Chemical | • BESS | Refrigerant leak | • Mechanical failure/damage<br>• 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 (refer to Table 3-1)<br>• Equipment will be procured from reputable supplier<br>• Engagement of reputable engineering and construction designers/contractors<br>• Following installation of the modules Elgin Energy will commission any liquid chillers and cooling pipes to check they are fully functional and undertake pressure tests.<br>• Elgin Energy will undertake inspections of any liquid chillers following commissioning and pressure testing.<br>• Installation and maintenance will be done by suitably qualified and experienced personnel<br>• BESS unit design and materials used<br>• Fault detection and shut-off function<br>• Air conditioner unit separation distance to other equipment<br>• PPE | Very Unlikely |
| **8** | Weather | • Solar arrays<br>• Inverter/transformers<br>• Substation<br>• BESS<br>• Onsite buildings | Fire | • Water ingress (e.g. rain, flood) | • Electrical fault/short circuit<br>• Fire<br>• Injury/fatality | • Location siting (i.e. outside of flood prone area)<br>• Drainage system<br>• Preventative maintenance (check for leaks) | Extremely Unlikely |
| **9** | Vandalism | • Solar arrays<br>• Inverter/transformers<br>• Overhead and underground cabling<br>• Substation<br>• BESS<br>• Onsite buildings | Vandalism | • Unauthorised personnel access | • Asset damage<br>• Potential hazard to unauthorized person (e.g. electrocution) | • Project infrastructures are located in secure fenced area<br>• Onsite security protocol<br>• Warning signs<br>• CCTV and security lighting (motion detectors)<br>• During construction, the area will be patrolled, and fence will be installed | Very unlikely |

# 6. 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 6-1.

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 6-1.

| | | | Likelihood | | | |
|---|---|---|---|---|---|---|
| | | | 1<br>Extremely Unlikely | 2<br>Very Unlikely | 3<br>Unlikely | 4<br>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<br>Major | Fatality / Permanent Injury | | | | |
| | 3<br>Moderate | Severe injury / Lost time | | | | |
| | 2<br>Minor | Minor Injury / Visit to Doctor | | | | |
| | 1<br>Insignificant | Slight injury / First aid | | | | |

**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 6-1 Qualitative risk matrix

Table 6-1 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 | Very Unlikely | Medium |
| **Chemical** | Release of electrolyte from the battery cell (liquid/vented gas) resulting in fire and/or explosion | Major | Very Unlikely | Medium |
| | 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 |

# 7. Risk assessment results

## 7.1 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.

## 7.2 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 battery coolant leak and unauthorised personnel access to the BESS resulting in vandalism/asset damage to the project infrastructure.

## 7.3 Risk assessment

A total of nine (9) risk events were identified. The breakdown of these events according to their risk ratings are as follows:

- Seven (7) medium risk events
- One (2) low risk events.

Based on the overall 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).

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 design and 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).

A recent fire at a battery facility in Victoria began whilst commissioning the facility, although was contained within the site. The fire was started from a coolant leak resulting in a short circuit of the electrical components. Additional safeguards have been included as a result of the Elgin Energy commitments in Table 4-1. The additional safeguards are included in Table 5-4.

Based on the size of the Development Footprint, proposed location for project infrastructure within the subject land, proposed controls and distance to neighbouring land uses, 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.

# 8. Conclusion

This PHA has been undertaken to respond to request from DPE by demonstrating that Glanmire Solar Farm risk levels do not preclude approval. 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, 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.

# 9. Recommendations and mitigation measures

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

- Bush fire Emergency Management and Operations Plan
- Fire Management Plan
- Emergency Response Plan
- Fire Safety Plan.

In addition to the above it is recommended that:

- Following a decision of the BESS OEM, the detailed design of the BESS will be undertaken to comply with the requirements of section 3.3.1.
- If the Proponent chooses to use the Tesla Megapack, all recommendations from the Victorian Big Battery Fire Statement of Technical Findings – Victorian Government 2021 will be implemented.

# 10. 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

DoP (2011). *Multi-Level Risk Assessment.* Retrieved from Department of Planning, Industry and Environment: https://www.planning.nsw.gov.au/-/media/Files/DPE/Guidelines/assessment-guideline-multi-level-risk-assessment-2011-05.pdf?la=en