Cattle Creek Wind Farm

Risk Management Assessment Report

RWE Cattle Creek Onshore Wind Pty Ltd

14 July 2026

→ **The Power of Commitment**

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<tr><th>Project name</th><td colspan="6">Cattle Creek Wind Farm</td></tr>
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Acronyms and abbreviations

Acronym	Description
AEPP	Annual Exceedance Probability
BESS	Battery Energy Storage System
BMS	Battery Management System
BRA	Bushfire Risk Assessment
CEMP	Construction Environmental Management Plan
EMR	Electromagnetic Radiation
EMS	Energy Management System
ERP	Emergency Response Plan
ESS	Energy Storage System
FRA	Fire Risk Assessment
FSS	Fire Suppression System
HAZID	Hazard Identification
HV	High Voltage
HVAC	Heating, Ventilation and Air Conditioning
kV	Kilovolt
LFP	Lithium Iron Phosphate
LGAs	Local Government Areas
LFL	Lower Flammability Limit
LOTO	Lock-Out Tag-Out
LV	Low Voltage
MHF	Major Hazard Facility
MHF	Major Hazard Facility
MV	Medium Voltage
MW	Megawatt
O&M	Operations and Maintenance Facility
OSOM	Oversize Overmass
PCS	Power Conversion System
PG	Packing Group
PPE	Personal Protective Equipment
RMAR	Risk Management Assessment Report
SDS	Safety Data Sheet
SPP	State Planning Policy
TNSP	Transmission Network Service Provider
WHS	Work Health and Safety
WTGs	Wind Turbine Generators

Executive summary

Background

This Risk Management Assessment Report (RMAR) has been prepared for RWE Cattle Creek Onshore Wind Pty Ltd (RWE) (the Proponent) for the proposed Battery Energy Storage System (BESS) forming part of the proposed Cattle Creek Wind Farm project in Queensland. The proposed Project comprises of up to 135 wind turbine generators (WTGs) and a BESS system of up to 450 MW capacity; covering an area of approximately 20,404.5 ha.

Objectives

The RMAR focuses specifically on the BESS battery unit and assesses hazards and credible risk scenarios across the lifecycle phases of design, construction, commissioning, operation, and maintenance (O&M), with the objective of identifying prevention and mitigation measures that reduce risk to an acceptable level.

A key objective of the RMAR is to demonstrate compliance with State Code 27: Battery storage facility development [1], specifically the risk mitigation performance outcomes PO2–PO4 relating to management of physical, chemical and battery failure hazards, and the containment of fire/thermal events to prevent escalation and propagation.

The assessment methodology is aligned with AS/NZS ISO 31000:2018 and applies a staged approach, comprising:

- a hazard screening;
- a structured desktop Hazard Identification (HAZID); and
- the development of principal safeguards and controls.

Results and recommendations

The analysis confirms that, during construction and operations, dangerous goods associated with routine activities are expected to remain at minor quantities typical of construction/O&M and therefore are not expected to drive off-site consequence risk under normal conditions.

In relation to BESS-specific hazards, the RMAR identifies that battery systems inherently present hazards such as overheating, thermal runaway, fire and (under certain conditions) explosion/deflagration.

These hazards are mitigated through layered, design-basis safeguards and proposed controls including:

- the container's integrated Battery Management System (BMS), which monitors cell/system parameters and initiates protective actions and controlled isolation via high voltage (HV) relays/contactors under abnormal conditions;
- the container's integrated Fire Suppression System (FSS), which provides staged functions including detection (smoke/heat/hydrogen), exhaust ventilation for deflagration risk reduction, and suppression features (including aerosol and water spray provisions);
- manufacturer-aligned separation/clearance requirements to reduce propagation potential and support safe access; and
- provision of dedicated firewater infrastructure (tanks, pump house and ring main) providing a robust capability for exposure cooling of adjacent containers and helps prevent escalation beyond the initiating enclosure, supporting containment of thermal events within the BESS compound.

The broader Project siting also strengthens risk outcomes:

- the BESS is centrally located within the Project area (increasing separation to boundaries and receptors),
- flammable/combustible storage is not proposed adjacent to the compound; and
- bushfire exposure is reduced because the BESS lies outside the mapped bushfire prone area with site-wide vegetation and separation measures proposed.

Conclusions

Overall, the RMAR concludes that credible BESS hazards are addressed through a combination of integrated system protections (BMS/FSS), site layout and clearance controls, dedicated firewater/response infrastructure, and proposed operational management measures.

On this basis—and consistent with the defined screening scope and limitations— the BESS aligns with the intent of State Code 27 PO2–PO4: managing physical/chemical/battery failure hazards (PO2), mitigating fire/explosion/thermal runaway (PO3), and ensuring fire/thermal events can be contained and isolated to prevent escalation and propagation on- and off-site (PO4).

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Table index

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1. Introduction

This document presents a standalone Risk Management Assessment Report for the Battery Energy Storage System proposed as part of the Cattle Creek Wind Farm in Queensland.

1.1 Project overview

RWE Cattle Creek Onshore Wind Pty Ltd (RWE) (the Proponent) proposes to develop, construct, and operate the Cattle Creek Wind Farm (the Project).

The Project is located approximately 60 kilometres south-west of Dalby and covers an area of approximately 20,404.5 hectares (ha).

The Proposed Development consists of the construction, operation, maintenance, and decommissioning of up to 135 WTGs, Battery Energy Storage System (BESS) and ancillary infrastructure (supporting infrastructure) consisting of:

- WTG foundations, crane hardstands, crane boom laydown, blade laydown and rotor assembly area;
- Access tracks, including:
  - New and upgraded tracks within the Project Area, generally comprising of a nominal range of 5.5 m – 10 m wide permanent access track, and a maximum 50 - 95 m wide cleared corridor for Oversize Overmass (OSOM) vehicles;
- Low voltage (LV) and medium voltage (MV) underground cabling, as well as MV and high voltage (HV) overhead transmission lines;
- Three internal collector substations;
- A switching station adjacent to the existing 330 kV Powerlink transmission line. This has been accounted for within the Disturbance Footprint, thereby allowing the clearing of the site to be assessed as part of the impacts associated with the Proposed Development (noting, however, that the switching station infrastructure will be constructed, owned and operated by Powerlink);
- Up to six permanent meteorological masts;
- Construction compounds and laydown areas;
- Washdown areas;
- Operational and maintenance facilities; and
- A construction workers accommodation facility.

Further, there is the potential for the inclusion of the below infrastructure:

- Concrete batching plants;
- Borrow pits; and
- Communications tower.

As part of the broader Project scope, and to strengthen the integration of renewable generation with the electricity network, a BESS will be implemented. The BESS is intended to support the efficient utilisation of wind generation and to contribute to grid services, including balancing and operational flexibility.’

1.2 Purpose of this report

The purpose of this RMAR is to identify and characterise hazards and credible risk scenarios associated with the BESS across its lifecycle, including design, construction, commissioning, operation, and maintenance. The RMAR also sets out the prevention and mitigation measures required to reduce risks.

A key objective of this RMAR is to demonstrate compliance with PO2–PO4 of State Code 27: Battery storage facility development [1]. Accordingly, the report is structured to:

– Identify credible physical, chemical, and battery failure hazards associated with the proposed battery storage infrastructure
– Consider fire, explosion, and thermal runaway scenarios that may arise from those hazards
– Qualitatively assess potential impacts to human health and safety, and to the built and natural environment
– Document existing and proposed controls and mitigation measures relevant to the identified risks.

1.3 Scope and limitations

This report has been prepared by GHD for RWE Cattle Creek Onshore Wind Pty Ltd and may only be used and relied on by RWE Cattle Creek Onshore Wind Pty Ltd for the purpose agreed between GHD and RWE Cattle Creek Onshore Wind Pty Ltd as set out in section 1.2 of this report.

GHD otherwise disclaims responsibility to any person other than RWE Cattle Creek Onshore Wind Pty Ltd arising in connection with this report. GHD also excludes implied warranties and conditions, to the extent legally permissible.

The services undertaken by GHD in connection with preparing this report were limited to those specifically detailed in the report and are subject to the scope limitations set out in the report.

The opinions, conclusions and any recommendations in this report are based on conditions encountered and information reviewed at the date of preparation of the report. GHD has no responsibility or obligation to update this report to account for events or changes occurring subsequent to the date that the report was prepared.

This study is limited to the BESS battery unit. All equipment upstream or downstream of the battery unit is excluded from the assessment. This includes, but is not limited to substations, overhead/underground transmission and collection assets, and wind farm generation equipment.

The following are excluded from the scope of this report:
- Detailed engineering design of fire suppression or protection systems;
- Quantitative fire, explosion or thermal modelling;
- Detailed emergency response planning.

The opinions, conclusions and any recommendations in this report are based on assumptions made by GHD described in this report. GHD disclaims liability arising from any of the assumptions being incorrect.

1.4 Assumptions

This assessment is based on the information available at the time of writing. Detailed engineering parameters have not yet been provided; accordingly, the assessment relies on the available data and adopts reasonable, conservative assumptions where information is absent.

2. Site description

2.1 Location of the project

The Project is located approximately 60km south-west of Dalby and 110 km west of Toowoomba, in the Toowoomba Regional Council and Western Downs Regional Council Local Government Areas (LGAs) of Queensland.

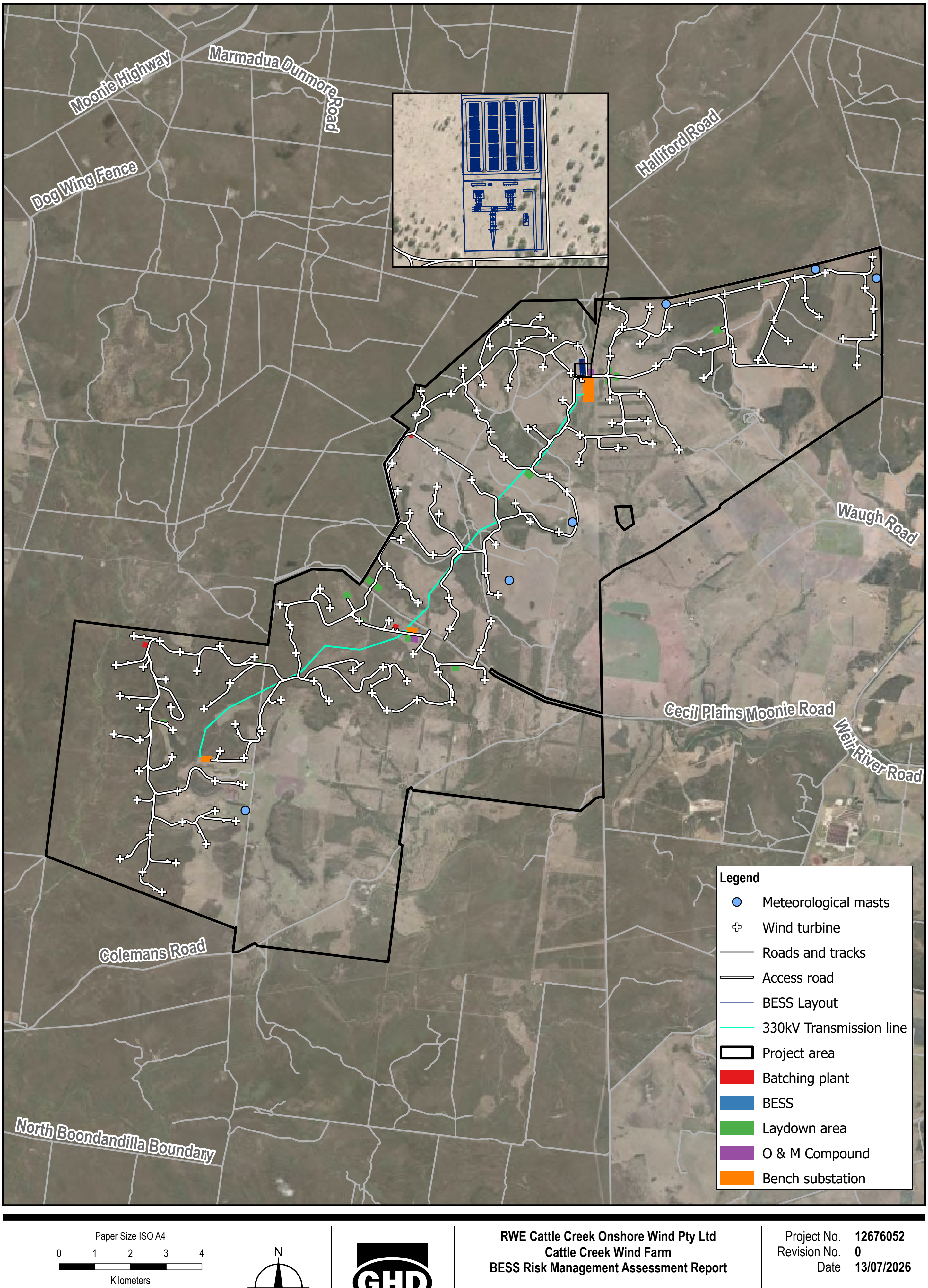
The Proposed Development will comprise of up to 135 WTGs including a BESS system and will be located on freehold grazing land, over twelve separate lots and road reserves herein referred to as the ‘Project Area’. The total area encompassing the Project Area is approximately 20,404.5 ha.

The predominant land use is cattle grazing, animal husbandry and related rural activities, and there are no identified sensitive human receptors (e.g. residences, schools or healthcare facilities) in the immediate vicinity of the Project. The BESS will be located in the centre of the Project area, providing additional separation distance from potential receptors.

Throughout the life of the Proposed Development, host properties will continue to use land for agricultural activities, and it is anticipated that tracks established during construction of the Proposed Development will aid continued agricultural activities.

A small number of dwellings, including dispersed farmhouses, are located throughout the broader area.

Figure 1 below provides an overview of the proposed Development within the Project Area.



Map Projection: Transverse Mercator
Horizontal Datum: GDA2020
Grid: GDA2020 MGA Zone 56

GHD

RWE Cattle Creek Onshore Wind Pty Ltd
Cattle Creek Wind Farm
BESS Risk Management Assessment Report

Project No.	**12676052**
Revision No.	**0**
Date	**13/07/2026**

Project Layout

FIGURE 1

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Print date: 13 Jul 2026 - 09:06

Data source: RWE: meteorological masts, wind turbine, access road, transmission line, batching plant, laydown area, O & M compound, Bench substation (2025), BESS layout (2026); DNRMMRD: roads and tracks (2026); GHD: project area (2025); World Imagery: Earthstar Geographics
World Imagery: Source: Esri, Vantor, Earthstar Geographics, and the GIS User Community extracted 13/07/2026. Created by: mvandermerwe

2.2 BESS description

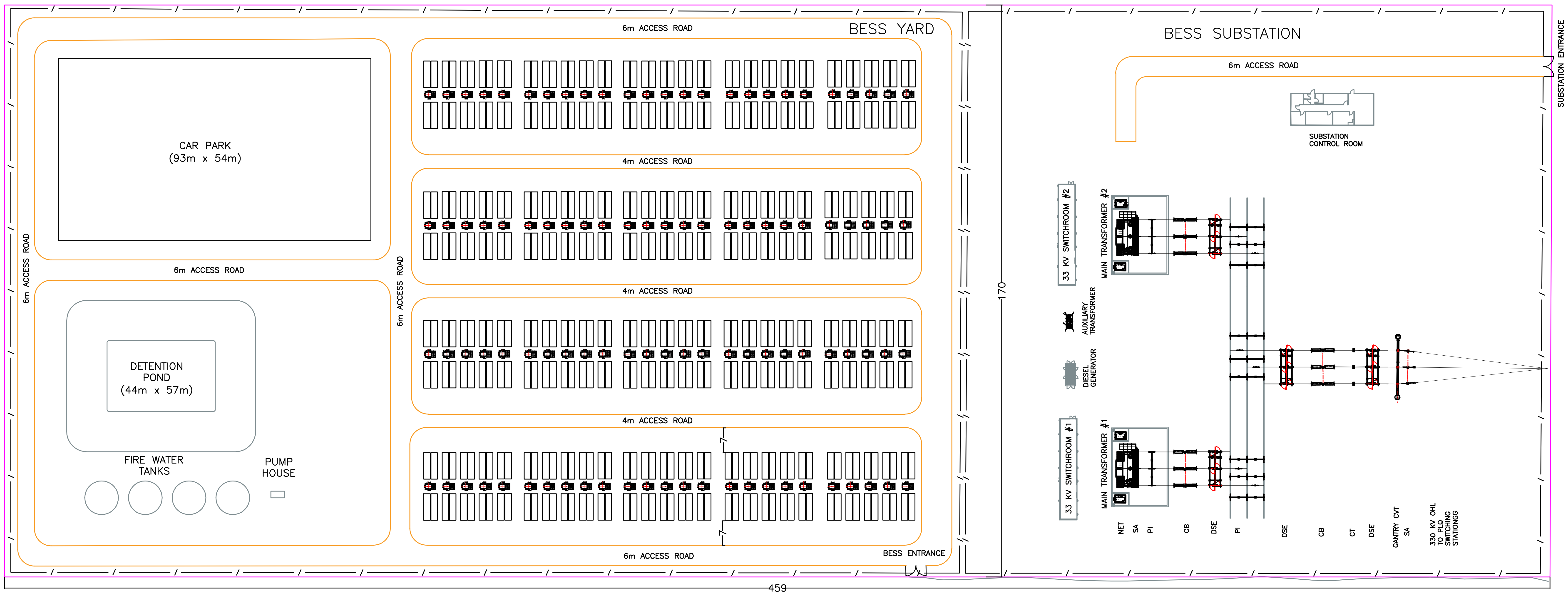
As part of the Project, a BESS with a generation/charge capacity of up to 450MW is designed as an integrated facility combining energy storage, power conversion, grid connection, and supporting infrastructure. It incorporates electrical, mechanical, and safety-related components arranged to ensure reliable operation, maintainability, and compliance with applicable standards.

The proposed BESS system is anticipated to utilise up to 13№ 33kV feeders from the main switchboards, connected to the Medium Voltage Power Stations (MVPS) and an estimated 400 BESS units. The project will be connected to the Powerlink 330 kV network at the Transmission Network Service Provider (TNSP) Switching Station, located adjacent to the BESS Project area.

A typical 450MW BESS system is composed of:

- Up to 400 battery containers;
- Up to 100 MV skids equipped with 100 medium-voltage step-up transformers;
- Up to 2 power transformers;
- 1 substation;
- 1 switch room building;
- 1 operation and maintenance building;
- 1 warehouse;
- 1 diesel tank;
- 1 diesel generator;
- 4 fire water tanks;
- 1 fire water pump house;
- 1 detention pond; and
- 1 car park.

Figure 2 presents the general arrangement of the BESS unit, illustrating the layout of the main components listed above.



LEGEND

FENCE
WATER TANK
ROAD
LOT BOUNDARY
BESS BLOCK
(NOTE 2)
OHL POLE

ABBREVIATIONS:

CB CIRCUIT BREAKER
CVT CAPACITIVE VOLTAGE TRANSFORMER
DSE DISCONNECTOR & EARTH SWITCH
PI POST INSULATOR
SA SURGE ARRESTOR
NET NEUTRAL EARTHING TRANSFORMER

PROJECT SUMMARY

Country	AUSTRALIA
State	QUEENSLAND
BATTERY UNIT	
Type of battery	TESLA-MEGAPACK3
Installed Capacity	482MW/1929MWH
Number of Battery	400
Duration	4HR
INVERTER	
Type of Inverter	TESLA-MEGAPACK3-INVERTER
Nominal AC power of Transformer (@ 25°C)	3180/3180/6360KVA
Number of inverters	400
Number of tranformers(33KV)	100

NOTES

1. THE INDICATED LAYOUT AND OVERALL FOOTPRINT OF THE PROJECT REMAINS SUBJECT TO CHANGE IN DETAILED DESIGN. THE PROVIDED LAYOUT AND FOOTPRINT IS INDICATIVE ONLY AND IS EXPECTED TO BE UPDATED IN LATER STAGES OF THE PROJECT TO INCORPORATE DESIGN OPTIMISATIONS, IN ADDITION TO CONSIDERATIONS TOWARDS OEM REQUIREMENTS.
2. BESS BLOCKS ARE BASED ON TESLA MEGAPACK 3 WHICH INCLUDES BATTERY, INVERTER, MV TRANSFORMER AND MV RMUs.
3. ALL DIMENSIONS RELATED TO EQUIPMENT AND ASSETS ARE APPROXIMATIONS AND MUST BE VERIFIED DURING DETAILED DESIGN STAGE AND AFTER FINAL SELECTION OF THE BESS AND PCS EQUIPMENT MODELS.
4. SITE FACILITIES INDICATIVE.
5. OHL LOCATION INDICATIVE.
6. MINIMUM ARC DISTANCE - 2200 MM, AS/NZS 7000
7. MIN GL CLEARANCE OVER PUBLIC ROADS,TRANSMISSION LINE ACCESS TRACKS, AND FARMER TRACKS -8.5 M (7.5 M - AS 7000:2016 + 1.0 M BUFFER).
8. OHL CONDUCTOR SIZE TO BE CONFIRMED.

E01

REV No.	REVISION DESCRIPTION	DRAWN BY	CHECKED BY	APPR'D BY	DATE
A	PRELIMINARY PROPOSED LAYOUT	HS			09/07/2026

RWE CATTLE CREEK ONSHORE WIND

RWE

REFERENCE DRAWINGS

DRAWN	HS	09/07/2026
REVIEW		
APPROVED		

DRAWING STATUS

CATTLE CREEK BESS PRELIMINARY LAYOUT

450 MW 4 hr BESS

A2

3. Legislative, standards and guidance context

This chapter describes the relevant legislative, standards and guidance context to the assessment, as listed in Table 1.

Table 1 Legislative and policy context

Legislative policy or guideline	Description
State Planning Policy (SPP)	The SPP addresses development risks, by establishing planning constraints based on a statewide risk assessment. The relevant State code for BESS facilities is Queensland State Code 27: Battery storage facility development [1]. State Code 27, and the associated performance outcomes relating to risk mitigation, provide the primary framework for identifying, assessing, and managing risks associated with battery storage facilities. The principal objective of this report is to demonstrate how the proposed BESS meets these performance outcomes.
Work Health and Safety Act and Regulation	The Queensland Work Health and Safety (WHS) Act 2011 and Regulation 2011 describe the duties of persons conducting businesses or undertakings that design, supply, install and manage fixtures, fittings or plant at workplaces. Within the WHS Act, there is a requirement to consider whether the facility is a Major Hazardous Facility (MHF) based on the quantity of dangerous goods contained within the Project area. This Project is not considered an MHF, as the dangerous goods expected to be within the Project area do not reach the quantity thresholds as stipulated in WHS Schedule 15.
NFPA 855 (Stationary Energy Storage Systems)	This NFPA standard provides internationally recognised installation and safety requirements for ESS, including spacing, fire protection and hazard mitigation expectations.

4. Methodology

The overall methodology and structure of this report are aligned with AS/NZS ISO 31000:2018 Risk Management – Guidelines [2]. In accordance with this framework, the assessment follows a staged process comprising:

- Hazard screening to identify hazardous goods, credible physical, chemical, and battery failure hazards associated with the proposed battery storage infrastructure;
- A structured desktop HAZID to define risk scenarios, including initiating causes, potential consequences, and candidate controls and mitigation measures; and
- The development of the principal controls and safeguards required for the Project, to demonstrate that risks are managed to an acceptable level.

4.1 Hazard screening

Hazard screening is conducted as an initial, high-level step to establish a complete and project-relevant hazard baseline for the BESS. This includes identifying hazardous goods and substances that may be stored or generated (e.g., electrolytes and off-gases), as well as credible physical hazards (electrical faults, arc flash, mechanical damage, external impacts), chemical hazards (toxic/flammable gas release), and battery failure modes (cell failure, propagation and thermal runaway).

4.2 Hazard identification

Building on the screened hazards, a structured desktop HAZID is then undertaken to develop credible risk scenarios in a systematic and traceable manner. For each hazard, the HAZID identifies initiating events/causes, the sequence of escalation where relevant, and the potential consequences to people, assets, continuity of supply, and the environment. The HAZID also documents existing and proposed controls, spanning design features, detection and protection systems, operational procedures, inspection/maintenance activities, and emergency response arrangements, so that each scenario has a clear line of sight from cause through to consequence and risk treatment.

4.3 Principal safeguards

This step refines and prioritises the control set (prevention, protection, mitigation, and response) and clarifies how each control is expected to perform (e.g., performance intent, operational dependency, and interface requirements). The result is a coherent control framework suitable for design development and implementation planning, supporting demonstration that risks have been appropriately reduced and are managed in a structured, defensible manner for the BESS throughout its lifecycle.

5. Preliminary risk screening

5.1 Dangerous goods summary

A dangerous good is a substance or article that poses a risk to people, property, or the environment. Each class represents a different type of dangerous good. Some classes are divided into packing groups where Packing Group (PG) I substances present a high level of danger, PG II substances present a medium level of danger, and PG III substances present a low level of danger.

5.1.1 Construction activities

A summary of the indicative type and quantity of dangerous goods that are expected to be handled and/or stored on-site as a result of the BESS construction are shown in Table 2.

Table 2 Summary of potentially dangerous goods on-site during construction

Chemical / product	UN #	Dangerous goods class	Packing group	Indicative storage quantity
Acetylene (for welding)	1001	2.1	N/A	Minimal amount stored on-site
Oxygen (for welding)	1072	5.1	N/A	Minimal amount stored on-site
Paint (oil based considered worst case)	1263	3	II	Minimal amount stored on-site
Solvents	multiple	3	II	Minimal amount stored on-site
Epoxy resins	multiple	3	III	Minimal amount stored on-site
Cleaning products	multiple	8	II	Minimal amount stored on-site
General oils and lubricants (C2)	1791	9	III	Minimal amount stored on-site

5.1.2 Operational activities

During operation, dangerous goods may be found at the BESS facility for general operation and maintenance requirements. This includes Lithium Iron Phosphate (LFP) batteries, LFP battery coolant, and transformer oil (contained within the transformers only). The location of the battery storage area, which contains the dangerous goods, will be within the proposed BESS yard shown on Figure 2.

A summary of the indicative type and quantity of dangerous goods that are expected to be handled and/or stored on-site as a result of the ongoing operation of the BESS is shown in Table 3. The dangerous goods are considered generic, and for example, manufacturer safety data sheets were used to confirm the dangerous goods class.

Table 3 Summary of indicative dangerous goods on-site during operation

Chemical/product	UN #	Dangerous goods class	Packing group	Maximum storage	Quantity (tonnes)
Spray paint	1950	2.1	N/A	Minimal amount stored on-site	0.01
General paint (worst case - oil based)	1263	3	II	Minimal amount stored on-site	0.1
Isopropyl alcohol	1219	3	II	Minimal amount stored on-site	0.1
Cleaning agents	multiple	8	II	Minimal amount stored on-site	<1
Lithium Iron Phosphate Batteries	3480	9	N/A	400 container units (3328 LFP cells per container [4]; 9.3±0.3kg/cell [3])	12,780 (Inside containers)
Ethylene Glycol (50% of EC-45 coolant)	3082	Not classified as dangerous goods		400 container units x 200 L per unit*	90 (Inside containers)
Herbicides	N/A	Not classified as dangerous goods		Minimal amount stored on-site 1 IBC*	<1
Transformer oil	N/A	Not classified as dangerous goods (K-Class fluid)		Oil in the transformers: 440V/33kV transformers - 100 x 3000L* Main Step-Up Transformers - 2x 60kL*	~370
Diesel	3082	9	III	Minimal storage for back-up generator – 1000L*	<1

* This value has been assumed based on past project experience

5.2 Construction of the project

5.2.1 Dangerous goods screening

During construction, the anticipated activities include lifting operations, welding/hot works, electrical works, and general civil and structural works. These activities will be undertaken entirely within the Project footprint and are not expected to involve routine handling or storage of dangerous goods beyond minor quantities typically associated with construction works.

The project will comply with all dangerous goods requirements designated in the WHS legislation during construction.

5.2.2 Transport movement screening

Construction will require the delivery of major equipment and materials, including battery containers, transformers, structural steel, and electrical equipment. However, the intent is to minimise on-site storage of dangerous goods within the construction compound, limiting this to small quantities typically required for construction plant and equipment (e.g., fuels, oils, and lubricants), managed through standard construction controls.

Construction traffic will need to be managed through project logistics planning to ensure safe access, and segregation from other construction activities, and appropriate scheduling of heavy vehicle movements.

5.2.3 Other risk screening

During construction, the highest-risk activities are expected to include lifting and handling of heavy components (e.g., battery containers and transformers), hot work activities, and electrical works, including connection and interfacing with the power network.

5.3 Operation of the project

5.3.1 Dangerous goods screening

During operations, the BESS facility will contain a limited range of hazardous substances associated with routine maintenance and minor site activities (e.g., small quantities of spray paint, paints/solvents, isopropyl alcohol and cleaning products). These materials are expected to be held only in minimal quantities typical of maintenance use and are therefore not anticipated to trigger dangerous goods licensing thresholds or represent a credible source of off-site consequence, provided they are stored and managed in accordance with standard hazardous chemical controls (segregation, bunding where relevant, SDS register, and spill response arrangements).

The principal hazardous inventory at the facility is the installed lithium-ion battery system, which is regulated for transport as UN 3480, Class 9 (miscellaneous dangerous goods). Lithium-ion batteries can pose unique safety hazards since they contain flammable electrolyte and may be kept pressurised. If a battery cell is charged too quickly, it can cause a short circuit, which leads to thermal runaway, potential explosions, and battery fires [5]. As summarised in Table 3, this inventory is contained within the BESS containers as part of the fixed installation (rather than being routinely handled or stored as packaged dangerous goods), and the container design incorporates integrated safety systems and controls (including a BMS and an integrated fire safety system) to manage battery hazards such as overheating/thermal runaway and associated fire/explosion risks.

Other bulk liquids listed in Table 3 (e.g., glycol-based coolant and K-class transformer insulating fluid) are identified as not classified as dangerous goods for the purposes of this screening; nonetheless, they should continue to be managed as environmentally relevant liquids through appropriate containment and spill management practices.

5.3.2 Transport movement screening

During operations, no transport of dangerous goods to or from the BESS unit is expected.

5.3.3 Other risk screening

Further details on the hazardous components that may cause offsite impacts are described in the following sections.

Thermal runaway background

A thermal runaway incident is “where one exothermal process triggers other processes, finally resulting in an uncontrollable increase in temperature. This can result in destruction of the battery or, in severe cases, in fire” [6]. Thermal runaway of a cabinet of batteries within a container, such as a Tesla Megapack, could result in gaseous release of electrolyte, refrigerant, coolant, or combustion products, including heated chlorinated or fluorinated hydrocarbons and other toxic compounds. There is also the possibility of the fire spreading to adjacent modules.

While thermal runaway is a possible consequence of a variety of failure modes, the potential causes can be broadly categorised into the following groups [7]:

– electrical misuse (e.g. over or under charging);
– thermal stress (e.g. overheating);
– physical damage (e.g. external impact); and
– existing, latent defects (e.g. electrolyte leaks, faulty components).

There have been several self-heating and thermal runaway incidents at gride scale BESS facilities over the past decade. Hence, extensive studies have been conducted to understand the mechanistic pathways which promote thermal runaway events. The release, dispersion and flammable effects of thermal runaway of lithium-ion batteries have been tested with smaller battery assemblies for consumer/retail equipment due to thermal events associated with hoverboards, e-cigarettes or mobile phones [5]. Some events have happened at a larger commercial scale, including events at a 2 MW battery array in the USA which injured a team of firefighters [8] and the Moorabool, Victoria Big Battery BESS facility fire in July 2021 [9].

This knowledge has been used to develop effective mitigation measures to either eliminate or reduce such occurrences in currently designed BESS facilities. Evidence has shown that sufficient separation distance between cabinets will reduce escalation potential, and slow down or eliminate propagation of a thermal event from one battery cabinet to adjacent equipment. Additionally, separation of containers will also limit escalation potential.

Transformers

The Project Area includes several transformers, with the insulation oil used in these transformers being the primary fire risk. If the oil is ejected and ignited, it could result in a pool fire within the transformer bund, radiating heat to nearby structures such as the BESS units and potentially causing an additional fire.

The transformers on-site include:

– Step-up transformers in the MV skid; and
– Power transformers.

BESS explosion

In the event of abnormal overheating or thermal runaway, lithium-ion batteries can vent flammable gases (typically including hydrogen, carbon monoxide and light hydrocarbons). If these gases accumulate within a confined space and mix with air, they may reach concentrations above the lower flammability limit (LFL) and, in the presence of an ignition source, result in a deflagration (subsonic speed explosion overpressure) rather than a battery detonation (supersonic speed explosion overpressure). This hazard is recognised in current industry guidance and is a key reason why modern BESS designs include dedicated gas detection and explosion management measures.

For this Project, explosion risk is mitigated through the container's integrated Fire Suppression System (FSS), which includes hydrogen detection and an exhaust ventilation function designed to reduce deflagration potential by purging combustible gases from the battery compartment, together with alarms/notifications and defined response actions (including operational isolation via site control systems and emergency procedures).

Toxic releases

Thermal runaway and battery fires can generate toxic and irritant combustion products, with carbon monoxide (CO) typically being a dominant acute hazard in enclosure fire scenarios, and additional irritant/acid gases possible depending on electrolyte and materials decomposition (notably hydrogen fluoride (HF) reported in lithium-ion vent gas analyses and industry guidance).

For this Project, these aspects are supported by the integrated FSS detection and alarm suite (smoke/heat/hydrogen detection and alarms), which enables early identification of abnormal conditions and timely escalation, and by the site's broader emergency arrangements (including isolation protocols and exposure management).

5.4 Bushfire risk

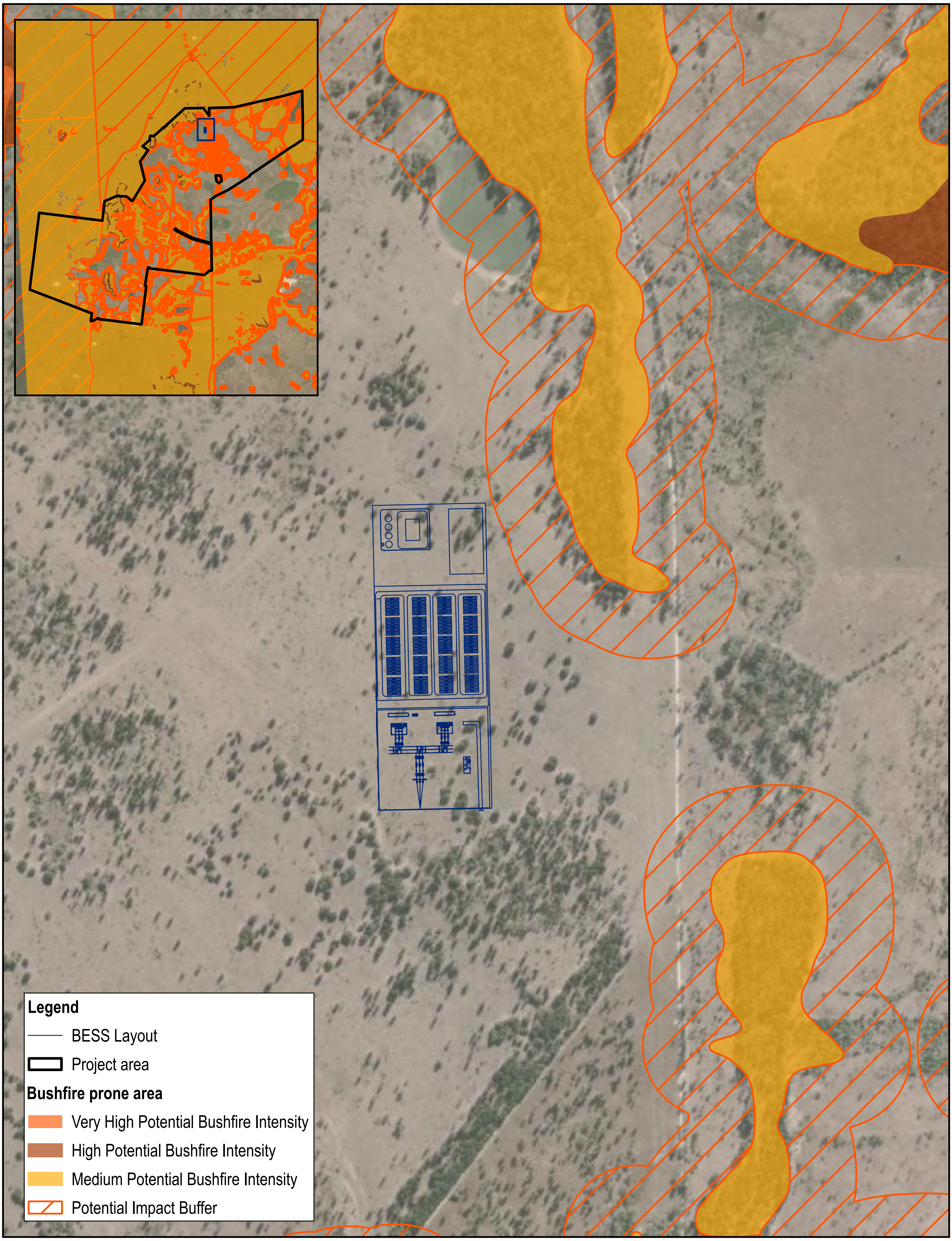
Bushfire risk is a relevant external hazard for BESS and should be explicitly considered, as exposure to radiant heat, flame contact, ember attack and smoke can affect container integrity, auxiliary systems (e.g., HVAC), cable routes and emergency access, potentially escalating an incident or constraining response.

Figure 3 presents the proposed BESS location overlaid with the Queensland Bushfire Prone Area mapping (state-wide mapping developed to support the State Planning Policy, July 2014). As shown, the proposed BESS is located outside the mapped bushfire prone area / bushfire hazard extent, indicating that it is not situated within the state-mapped bushfire risk zones.

A site-wide bushfire risk assessment has been undertaken by Covey Associates (Report N25-0493). The assessment indicates that, based on bushfire modelling, the BESS is located outside the 3 kW/m² bushfire radiant heat intensity contour.

Finally, the BESS is proposed near the centre of the Project area, providing additional separation from external bushfire-prone vegetation and public receptors.

Accordingly, it is considered unlikely that the BESS would be materially affected by bushfire risk.



Paper Size ISO A4

0 50 100 150 200

Metres

Map Projection: Transverse Mercator
Horizontal Datum: GDA2020
Grid: GDA2020 MGA Zone 56

N

RWE Cattle Creek Onshore Wind Pty Ltd
Cattle Creek Wind Farm
BESS Risk Management Assessment Report

Project No. **12676052**
Revision No. **0**
Date **13/07/2026**

State Planning Policy - Bushfire Prone Area

FIGURE 3

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Print date: 13 Jul 2026 - 09:06

Data source: QFES: bushfire prone area (2015); GHD: project area (2025); RWE: BESS layout (2026); World Imagery: Source: Esri, Vantor, Earthstar Geographics, and the GIS User Community
World Imagery: Earthstar Geographics extracted 13/07/2026. Created by: mvandermerwe

6. Hazard identification

6.1 Desktop HAZID

The hazard identification and safeguards for the construction and operational phases are provided in Table 4. The safeguards are required to ensure the risk scenarios that were identified are contained or at least controlled to an acceptable level. In undertaking the hazard identification study, the following assumptions were made:

– All plant and equipment are installed and operated in accordance with appropriate Australian Standards, codes and guidelines;
– Dangerous goods are stored in accordance with the Australian Dangerous Goods Code, relevant standards and guidelines, even if not a licensable quantity;
– All equipment and systems are designed to incorporate safety-in-design principles that aim to eliminate or minimize hazards through engineering controls and protective measures;
– Personnel are trained and competent to perform their assigned tasks;
– Personnel attend work free from the influence of drugs, alcohol and fatigue; and
– Supervision arrangements are in place for all works performed at site.

Table 4 Hazard identification

#	Hazard scenario	Causes	Consequence	Potential for off-site impact	Safeguards
Construction Phase					
1	Vehicle interactions on public roads	– Vehicle movements to and from the Project area adjacent to public roads	– Personal injury / fatality	Yes	– Prepare traffic management plans including standard traffic rules and signage for construction and operation – Licensed and inducted driver on-site roads.
2	Vehicle interactions within the Project area	– Vehicle movements in vicinity of personnel	– Personal injury	No	– Prepare traffic management plans including standard traffic rules and signage for construction and operation – Implement Project area speed limits – Provide designated pedestrian areas for construction and operation – Licensed and inducted drivers
3	Natural hazards	– Flooding, earthquake, extreme wind, lightning, bushfire	– Personal injury – Asset damage – Site shut down	No	– Construction environmental management plan (CEMP) – Dust management and Personal Protective Equipment (PPE) measures – Door hardware to prevent uncontrolled closure due to wind – Lightning protection – BESS site built above 1% Annual Exceedance Probability (AEP) flood levels – Firebreaks around the facility – Onsite firewater infrastructure (tanks, pump house and ring main) – Structures built to Australian Standards for wind and earthquakes.
4	Fire started within the Project area	– Hot works	– Personal injury / fatality	No	– Manage fuel for vehicles and machinery within the Project area to appropriate standards – Hazardous goods storage areas are to be kept free of vegetation – Construction environmental management plan (CEMP) including hot work permit process – Hot Work Procedure, including Hot Work Permits, Designated Hot Work Bays, no hot work permitted on fire ban days.
5	Loss of containment of chemicals, including dangerous goods	– Damage to storage containers e.g. due to external impact – Human error	– Environmental damage – Personal injury	No	– Store chemicals in line with appropriate standards – Implement a regular inspection and maintenance regime for chemical storage areas – Implement standard handling/lifting procedures – Provide a Safe Work Method Statement detailing methods for chemical handling procedures – Provide spill kits to be used in the event of an incident involving release of chemicals – Implement standard transfer and handling procedures – Provide appropriate PPE to staff handling dangerous and hazardous goods – Minimise use of dangerous materials within the Project area

#	Hazard scenario	Causes	Consequence	Potential for off-site impact	Safeguards
6	Contact with chemicals, including dangerous goods	– General construction activities (welding, refuelling) – Vegetation management	– Personal injury	No	– Store chemicals in line with appropriate standards – Implement a regular inspection and maintenance regime for chemical storage areas – Implement standard handling procedures – Provide a Safe Work Method Statement detailing methods for chemical handling procedures – Provide spill kits to be used in the event of an incident involving release of chemicals – Implement standard transfer and handling procedures – Provide appropriate PPE to staff handling dangerous and hazardous goods – SDS folder to be kept on-site containing a copy of the relevant SDS for hazardous chemical substance, stored as per segregation requirements of the Dangerous Good Code
7	Contact with electricity	– Contact with live electrical source – Cranes impacting overhead lines – Connection to existing overhead power lines	– Personal injury / fatality	No	– Construction environmental management plan (CEMP) – Undertake a detailed Safety in Design process – Implement isolation procedures prior to maintenance of electrical equipment – Use a spotter for crane operation – Install fit for purpose electrical systems – Supply and use of arc flash protective PPE – Secure Project area and BESS footprint (fencing, gate person) – Emergent response procedures – Unenergized site until commissioning – Clear identification of electrical hazards once Project area is engaged – Permit to Work and lock-out-tag-out processes – Designed to appropriate standards – Low voltage rescue training and associated rescue equipment
8	Lifting operations – dropped load/falling object (e.g., battery container, transformer, crane components)	– Rigging failure – Human error – Strong wind / adverse weather conditions – Inadequate ground bearing / crane instability	– – Serious injury / fatality to personnel – Asset damage	No	– Lift plan developed for all critical lifts (including lift studies as required) – Competent personnel (licensed crane operators, qualified riggers/doggers) and designated lift supervisor – Inspection and certification of lifting equipment (slings, shackles, spreader bars) – Exclusion zones and controlled access during lifting, including spotters and barricading – Weather/wind limits defined and enforced; lifts stopped under unsafe conditions – Ground bearing assessment and crane set-up controls (outrigger mats, level verification)

#	Hazard scenario	Causes	Consequence	Potential for off-site impact	Safeguards
Operation & Maintenance					
9	Thermal runaway of lithium-ion batteries	– Over and under-voltage during discharge of batteries – Over discharge of batteries – Internal short-circuit – Damaged battery – Coolant leak	– Thermal runaway event leading to battery fire – Toxic gas generation – Personal injury / fatality – Asset damage	No	– Thermal control and thermal runaway detection – Batteries stored as per supplier's specifications – Fusible separators inside cells – Provide insulation around batteries – Battery Management System (BMS) to properly manage the batteries state of charge – Integrated circuit control systems, to avoid voltage drift – Current sensing circuits, to avoid short circuiting – Battery balancing devices, to avoid deterioration and individual cell over/under voltage – Factory cell matching (capacity balancing of battery batches to avoid single cell overcharge situations) – Incorporate the potential for toxic gases being generated during a BESS fire into the Emergency Response Procedures, including appropriate PPE and or exclusion zones for emergency responders. – Detailed design and installation to NFPA 855 and manufacturer's manual – Use of BESS compliant with UL9540 and tested to UL9540A – Integrated Fire Suppression System (FSS) – Onsite firewater infrastructure (tanks, pump house and ring main) – Contaminated firewater management system (drainage + detention basin)
10	Fire propagation to other batteries	– Heat transfer and subsequent thermal runaway reaction in adjacent battery	– Thermal runaway event leading to battery fire – Toxic gas generation – Personal injury / fatality – Asset damage	No	– Fire Risk Assessment/Safety Study, including validation of separation distances to prevent escalation – Integrated Fire Suppression System (FSS) – Detailed design and installation to NFPA 855 and manufacturer's manual – Fire testing by Original Equipment Manufacturers (OEMs) in accordance with UL9540A – Clearance as per manufacturer requirements – Onsite firewater infrastructure (tanks, pump house and ring main) – Contaminated firewater management system (drainage + detention basin)

#	Hazard scenario	Causes	Consequence	Potential for off-site impact	Safeguards
11	Mechanical or chemical damage of lithium-ion battery assemblies, causing thermal runaway	– Rapid heating of individual cells (e.g. lack of venting, thermal runaway reactions) – Vehicle impact into batteries	– Thermal runaway event leading to battery fire – Toxic gas generation – Personal injury / fatality – Asset Damage	No	– Batteries are Quality Assured to ISO 9001, AS/ NZS 5139 – Physical measures to mitigate possible vehicle impact – Batteries stored as per supplier's specifications – Implement a regular inspection and maintenance regime for the battery assemblies – Units will be ground mounted to a foundation or base strong enough to support the weight of the equipment and anchor loads – Integrated Fire Suppression System (FSS) – Site traffic management plan – Onsite firewater infrastructure (tanks, pump house and ring main) – Contaminated firewater management system (drainage + detention basin)
12	Battery Explosion	– Battery thermal runaway and generation of off gases that are flammable. – Ignition of off gases within enclosure resulting in confined explosion	– Toxic gas generation – Personal injury / fatality – Asset Damage	No	– Thermal control systems inside BESS containers – Integrated Fire Suppression System (FSS) – General container ventilation – Pressure sensitive vents (on BESS containers) that discharge to safe locations – Battery Management System (BMS) to properly manage the batteries' state of charge
13	Electromagnetic Radiation (EMR)	– EMR generated from BESS, High Voltage Power lines, Grid infrastructure)	– Personal injury / fatality	No	– All designs will be in accordance with the Guidelines for limiting exposure to Time varying Electric, Magnetic and Electromagnetic Fields (International Commission on Non-Ionizing Radiation Protection, 1998; International Commission on Non-Ionizing Radiation Protection, 2010) and relevant codes and industry best practice standards in Australia. – All relevant procedures in relation to a high voltage installation will be adhered to throughout the life of the Project. – The security access system for the Project area, including safety fencing and closure of gates, will be maintained throughout the construction and operation, to provide safe exposure distances to the public. – Restricted access to Project area and access only to safety inducted personnel.

#	Hazard scenario	Causes	Consequence	Potential for off-site impact	Safeguards
14	Natural Hazards	– Flooding, earthquake, lightning, bushfire	– Personal injury / fatality – Asset Damage – Project area shut down	No	– Design structures to appropriate codes and standards – Manage fuel for vehicles and machinery within the Project area to appropriate standards – Design buildings to appropriate codes – Provide fire protection systems – Prepare a bushfire management plan in consultation with the Rural Fire Service – Lightning protection – BESS site built above 1% AEP flood levels – Firebreaks around the facility – Site specific emergency management plan, trained fire wardens, site first aiders, fire extinguishers, first aid kits – Onsite firewater infrastructure (tanks, pump house and ring main) – Contaminated firewater management system (drainage + detention basin)
15	Internal Project area fire	– Diesel tank or piping leak	– Personal injury / fatality – Asset Damage –	No	– Standard operation procedure – Tank placed above a retention bund – Emergency Response Plan – Onsite firewater infrastructure (tanks, pump house and ring main) – Contaminated firewater management system (drainage + detention basin)
16	External Fire	– Fire or explosion from sources external to the BESS.	– Personal injury / fatality – Asset Damage – Project area shut down	No	– Design structures to appropriate codes and standards – Manage fuel for vehicles and machinery within the Project area to appropriate standards – Design buildings to appropriate codes – Implementing minimum clearance / firebreaks to mitigate external fire hazards, as well as mitigation of propagation of external fires to outside the Project area boundary – Onsite firewater infrastructure (tanks, pump house and ring main) – Contaminated firewater management system (drainage + detention basin) – Site specific emergency management plan, trained fire wardens, site first aiders, fire extinguishers, first aid kits

#	Hazard scenario	Causes	Consequence	Potential for off-site impact	Safeguards
17	Loss of containment of chemicals, including dangerous goods	– Damage to storage containers e.g. due to external impact – Wear and tear – Thermal runaway	– Environmental damage – Personal injury	No	– Avoid/limit storage of hazardous materials within the Project area – Store chemicals and hazardous materials in line with appropriate standards (e.g. herbicides) – Implement a regular inspection and maintenance regime for chemical storage areas – Implement standard handling procedures – Provide a Safe Work Method Statement detailing chemical handling procedures – Provide spill kits to be used in the event of an incident involving release of chemicals – Implement standard transfer and handling procedures – Provide appropriate PPE to staff handling dangerous and hazardous goods – Self bunding flammable goods cabinets, bunded pallets
18	Contact with chemicals, including dangerous goods	– Maintenance of batteries	– Contact with chemicals, including dangerous goods	No	– Store chemicals in line with appropriate standards – Implement a regular inspection and maintenance regime for chemical storage areas – Implement standard handling procedures – Provide a Safe Work Method Statement detailing methods for chemical handling procedures – Provide spill kits to be used in the event of an incident involving release of chemicals – Implement standard transfer and handling procedures – Provide PPE to all staff
19	Power converter fire/explosion	– Internal failure of a power capacitor – Overvoltage and vales overheated – Overcurrent and cables overheated – Arc Fault	– Personal injury / fatality – Asset Damage – Project area shut down	No	– Equipment certified and installed to relevant standards - Voltage rating to match maximum open circuit voltage – Overcurrent trip if maximum current exceeded – Quality checks of installation before commissioning
20	Inverter failure	– Overvoltage – Reverse polarity of cables (human error)	– Personal injury / fatality – Asset Damage – Project area shut down	No	– System trip/shutdown – Voltage rating to match maximum open circuit voltage – Equipment tested and approved – Certified electrician – Quality checks of installation before commissioning – System configuration - use of integrated battery solution. e.g. Tesla Megapack where inverter size is reduced

#	Hazard scenario	Causes	Consequence	Potential for off-site impact	Safeguards
21	Power Transformer Fire within the BESS	– Coolant leak and ignition – Transformer oil overheating – Earth leakage – Arc fault – Fire spread from BESS	– Transformer fire – Injury to personnel in the vicinity – Potential for escalation	No	– Designed to AS 2374.8:2000 – Power Transformers – Application Guide – Fire protection provided – Separation distance/fire isolation of transformers – Design to AS2067 – Substations and high-voltage installations – Site specific emergency management plan, trained fire wardens, site first aiders, fire extinguishers, first aid kits – Onsite firewater infrastructure (tanks, pump house and ring main) – Contaminated firewater management system (drainage + detention basin)
22	Transformer explosion	– Gases generation inside transformer enclosure (hydrogen)	– Overheating of transformer and explosion from overpressure – Personal injury / fatality – Asset Damage – Project area shut down	No	– Relief valve on transformer to vent off gases – High temperature trip – Design to AS2067 – Substations and high-voltage installations
23	Contact with electricity	– Vermin exposing conductors – Contact with live electrical sources – Cranes impacting overhead lines	– Personal injury / fatality	No	– Permit to Work, including isolation procedures – Install fit for purpose electrical systems – Supply and use of arc flash protective PPE – Prevention of unauthorised/unnecessary access. – Mechanical interlocking of electrical equipment – Earthing of switchgear, circuit boards and inverters – Training of operational staff – Lock-Out/Tag-Out (LOTO) procedures
24	Vehicle collision with on-site infrastructure	– Vehicle movements in the vicinity of personnel – Vehicle impact to infrastructure	– Personal injury / fatality – Asset Damage	No	– Prepare traffic management plans including standard traffic rules and signage for construction and operation – Implement Project area speed limits – Provide designated pedestrian areas for construction and operation – Driver competency – Installation of bollards/protective barriers in high-risk areas, as per AS2067

6.2 HAZID conclusion

The only scenarios identified through this HAZID with any credible potential to extend beyond the site boundary relate to heavy vehicle movements on the public road network during construction, including the delivery of major equipment and transport of cranes.

These public-road transport hazards are not considered risk-dominant for the overall assessment, as construction transport activities are primarily limited to the delivery of equipment and materials and do not involve routine transport of dangerous goods. Accordingly, no credible off-site risk is retained from dangerous goods-related transport scenarios for the construction phase.

While a BESS presents inherent hazards, such as overheating, thermal runaway, fire and, under certain conditions, explosion/deflagration, these risks are addressed through a combination of design-basis safeguards and operational controls.

The BESS is being developed in accordance with recognised good practice and applicable standards and incorporates multiple design-basis safeguards. These include the OEM battery safety systems (notably the Battery Management System (BMS) and Fire Suppression System (FSS)), separation and layout measures (including clearances between containers and separation to adjacent infrastructure such as transformers and the MV skid), and siting measures such as locating the BESS centrally within the Project area to maximise separation from site boundaries and sensitive receptors.

On this basis, hazardous phenomenon modelling is not required to demonstrate that risks from the proposed BESS are appropriately managed for construction and for operations/maintenance.

The following sections summarises the principal design safeguards and the proposed controls to ensure the Project remains safe during construction and throughout the operational life of the facility.

7. Design safeguards

7.1 Fire spread prevention

Separation distances are a key, first-line safeguard to limit the escalation of a BESS fire and to reduce the likelihood of propagation from an initiating enclosure to adjacent enclosures and nearby infrastructure.

Table 5 below summarises the manufacturer’s minimum clearances. It shows that substantial separation to off-site receptors (e.g., residential areas and other listed land uses) exists. Separation/clearance distances between individual BESS units and between BESS units and adjacent equipment/infrastructure within the current design also exceeds the manufacturer’s minimum clearance requirements.

Table 5 Clearance requirements

Clearance description	Manufacturer minimum distance	Actual distance
Clearance between containers within the same four-container block	0.9m	~1.4m
Clearance between adjacent container blocks	3.5m	7m
Clearance between a container block and adjacent equipment/infrastructure	3.5m	4m
Separation distance to the nearest residential dwelling	50m	~4.8km
Separation distance to airport, landfill, riverbank/shoreline or dam	500m	~45km (closest is the Condamine River)

7.2 Container and cell certification

The table below summarises the standards compliances of the BESS container as stated in the user manual applicable to the cell and container (system) level.

Table 6 Fulfill standard

Component	Standard	
Container	UL1973	Batteries for Use in Stationary and Motive Auxiliary Power Applications
	NFPA855	Standard for the Installation of Stationary Energy Storage Systems
	UL9540A	Test Method for Evaluating Thermal Runaway Fire Propagation in Battery Energy Storage Systems
	UL9540	Energy Storage Systems and Equipment
	IEC 62477	Safety requirements for power electronic converter systems and equipment – Part 1: General
	IEC 62619	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 62933-5-2	Electrical energy storage (EES) systems – Part 5-2: Safety requirements for grid-integrated EES systems – Electrochemical-based systems
	IEC 63056	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 61000-6-2	Electromagnetic compatibility (EMC) – Part 6-2: Generic standards – Immunity standard for industrial environments
	IEC 61000-6-4	Electromagnetic compatibility (EMC) – Part 6-4: Generic standards – Emission standard for industrial environments
Cell	UN38.3	Lithium metal and lithium-ion batteries
	UL1973	Batteries for Use in Stationary and Motive Auxiliary Power Applications
	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
	UL9540A	Test Method for Evaluating Thermal Runaway Fire Propagation in Battery Energy Storage Systems

7.3 Battery Management System (BMS)

The Battery Management System (BMS) is designed to supervise and protect the battery system by continuously monitoring key parameters (including cell voltage, total voltage, current and temperatures) and by managing safe energy absorption and release.

The BMS is interfacing with both the Power Conversion System (PCS) and the Energy Management System (EMS) for external communication and control, while also supporting thermal management, low-voltage power supply management, high-voltage safety monitoring, and fault diagnosis/recording to support stable operation of the energy storage system.

In operation, the BMS implements protective functions against abnormal conditions such as:

– Under/over-voltage;
– Over-discharge;
– Over-temperature; and
– Over-current.

When a fault condition is detected, it can alarm supervisory systems, apply charge/discharge power or current limitations, and (depending on severity) initiate controlled isolation actions, including delayed or immediate disconnection of HV relays/contactors (e.g., from isolating a single rack to tripping all racks for higher severity categories).

These layers support both equipment protection and overall system safety while maintaining controlled operation where possible.

7.4 Fire Suppression System (FSS)

The Fire Suppression System (FSS) is presented as an integrated solution providing detection, explosion/deflagration risk control, and fire suppression, suitable for an outdoor non-walk-in BESS container. There is a four-level control strategy:

- Alarm warning;
- Smoke exhaust ventilation to reduce deflagration risk;
- Aerosol release to extinguish an incipient fire; and
- Water spraying to control fire spread.

The FSS is structured into three functional parts—detection and alarm, exhaust ventilation, and fire suppression—coordinated by a fire control panel (FCP) receiving inputs from:

- Hydrogen detection;
- Heat detection; and
- Smoke detectors.

Functionally, when combustible gas indicators are detected, the exhaust ventilation strategy is activated: the FCP signal triggers opening of air louvers and starts an explosion-proof exhaust fan to discharge combustible gas from the battery compartment; the fan does not automatically stop once opened.

For fire scenarios, the system can automatically (or manually) initiate aerosol discharge for early-stage fire control, and it provides provisions for a dry-pipe/nozzle arrangement and water spray as a later-stage measure to limit spread.

Strobes and alarms for evacuation are also activated by the FSS.

7.5 Other Battery container safeguards

The container is also equipped with an emergency stop (E-Stop) and external warning devices (horn/strobe), and the manual recommends locking container access doors (padlocks) to prevent unauthorised access.

7.6 Firefighting equipment

The BESS unit will be supported by dedicated firefighting infrastructure comprising four firewater tanks and a firewater pump house supplying a firewater ring main around the BESS facility. This arrangement provides a reliable on-site water supply and distribution network to support emergency response activities and, critically, to enable exposure cooling of equipment adjacent to an affected unit.

The ring main provides the capability to apply cooling water to containers and nearby assets to reduce radiant heat exposure, limit temperature rise in adjacent enclosures and thereby support containment of a fire/thermal event to the area of origin and prevent escalation and propagation within the BESS compound.

8. Recommendations

Following the hazard identification summarised in Table 4, a set of controls should be implemented to manage BESS-related hazards in accordance with applicable legislative and regulatory requirements. Table 4 outlines the key hazard pathways and associated controls that address both on-site and potential off-site impacts. The recommendations below consolidate the principal safeguards required to prevent credible incident scenarios, and should be progressed through design, procurement, construction, commissioning and operations.

8.1 Recommended controls/safeguards

8.1.1 Battery safety management plan

A BESS Battery Safety Management Plan should be developed and implemented to define lifecycle safety requirements from delivery and installation through to operation, maintenance and end-of-life. The plan should include, at a minimum, the following elements:

1. Storage, handling and installation
   - Batteries should be stored and handled in accordance with manufacturer requirements and installed/commissioned by competent, qualified personnel.
   - Handling and lifting activities should interface with construction controls and aligned with manufacturer recommended practice.
2. Inspection, maintenance and performance assurance
   - Establish an inspection and preventative maintenance plan covering batteries and associated equipment (e.g., Power Conversion System (PCS), Heating, Ventilation and Air Conditioning (HVAC) systems, detection systems, protection systems and cabling), including functional testing intervals, calibration where required, and defect rectification processes.
3. Damaged battery protocol and emergency response interface
   - Implement a protocol for damaged or suspect batteries/modules, including immediate isolation/removal from service, safe staging away from combustibles, and monitoring for heat, smoke, electrolyte/coolant leakage and other indicators of a progressing thermal event.
   - Ensure escalation and “do not move” criteria are defined where thermal reaction is suspected (e.g., observation period prior to handling).
   - Confirm response strategies for a container event in line with manufacturer guidance and site emergency response arrangements (refer to Section 8.2.4), including cooling exposures and protection of adjacent assets as appropriate.

8.1.2 Hazardous chemicals, hazardous goods and spill management

Any hazardous chemicals or hazardous goods brought onto the Project Area during construction, commissioning and maintenance should be managed in accordance with applicable Australian guidance (including the Model Code of Practice: Managing risks of hazardous chemicals in the workplace) and relevant Australian Standards. As a minimum:

– Chemicals should be correctly labelled, segregated where required (compatibility), and stored in suitable containers/locations;
– Storage areas should incorporate appropriate spill controls (e.g., bunding/secondary containment where relevant) and be protected from ignition sources; and
– Chemical wastes should be disposed of via compliant waste streams and contractors.

A current Safety Data Sheet (SDS) register should be maintained and made readily available for emergency services and site personnel. In addition, task-specific safe work procedures should be implemented for chemical receipt, transfer, storage, spill prevention and spill response/clean-up.

Note: Management of potentially contaminated firewater/runoff is addressed separately under Section 8.2.4.

8.1.3 Bush fire risk assessment

A Bushfire Risk Assessment (BRA) should be developed as a qualitative risk assessment, implemented, and maintained as a live document for the full lifecycle of the facility to confirm that:

– An external bushfire cannot credibly compromise the BESS or associated infrastructure; and
– The Project does not introduce credible ignition sources that could initiate a bushfire.

It should be reviewed and updated at defined intervals (e.g., annually) and following key triggers such as changes to vegetation/fuel load, layout modifications, extreme fire seasons, relevant incidents/near misses, or updates to State bushfire hazard mapping and planning guidance (including the Queensland bushfire prone area mapping used to support the State Planning Policy).

8.1.4 Fire Risk Assessment (FRA) / Safety Study

It is recommended to conduct a comprehensive Fire Risk Assessment (FRA) / Fire Safety Study for the entire Project (including the BESS system and Wind Farm) to identify fire and explosion hazards associated. The assessment should evaluate credible fire scenarios, escalation pathways, and potential impacts on personnel, assets, and critical equipment.

The study should include validation of equipment and facility separation distances, taking into account thermal radiation, flame impingement, jet fire and/or pool fire effects (as applicable), to confirm that adequate spacing is provided to prevent fire propagation and escalation between units.

The assessment should also confirm the adequacy of existing fire prevention, detection, protection, and mitigation measures, and identify any additional safeguards or design modifications required to reduce fire risk to ALARP.

8.2 Recommendations by Project phase

8.2.1 Design and procurement

Confirm transformer specifications and, where practicable, select less-flammable insulating liquids and/or dry-type transformers, incorporating appropriate containment and separation into the design. Confirm that the containers BMS and FSS comply with the specifications in the datasheet.

8.2.2 Site layout, access and vegetation management

– Maintain adequate emergency response access routes, turning areas and staging locations, positioned outside credible consequence zones and not obstructed by barriers or bollards;
– Incorporate design measures to maintain appropriate setbacks and separation for fire spread prevention and receptor protection, including separation to boundaries, occupied buildings and exposure hazards;
– Establish and maintain vegetation clearance/firebreaks around the BESS and other critical infrastructure and apply ignition source controls during high fire danger periods; and
– Provide appropriate impact protection (e.g., bollards/barriers) where vehicle interaction could credibly damage enclosures, cables or critical interfaces, ensuring these measures do not impede operation and maintenance access and emergency access or egress.

8.2.3 Construction and commissioning

– Implement traffic, delivery and lifting management plans for major components (containers, transformers), including wind limits, exclusion zones and lift studies where required;
– Apply permit-to-work and lock-out/tag-out (LOTO) controls during commissioning and energisation, supported by an agreed energisation plan and independent verification of protection settings where required; and

- Maintain a construction risk register that includes BESS-specific hazards and provides a clear mechanism for handover of critical controls into operations (procedures, inspections, spare parts, training and emergency arrangements).

8.2.4 Operational controls and emergency response

- Develop and implement a BESS-specific Emergency Response Plan (ERP), including isolation arrangements, hazard/exclusion zones, responder PPE expectations (e.g., SCBA for close approach where applicable), and clear communication/escalation protocols. The BESS-specific ERP can be a standalone document or incorporated into the site-wide ERP;
- Implement monitoring and alarm response procedures for abnormal BESS conditions (thermal alarms, BMS alarms, off-gas detection where applicable), including response time expectations, escalation triggers and shutdown criteria; and
- Define measures for contaminated firewater/runoff management, including containment/retention where required, use of isolation valves at the detention pond outlet, and disposal procedures consistent with environmental and waste requirements.

9. State Code 27 compliance

Table 7 below summarises how the proposed BESS addresses the risk mitigation performance outcomes (PO2–PO4) of State Code 27: Battery storage facility development. This assessment is based on the implementation of the recommendations set out in Section 8.2.

Table 7 State code 27 Risk mitigation performance outcomes compliance

Performance outcomes	Response
PO2 Development is designed, sited and constructed to ensure that risks from physical hazards, chemical hazards and battery failure hazards are avoided and/or mitigated with respect to: – Human health and safety – The built and natural environment.	The BESS will be designed, sited and constructed to manage physical, chemical and battery failure hazards through a layered set of controls, including: – All elements of the project are designed in accordance with relevant Australian Standards; – Appropriate siting and setbacks (BESS located centrally within the Project area to maximise separation from potential receptors and adjacent uses); – Appropriate separation of individual BESS containers to mitigate escalation and propagation of a battery fire; – Appropriate separation of the BESS containers to other electrical systems; – Engineered safety systems (BMS protections, integrated FSS, electrical protection and isolation, monitoring/alarms, and container/infrastructure design features); – Hazardous goods and spill management arrangements (SDS register, safe storage/handling procedures, spill response capability); – A dedicated firewater infrastructure comprising four firewater tanks and a firewater pump house supplying a firewater ring main around the facility ; – Drains and detention pond to contain any contaminated firewater; and – Construction controls (permit-to-work, LOTO, lifting/traffic management, controlled access and segregation).
PO3 Development mitigates the risks of fire, explosion and thermal runaway from battery storage infrastructure.	Fire, explosion and thermal runaway risks will be mitigated through prevention, early detection and consequence management measures, including: – Selection of a BESS solution supported by appropriate product/system safety evidence and large-scale testing (e.g., UL 9540 / UL 9540A); – Early intervention functions via BMS and monitoring to detect abnormal conditions (thermal/BMS alarms and other diagnostics as applicable) and initiate automatic isolation/shutdown actions; – Integrated FSS fire and explosion risk controls integrated into design (venting/deflagration management approach, detection, alarm and interlocks, limitation of gas accumulation and ignition potential); and – Emergency response planning that defines exclusion zones, isolation procedures, onsite firefighting equipment and response strategies aligned with the technology and site configuration.

Performance outcomes	Response
PO4 Development is designed to ensure fire and thermal events can be contained and isolated to prevent escalation and propagation to other developments and uses on and offsite.	The BESS is designed to ensure that credible fire and thermal events can be contained and isolated within the BESS compounds. The key elements supporting this outcome are: – The integrated Fire Suppression System (FSS), which provides detection, ventilation/exhaust and staged suppression functions; – The provision of minimum clearances between containers and adjacent equipment in accordance with the manufacturer's siting and clearance requirements; – The provision of minimum clearances between containers and adjacent equipment to enable safe access and deployment of emergency service vehicles; and – A dedicated firewater infrastructure comprising four firewater tanks and a firewater pump house supplying a firewater ring main around the facility. The ring main provides the capability to apply cooling water to containers adjacent to an affected unit, reducing radiant heat exposure and supporting containment of the event to the area of origin. In addition, the BESS is located centrally within the Project area and in proximity to the operations and maintenance facilities, which supports timely detection, rapid intervention and coordinated site response. Central siting also increases separation distances to site boundaries and external receptors, reducing the potential for off-site impacts should an incident occur. No flammable or combustible storage is proposed in the immediate vicinity of the BESS compound, further limiting external fuel sources and reducing the likelihood of fire spread into or out of the BESS area.

10. Conclusion

This RMAR has identified that the proposed BESS presents inherent hazards typical of lithium-ion battery storage systems including electrical hazards, overheating/thermal runaway, fire potential explosion/deflagration and ancillary chemical and environmental hazards.

However, the assessment demonstrates that credible major escalation scenarios are prevented or effectively mitigated through a layered set of design-basis safeguards and proposed controls, notably:

- The integrated BMS protective functions (monitoring, alarms, limiting and controlled isolation);
- The integrated FSS (detection, ventilation/exhaust and staged suppression);
- Manufacturer-aligned separation/clearance requirements to reduce propagation potential and support safe access; and
- Provision of dedicated firewater infrastructure (tanks, pump house and ring main) provides a robust capability for exposure cooling of adjacent containers and helps prevent escalation beyond the initiating enclosure, supporting containment of thermal events within the BESS compound.

The broader Project siting also strengthens risk outcomes:

- The BESS is centrally located within the Project area (increasing separation to boundaries and receptors);
- Flammable/combustible storage is not proposed adjacent to the compound; and
- Bushfire exposure is reduced because the BESS lies outside the mapped bushfire prone area with site-wide vegetation and separation measures proposed.

Accordingly, this RMAR concludes that, subject to implementing the safeguards and recommendations identified, risks to human health and safety and the built and natural environment are reduced to an acceptable level and that the BESS aligns with the intent of State Code 27 PO2–PO4: managing physical/chemical/battery failure hazards (PO2), mitigating fire/explosion/thermal runaway (PO3), and ensuring fire/thermal events can be contained and isolated to prevent escalation and propagation on- and off-site (PO4).

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