Fire Safety Studies

for

Battery Energy Storage Systems

OUR COMMUNITY • OUR CFA

CFA

Version 1, June 2025

CFA Specialist Risk and Fire Safety Unit

Foreword

CFA plays a vital part in ensuring the risk to life and property from fire is minimised in the country area of Victoria. To enable this, CFA develops guidance for industry and authorities with the intent of **protecting lives and property from fire**.

This supplementary guideline to CFA's internationally recognised *Design Guidelines and Model Requirements for Renewable Energy Facilities* provides detailed guidance for the development of fire safety studies where recommended by CFA for proposed battery energy storage facilities.

The intent of this guideline is to ensure that facilities with battery energy storage systems incorporate appropriate fire safety systems for the safe and effective management of fires and the protection of firefighters and communities.

CFA gratefully acknowledges the support provided by our regulatory partners, particularly WorkSafe Victoria, and industry. CFA is particularly grateful for the support of NSW Department of Planning, Housing and Infrastructure, as authors of the *Hazardous Industry Planning Advisory Paper 2: Fire Safety Study Guidelines* in 2011, in allowing CFA to adapt their guideline for battery energy storage systems.

Alen Slijepcevic
Deputy Chief Officer
Fire Risk, Research and Community Preparedness

Introduction

What is a fire safety study?

A ***fire safety study*** is an analysis that considers the specific hazards present at a facility and identifies the requirements of the fire systems to manage those hazards properly. A ***fire safety study*** is useful to analyse the adequacy of proposed and actual fire and explosion protection systems.

When is a fire safety study required for battery energy storage systems?

In most cases, the preparation of a ***Risk Management Plan*** to capture the outputs of a comprehensive risk management process is sufficient to provide CFA with assurance on the adequacy of risk controls for battery energy storage systems and facilities.

Following review of a ***Risk Management Plan***, CFA may request the preparation of a ***fire safety study*** for large-scale battery energy storage systems (BESS) over 1MWh where the design, capacity, complexity, location or proposed operations necessitate an enhanced, detailed analysis of requirements for fire and explosion safety systems.

A ***fire safety study*** complements the broader risk management process (captured in a ***Risk Management Plan***) by determining appropriate, effective, fit-for-purpose fire risk controls (encompassing fire and explosion prevention, detection and protection), that are then incorporated into facility planning and design.

A fire safety study should always produce a better outcome than the application of generalised codes and standards alone. (HIPAP2)

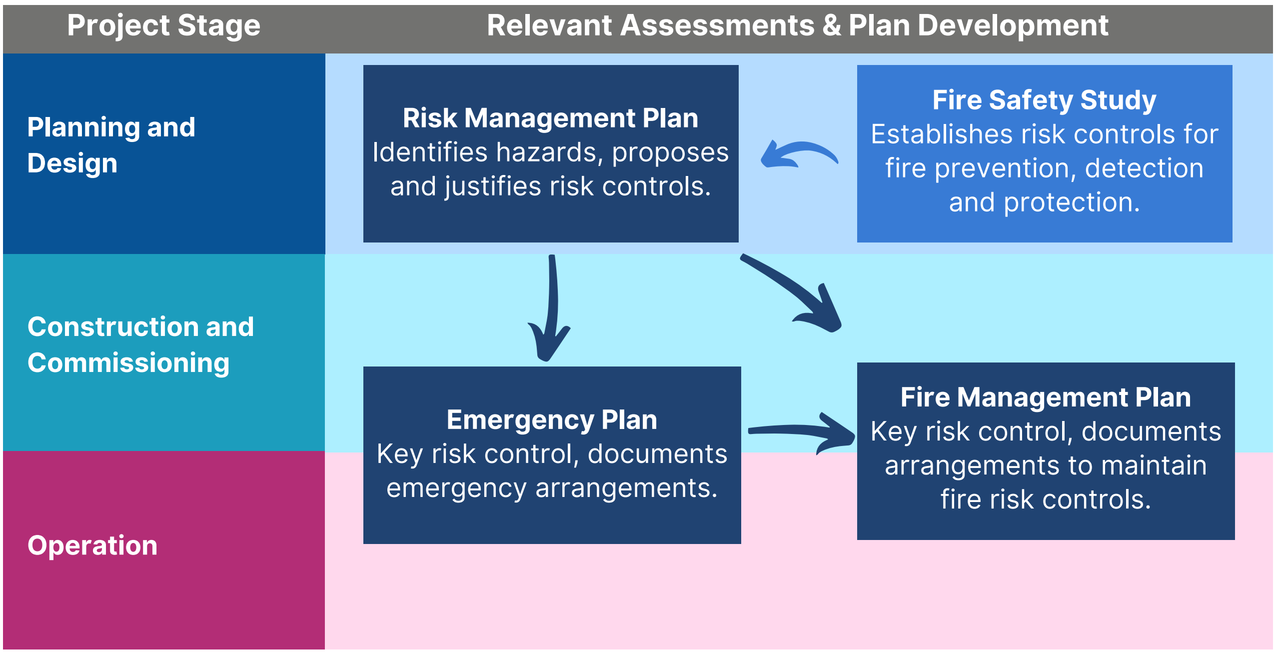
What is the purpose of this guideline?

To assist developers, industry and consultants to develop ***fire safety studies*** for facilities with BESS, where requested by CFA.

This guideline supplements ***CFA's Design Guidelines and Model Requirements for Renewable Energy Facilities***, which contains CFA's expectations for the planning, design and operation of renewable energy facilities (including stand-alone and BESS-integrated) to ensure fire risk is effectively considered in facility design, commissioning and operation.

This guideline adopts the umbrella term '***BESS unit***' to succinctly capture the variety of BESS cabinets, containers and enclosures in which BESS modules are housed. The type of BESS unit must be specified in Part 1.4 of the ***fire safety study***.

Figure 1: Plans and assessments for large-scale battery energy storage systems.



Fire Safety Studies

Fire Safety Study Report Structure

Cover	A ***cover page with*** the facility name, location, author, version, preparation date.
Review	Document ***control information, review procedures*** and a table of ***contents***.
Executive Summary	An ***executive summary of findings and recommendations*** based on the study for implementation in design.
Scope	Specified ***scope, purpose*** and ***limitations*** of the fire safety study and report.
Part 1	A ***description of the facility***, including its processes, infrastructure, layout and location.
Part 2	Identification of BESS hazards.
Part 3	Consequence identification and analysis.
Part 4	Identification of fire and explosion prevention strategies and measures.
Part 5	Identification and analysis of BESS fire detection and protection requirements.
Part 6	Fire water demand and supply analysis, including demonstration of adequacy to cope with credible worst-case fire scenarios.
Part 7	Requirements and arrangements for management of fire water runoff.
Part 8	Identification of first-aid fire protection.
Part 9	Considerations for emergency planning and management.
Part 10	Recommendations and implementation process.
Appendices	Any ***relevant supporting information.***

Objectives and Principles

For CFA, an effective ***fire safety study:***

- Comprehensively identifies and describes the fire and explosion hazards for BESS.
- Provides analysis and modelling of consequences of potential credible worst-case incidents.
- Identifies, describes and justifies effective fire and explosion risk controls, commensurate to the modelling and analysis.
- Demonstrates that the proposed fire and explosion prevention, detection and protection measures are appropriate and adequate to cope with the identified, credible worst-case fire and explosion incidents.

Fire safety studies should:

- Be conducted as early as possible in the detailed design stage of a facility.
- Be based on information specific to the:
  - Proposed BESS unit/technology/product.
  - Site location, infrastructure and operations.

  Acceptance of equivalency where the BESS unit or its arrangement does not exactly align to the proposal is at the discretion of CFA.
- Be consequence-focused, based on credible potential worst-case scenarios with on-site and off-site impacts.
- Not discount or exclude potential credible incident scenarios where there are known incidents nationally or globally.

Purpose, Scope and Limitations

The purpose, scope and limitations of the ***fire safety study*** should be clearly defined. For example:

- Why is the study being undertaken?
  - To satisfy a CFA requirement, building or planning permit condition or other requirement?
  - What is the intended outcome of the study?
- Who is undertaking the study?
  - What is the role or brief for the study?
  - Is it on behalf of a third party?
- What are the conditions for the study?
  - What was the process of undertaking the study?
  - What are the limits of its application?
  - What other reports or analysis does the study relate to?

Fire Safety Studies

Part 1: Facility Description

A facility description provides contextual information for the fire safety study.

Provide a description of the facility's location, infrastructure and operations.

1.1 General information:

- A description of the site (area, landscape, planning zones/overlays, weather conditions, any co-located facilities, operations).
- A list of surrounding public and private roads, the names and function (capacity) of public roads, the proposed site access points.
- A description of internal access roads (width, construction material and standard, confirmation that they will support fire vehicles).
- A description of all infrastructure and buildings including egress points, floor area, proposed passive and active fire protection.
- A list of the design and construction standards.
- A description and photos of the vegetation on-site.
- A description of adjacent/surrounding land uses.
- The hours of operation and maximum number of people likely to be on site.

1.2 Site layout plan that shows:

- Buildings, internal roads (with widths specified), all vegetation.
- Fences, gates/road access points, external roads.
- BESS unit, power conversion systems/units/ infrastructure (PCS), substation, transformers, switchgear, powerlines and grid connection infrastructure.
- All other energy generation infrastructure.
- Site dimensions (including area), separation distances between site infrastructure, vegetation and buildings.

1.3 Locality map that shows the facility relative to:

- The Bushfire Management Overlay, Bushfire Prone Areas, and Land Subject to Inundation Overlay.
- Landscape features, including waterways, mountains, state forests and national parks.
- Dwellings, schools, hospitals, child care, aged care facilities, community hubs, bushfire places of last resort and their distance from the site.
- Fire, police and ambulance stations.

1.4 Details of the BESS, including:

- The manufacturer and model name/number.
- The unit type (e.g., cabinet, container, enclosure).
- Number of BESS units, their individual capacity (in MW/MWh) and aggregate capacity across the site.
- The battery chemistry.
- The fire prevention systems, including Battery Management Systems (BMS), cooling/ventilation systems, measures to prevent water ingress (from powerful water jets) and ember penetration.
- The fire and explosion suppression systems provided within the BESS unit.
- A list of Australian and international Standards to which the BESS complies.

1.5 Details of supporting/interconnected infrastructure for the BESS, including PCS, substations, transformers, grid connection infrastructure, solar/ wind/hydro energy generation infrastructure.

Part 2: Identify BESS Hazards

Identifying all hazards provides the foundation for effective risk management within the fire safety study.

Identify all fire and explosion hazards and their potential causes associated with the specific battery energy storage system.

2.1 The analysis should include:

- **a)** The nature of the materials and the quantities involved.
- **b)** The nature of hazardous events (such as the loss of containment).
- **c)** Potential initiating events.
- **d)** Ignition sources.

2.2 Other hazards or factors that may interact with or exacerbate BESS hazards must also be identified. These may include:

- Landscape features and hazards.
- Weather events, including heatwave, flood, storm surge and lightning.
- Surrounding land uses, including sensitive receptors.
- Nearby infrastructure, services and industry.
- Storages of dangerous goods.
- Requirements of statutory authorities.

Information on hazards should be sought from:

- Technical data sheets and design specifications.
- Installation and operation manuals.
- Emergency response guides specific to the proposed BESS.
- Test results for the proposed BESS, including:
  - UL9540A cell, module and unit level tests.
  - Large-scale fire test to CSA TS-800:24 or equivalent.
  - Performance of thermal runaway prevention systems.
  - Performance of fire detection and protection systems.
- Incident data/reports and analysis of incidents at large-scale BESS facilities, locally, nationally and globally.
- Relevant Australian and international standards, codes and guidance.
- CFA's Design Guidelines and Model Requirements for Renewable Energy Facilities.
- Previous fire history within the landscape within 20km of the site.

Any bushfire hazards are to be identified in the fire safety study.

Part 3: Identify Consequences

Identifying and analysing potential consequences informs the determination of effective risk controls.

Identify and analyse the potential impacts of incidents involving the battery energy storage system, including thermal runaway, fire propagation and secondary incidents.

The analysis should include:

3.1 Identification of potential incident scenarios. (Failure mode, incident progression timeline, state-of-charge.)

3.2 Identification, assessment and evaluation of the consequences of potential incident scenarios.

3.3 Time-related exposures including radiant heat flux, explosion overpressure, gas concentrations and impacts, and surface fire of BESS units, on on-site and off-site receptors.

3.4 Appropriate tables, charts and site plans/locality overlays with consequence contours that show the potential extent of exposures, including:

- Radiant heat flux from a BESS unit(s) fully involved in fire to site infrastructure and various distances, including 1m, 3m, 10m and 20m.
- Plume analysis that shows likely spread of gases/vapours and smoke across a unit-level and large-scale fire test, in both typical seasonal conditions and fire weather conditions.
- A breakdown of toxic, flammable or oxidising gases that may be released.
- Potential explosion overpressures to 3.5kPa.
- Potential BESS unit surface fire.

3.5 Assessment of:

a) The potential impact of radiant heat on adjacent BESS, including the potential for thermal runaway and surface fire in those BESS.

b) The potential impact of explosion on adjacent BESS and on-site and off-site infrastructure.

The assessments should consider scenarios in which in-built BESS fire and explosion safety systems succeed and fail, and their consequences. The potential for fire propagation without fire protection measures should be detailed.

3.6 The assumptions and conditions on which the radiant heat flux calculations and plume analysis are based, including flame temperatures, separation distances, weather/meteorological conditions and the terrain/landscape.

Analysis of potential impacts should be drawn from:

- Evaluations of thermal runaway, fire and explosion.
- Results from UL9540A tests, and CSA TS-800:24 large-scale fire tests (or equivalent) of the proposed BESS.
- Analysis of previous incidents (see the EPRI BESS Failure Incident Database).

Where non-specific, representative or 'best available' data is used, this is to be identified in the study.

On-Site and Off-Site Receptors

Potential receptors may be on-site infrastructure, community sensitive receptors and environmental sensitive receptors, including:

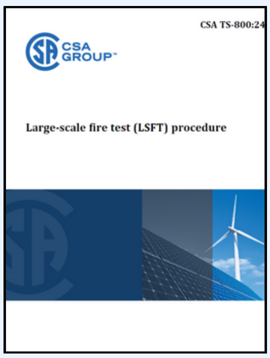
- Other battery enclosures.
- Battery-related infrastructure, such as PCS, transformers, substations and grid connection infrastructure.
- Buildings and structures on-site and off-site.
- Vegetation on-site and off-site.
- Nearby community sensitive receptors, including dwellings, schools, child/aged care, hospitals and community facilities, emergency services.
- Environmental receptors such as soil, flora and fauna, and waterways.

Justification is to be provided for the selection of receptors, exposures, analysis and models used in the consequence analysis.

Large-Scale Fire Test

An addition to UL9540A testing at cell, unit, module and installation levels, CFA advocates for large-scale fire tests to be conducted on BESS units to evaluate the propagation potential for fire events from a fully involved BESS unit to adjacent units or external infrastructure.

CFA recommends testing in accordance with *Canadian Standards Association TS-800:24 – Large Scale Fire Test (LSFT) Procedure* (August 2024), as a standardised method for evaluating fire hazards associated with BESS.



Part 4: Fire and Explosion Prevention

Effective fire and explosion prevention measures reduce the potential for incidents to occur, protecting community and emergency responders.

Identify the fire prevention strategies and measures for the site and the battery energy storage system to prevent fires occurring, and reduce its potential consequences.

4.1 The design strategies and measures should include:

- Siting of facilities in lower-risk environments.
- Procuring BESS equipment:
  - With integrated fire safety systems, and
  - That have been subject to fire testing, including large-scale fire tests.
- Designing and laying out site infrastructure to prevent fire impact and spread. Including:
  - Separation to prevent fire spread between BESS units (or groups of units), other site infrastructure, and safe access by emergency responders (such as ensuring means of egress separation of at least 3m (10 ft) as per NFPA 855).
  - Buildings with active and passive fire safety systems above NCC requirements.
  - Fire water supplies (and retention facilities) of a quantity sufficient for credible worst-case fire scenarios.
  - Fire service infrastructure, located away from hazards and outside potential consequence zones, including the 3kW/m^2 radiant heat flux impact zone and areas with potential toxic gas concentration.
  - BESS compounds to be devoid of vegetation.
  - Fire breaks at the site perimeter and around assets.
  - Internal all-weather site access roads that provide access to all areas of the facility.
- Providing impact protection from mechanical damage to the BESS.
- Providing security infrastructure, including fences, gates, CCTV, security monitoring/patrols.

4.2 Operational strategies and measures should include:

- Adherence to Australian, international and industry standards and codes.
- Documented safe systems of work.
- Engaging qualified and experienced electrical installers.
- Battery monitoring systems and response processes with capability for direct brigade notification.
- Management of electrical and arc-flash hazards.
- Obtaining required permits to operate within the Fire Danger Period.
- Hazardous area identification and management and ignition source control.
- Regular housekeeping inspections.
- Inspecting, maintaining and servicing equipment and vehicles.
- Training personnel regarding hazards, safe use of equipment and emergency management.

Bushfire impacting the site is to also be identified, analysed and considered in fire prevention strategies.

BESS Separation

Separation must be at least the distance where the radiant heat flux (output) from a BESS unit fully involved in fire does not create the potential for injury during site egress or ignition of:

- Other BESS units (including thermal runaway).
- On-site and off-site buildings.
- Substations, transformers or any other supporting electrical infrastructure.
- The site boundary.
- On-site and off-site vegetation.

CFA advises that applying non-BESS specific standards in isolation to determine minimum separation distances between BESS units, or BESS units and other electrical infrastructure, is not acceptable to CFA.

These standards - including *AS 2067-2016: Substations and high voltage installations exceeding 1 kV a.c.; AS 1530.4-2014: Methods for fire tests on building materials, components and structures;* and *IEEE Std 979-2012: Guide for substation fire protection* - do not effectively account for potential thermal runaway of lithium-ion batteries in their determination of separation distances.

Part 5: Fire Detection and Protection

Effective fire detection and protection systems reduce or eliminate the potential for ignition, and reduce or eliminate consequences of incidents.

Analyse the requirements for BESS fire and explosion detection and protection. This includes detection and response to the pre-conditions for fire and explosion, such as thermal runaway, off-gassing and flammable atmospheres.

5.1 In addition to in-built systems within the BESS, the analysis should consider a range of fire detection and protection options. The chosen system should prioritise emergency responder safety and strategies for response.

The chosen solution will be to the satisfaction of CFA.

The systems for detection and management of BESS fire, explosion and pre-conditions should include:

- All in-built BESS fire detection and protection systems and measures.
- On-site and remote alarms/notifications for abnormal BESS events, including high/elevated temperatures, overcharging, electrical faults, thermal runaway, water ingress, BMS failure, activation of safety systems (including cooling, venting and fire protection).
- Thermal, fire, smoke and gas detection systems.
- Identification and management of leaks of coolant, electrolyte or dangerous goods/ hazardous substances.
- Ventilation/cooling systems.
- Explosion prevention/management systems (including venting and deflagration panels).
- Automatic shut-off/emergency stops, electrical isolation systems and processes.
- Fire suppression systems, such as internal automatic sprinkler systems, gas suppression, hydrant systems, monitors, deluge/drencher systems, fire water supplies.

5.2 The design and performance requirements of all fire and explosion detection and protection systems should be identified and described, including:

- The Standards to which they comply, and justification for any departures.
- Details of tests and their results for the systems. Tests should be based on from credible worst-case scenarios that reflect real world conditions.
- The conditions for effective performance.
- Whether they are manually or automatically actuated, and the processes and triggers for actuation.
- How flammable gases released during charging, discharging, and normal operation will not exceed 25 percent of the lower explosive limit.
- The inspection, testing and maintenance requirements to facilitate effective operation throughout the facility's lifecycle.

5.3 Where appropriate, scale drawings of fire detection and protection systems should be provided to support proposed facility designs.

Drawings should contain all relevant fire service infrastructure, site access points, internal roads, BESS units and supporting infrastructure, fire water containment systems. A clear key should be provided.

Drawings may be provided in an appendix to the ***fire safety study***.

Consequences of bushfire impacting the site are to also be identified, analysed and considered in fire prevention strategies.

System and Equipment Maintenance

Maintenance of equipment is a critical factor in its reliability and effectiveness. To ensure that all equipment is inspected and maintained to appropriate Standards, CFA recommends that inspection and maintenance requirements of fire safety systems, access roads and vegetation management are detailed in a ***Fire Management Plan***.

CFA's Design Guidelines and Model Requirements for Renewable Energy Facilities, Section 6.1, contains detailed guidance on the development of ***Fire Management Plans***.

Part 6: Fire Water Demand and Supply

Conservative calculations of fire water demand support effective incident management, community and emergency responder safety.

Determine the fire water demand (hydraulic design) required for your chosen fire protection/ suppression system(s). The hydraulic design should enable safe and effective response to hazards and consequences of credible worst-case scenarios.

6.1 The following should be considered in determining fire water demand, quantity and performance:

- Requirements for internal BESS sprinklers or deluge/drencher systems.
- Requirements for cooling adjacent exposures, including:
  - All adjacent BESS units, sufficient to:
    - Prevent ignition of BESS surface coatings and external elements.
    - Prevent thermal runaway due to flame or radiant heat impact.
  - Other adjacent infrastructure, including power conversion units and transformers.
- Requirements for smoke, gas and vapour knockdown to prevent off-site impact.
- Requirements for managing grassfires ignited by burning debris, as a result of BESS or other infrastructure fire.

6.2 On-site water storage should be calculated to meet worst-case scenario demand. CFA's expectation is at least **a four-hour supply**.

Calculations should consider:

- The duration and intensity of potential fires, incorporating (*refer to* ***Part 3***):
  - Fire, heat and thermal runaway propagation within BESS units.
  - Fire spread/radiant heat impact to adjacent BESS units and infrastructure within the site.
  - External fire entering the site.
  - Site and BESS monitoring, notification and the implications for fire brigade response time.
- The battery energy storage system:
  - Chemistry/technology.
  - In-built fire suppression systems.
  - In-built explosion prevention systems.
  - Fire-rating/construction standard.
  - Arrangement on-site. Fire water must be available for every BESS unit, including decentralised arrangements.
- The fire protection systems. (*Refer to* ***Part 5***.)
- Competing demands for reticulated and static water supply.

6.3 The determination should detail and justify:

- The assumptions and limitations in the calculations and design choices.
- The Australian and international standards, codes and guidelines informing the design. Any deviation from a relevant design standard should be identified and justified.
- Calculations for fire water demand, individually for each system and combined, including internal BESS fire suppression systems, under typical and worst-case conditions of fire and wind.
- The adequacy of the mains water supply (if applicable) and/or the number of fire water supplies, their location and capacity.
- The number of fire pumps and their configuration, the pump capacity, type, curves, backup(s) and power supplies.
- Pressure and flows for all potential fire scenarios, including simultaneous operation of fire suppression systems (e.g., internal enclosure sprinklers and hydrant systems).

BESS Controlled Burn Strategy

CFA acknowledges that BESS manufacturers may advocate for a supervised 'controlled burn' approach when thermal runaway in lithium-ion batteries leads to fire.

Where this strategy is recommended by manufacturers or suppliers, the following information, based on the results of large-scale fire tests, is to be provided in the ***fire safety study***:

- The anticipated timeline of the burn.
- The estimated duration of the burn (e.g., the time for the BESS to 'burn-out').
- The assumptions informing the strategy and timeline of the burn.
- Analysis and modelling in accordance with ***Part 3*** of this guideline for the duration of the burn.

A controlled burn strategy does not negate the need for the provision of fire water on-site. Fire water may be required for internal BESS suppression systems, cooling of adjacent exposures, smoke, gas and vapour knockdown, and the management of grassfires.

The selected fire suppression systems must have the water supply and performance to meet the required demand. Where this is not the case, the system and/or its proposed design should be revised.

6a. Factors Influencing Fire Water Demand and Supply

i. *Site Layout*

For battery energy storage facilities, the site layout heavily influences fire water demand for cooling of adjacent BESS and other assets/exposures. Effective site design can prevent radiant heat from initiating thermal runaway in adjacent BESS units.

CFA's expectation is that BESS units are separated to at least the distance where radiant heat flux (output) does not create the potential for ignition in adjacent BESS or other infrastructure.

Further information on site arrangement, including model requirements for facility design for centralised and decentralised BESS arrangements, are contained in *CFA's Design Guidelines and Model Requirements for Renewable Energy Facilities.*

ii. *Mains Water Supplies*

Where mains water is available to the site, its quantity and reliability must be determined and analysed within the ***fire safety study***.

The local water authority should be contacted to verify the pressure and flow in the relevant water mains, and a copy of the report provided by the water authority should be included as an appendix within the ***fire safety study***.

Where mains water is not available, adequate or reliable, static water supplies are to be provided.

iii. *Fire vs. Explosion Management*

In thermal runaway scenarios, extinguishing a BESS fire that's burning flammable off-gas may create an explosion hazard. Extinguishing an internal fire is very unlikely to sufficiently cool the battery to stop the exothermic chain reaction of thermal runaway.

Where internal fire suppression systems are proposed for internal BESS fires, the management of any resulting gas build-up and explosion risks are to be identified and control measures detailed and justified within the ***fire safety study***.

Bushfire scenarios should be considered in determining fire detection and protection systems, fire water demand and supply.

Case Study: Water Requirements

Calculations of fire water supply for bespoke systems should always provide a better outcome than the application of generalised standards. CFA's expectation is that fire water calculations account for scenarios that require the management of smoke/vapour/gas release, cooling of exposures, and grassfire. **CFA will not accept a proposed water supply below the quantity and design requirements of *CFA's Design Guidelines and Model Requirements for Renewable Energy Facilities*.**

BESS Details	CFA Model Requirements	FSS Determination

Facility: Stand-alone BESS
Chemistry: Lithium Iron Phosphate (LFP)
Capacity: 200MW/400MWh
Site Area: 22,000m^2
Landscape: Low-risk as per CFA's Design Guidelines and Model Requirements for Renewable Energy Facilities.
	Fire protection system:
	Fire hydrant system to AS 2419.1-2021.
	Fire water supply:
	• 432,000L(30L/s) based on area of BESS installation (including 10m fire breaks).
		Fire protection system:
		• Fire hydrant system to AS 2419.1-2021.
		• Fire water supply:
		  ◦ 20L/s - hand lines.
		  ◦ 80L/s - monitors.
		-- 	
		Total: 100L/s (or 6,000L/m, 360,000L/h)
		-- 	
		Fire water supply x four hour duration (360,000 x 4) = **1.44ML**
		-- 	

Part 7: Fire Water Management

Fire water used at emergency incidents at BESS facilities must be appropriately managed to prevent harm to people and the environment.

Analyse the requirements for the control, drainage, storage and disposal of fire water runoff.

7.1 The systems and processes for managing fire water runoff should be listed and described.

7.2 The assumptions and calculations on which the system and arrangements are based and justification for the design should be provided.

7.3 Detail any actions required by on-site personnel or emergency responders to initiate or manage these systems.

Fire water management systems should:

- Be in accordance with the requirements of *EPA's Liquid Storage and Handling Guidelines* (publication no. 1698, dated June 2018).
- Any manually-operated components of the system must be designed so that they are located at least 10m away from the BESS and any other hazards on-site.
- Be of a capacity at least equal to the entire fire water demand for credible worst-case scenarios.
- Have processes in place to test, and where contaminated, dispose of fire water in accordance with EPA requirements.
- Have clearly marked isolation valves and instructions for any required manual operation.

Part 8: First-Aid Fire Protection

First-aid firefighting equipment is designed for on-site personnel to undertake an initial response to an incident, where it is safe to do so.

Identify provision, specification, location, signage, testing, maintenance and training requirements for first-aid fire protection equipment.

8.1 First aid fire protection equipment is to be listed and described.

First-aid fire protection equipment includes, but is not limited to:

- Portable fire extinguishers, suitable to the hazard.
- Knapsack spray pumps.
- Fire hose reels.
- Fire blankets.
- Warning and safety signage.

The provision of first-aid fire protection equipment should be in accordance with:

- The National Construction Code and relevant Australian Standards for any associated building infrastructure within the facility.
- *CFA's Design Guidelines and Model Requirements for Renewable Energy Facilities* for power conversion systems/units (PCS) and vehicles.
- The outcomes of the risk assessment process, as documented in the **Risk Management Plan**.

The provision and use of first-aid fire protection should always be supported by regular training in its appropriate, safe and effective use.

Fire Extinguishers and Lithium-Ion Batteries

In accordance with the *CSIRO's Advisory Note (AN-004) on 'Extinguishment of Li-Ion Battery Fires'* (Version 2, dated November 2023), CFA does not advocate the use of non-certified fire extinguishers on lithium-ion batteries involved in fire.

Part 9: Emergency Planning

Emergency planning is a critical risk control for battery energy storage facilities.

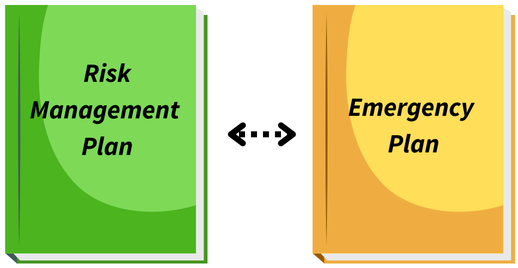
Emergency planning and effective, safe response relies on comprehensive and accurate analysis within the entire ***fire safety study*** and its integration into the broader ***Risk Management Plan***, which informs the ***Emergency Plan.***

9.1 CFA recommends the development of an ***Emergency Plan*** in accordance with *AS 3745-2010: Planning for Emergencies in Facilities*, and *CFA's Design Guidelines and Model Requirements for Renewable Energy Facilities*.

9.2 CFA recommends that the following strategies and measures are incorporated into emergency planning and management for BESS facilities.

- **Collaborative, ongoing emergency planning.** Establish an Emergency Planning Committee that meets regularly and includes CFA and other local authorities.
- **Determine CFA notification triggers and processes.** Notify CFA at least 7 days prior to the construction period, prior to commissioning activities, and at significant maintenance periods for BESS.
- **Determine initial response actions.** Document the actions to be taken by site or monitoring personnel to:
  - Identify BESS conditions that may escalate to thermal runaway.
  - Monitor and manage the conditions.
  - Notify CFA, any on-call support teams, and site personnel (as appropriate).
- **Develop emergency procedures.** Procedures for foreseeable emergency scenarios involving the BESS are to be developed in conjunction with CFA.

- **Select a BESS manufacturer/supplier that provides active support during emergencies.** BESS manufacturers/suppliers should:
  - Have 24/7/365 specialist technical support available for emergencies.
  - Provide in-person, on-site support during emergencies.
  - Provide detailed emergency response guides specific to the BESS.
- **Actively involve CFA.** CFA should be involved in:
  - Development and reviews of emergency plans.
  - Any post-incident review processes.
  - Regular site-familiarisation visits. An invitation should be provided to the local brigade at least annually.
- **Provide emergency information** for emergency responders.



Emergency Plans

CFA's Design Guidelines and Model Requirements for Renewable Energy Facilities contain detailed guidance on the development of ***Emergency Plans*** for battery energy storage facilities.

Part 10: Recommendations and Implementation

Emergency planning is a critical risk control for battery energy storage facilities.

List recommendations and detail the process for implementation.

10.1 Summarise:

a) The assessment.

b) The main study findings.

c) The recommendations with justification for chosen solutions.

d) The process for implementing the recommendations.

e) The conclusions of the ***fire safety study***.

10.2 Submit the ***fire safety study*** to CFA's Specialist Risk and Fire Safety Unit at risk-info@cfa.vic.gov.au for review, advice and approval.

Appendices

Provide relevant information that supports and justifies the information and analysis within the *fire safety study*.

Appendices should include:

- BESS technical data sheets/specifications.
- Detailed water calculations.
- Mains water analysis.
- Summaries of analytical models.
- VicPlan Property Report.
- Site plans that show the proposed location of:
  - Fire and explosion prevention measures.
  - Fire detection and protection systems.
  - First-aid firefighting equipment.
  - Drainage/fire water retention systems.
- Building plans marked up with proposed active and passive fire protection systems.
- Lists of referenced Standards and other documents.
- Emergency Response Guide for the BESS.

Bushfire and Fire Safety Studies

How should bushfire be incorporated?

Victoria's bushfire planning policy requires identification and inclusion of bushfire protection measures in the design response wherever there is a bushfire hazard.

Where landscape hazards such as bushfire and grassfire are identified, CFA's expectation is that these are considered and addressed within ***fire safety studies***.

In relation to bushfire, the ***fire safety study*** should:

- Describe landscape features, vegetation and any applicable planning overlays at the site in ***Part 1***.
- Identify bushfire hazards in ***Part 2***, through a bushfire hazard identification and assessment in accordance with ***VPP 13.02-1S***, that:
  - Identifies vegetation, topographic and climatic conditions that create a bushfire hazard.
  - Considers the landscape, local, neighbourhood and site bushfire hazards.
- Identify consequence scenarios involving bushfire in ***Part 3***, including:
  - To the BESS: Potential bushfire exposure thresholds (radiant heat flux), direct flame contact and ember attack to BESS units and other structures.
  - From the BESS: Potential radiant heat flux, direct flame contact, and expelled gases and projectiles from the BESS to on-site and off-site vegetation.
- Identify fire prevention measures and strategies for bushfire in ***Part 4***.
- Analyse the requirements for fire detection and protection for bushfire in ***Part 5***.
- Determine the fire water demand (hydraulic design) required for your chosen fire protection/ suppression systems, incorporating bushfire scenarios in ***Part 6***.
- Analyse the requirements for fire water management systems and processes, incorporating bushfire scenarios in ***Part 7***.
- Incorporate bushfire preparedness, monitoring and response into emergency planning processes in ***Part 9***.

BAL Assessments

A Bushfire Attack Level (BAL) assessment is designed to inform construction standards for residential developments and is ***not required*** for renewable energy facilities in Bushfire Prone Areas (BPA) in Victoria.

Rather than a BAL rating, radiant heat calculations from ***Part 3*** can support:

- The ***Risk Management Plan***, informing the design of fire risk controls, including site layout, fire breaks, separation distances between BESS and vegetation, and safer locations for evacuation assembly areas, site access points and internal roads.
- The ***Fire Management Plan***, informing vegetation management activities, including maintenance of fire breaks.

Risk Management Plans

Developing a Risk Management Plan

CFA's Design Guidelines and Model Requirements for Renewable Energy Facilities specifies the development of a ***Risk Management Plan*** for renewable energy facilities, including those with battery energy storage systems.

The ***Risk Management Plan*** outlines the process and outcomes of the risk assessment process, and draws from the findings of technical studies, such as ***fire safety studies***, to inform the design of facilities.

When a ***fire safety study*** is requested by CFA, CFA recommends that it is developed in conjunction with a ***Risk Management Plan***, to capture a comprehensive analysis of the hazards and risks associated with the design, construction and operation of BESS.

CFA's Design Guidelines and Model Requirements for Renewable Energy Facilities, Section 3.3, contains detailed guidance on the development of ***Risk Management Plans***.

Model Requirements from CFA's Guidelines

The Risk Management Plan must:

a) Describe the infrastructure (natural and built), landscape, nature of operations and occupancy of the facility.

b) Describe the risks and hazards at the facility to and from the renewable energy infrastructure (including battery energy storage systems).

c) Specify and justify, in accordance with **Section 4.2** of CFA's Guideline:

- The **location** of the facility in the landscape, and the proposed infrastructure on-site.
- **Emergency vehicle access** to and within the facility that:
  - Includes site access points of a number suitable to the size and hazards of the facility (a minimum of two).
  - Provides access to renewable energy infrastructure, substations and fire service infrastructure.
- **Firefighting water supply** for the facility.
- A **fire break width** of 10m or greater, based on radiant heat flux (output) as an ignition source:
  - Around the perimeter of the facility.
  - Between any landscape buffer/vegetation screening and infrastructure.
- The **separation distance**, based on radiant heat flux (output) as an ignition source, between:
  - Adjacent renewable energy infrastructure (eg., between adjacent battery containers/ enclosures).
  - Battery containers/enclosures and related battery infrastructure, buildings/ structures, and vegetation.
- **All other controls** for the management of on- and off-site hazards and risks at the facility (including all proposed battery energy storage system safety and protective systems).

d) Provide an evidence-based determination of the effectiveness of the risk controls against the identified hazards, including justification for the omission of any battery safety and protective system/s.

e) Form the basis for the design of the facility.

Modifications to Model Requirements must be in consultation with CFA.

References

Country Fire Authority 2023, *Design guidelines and model requirements for renewable energy facilites v4*, Country Fire Authority (CFA), Burwood East.

Fire Rescue Victoria 2024, *Fire Safety Study Guideline 54*, Version 1.0, Fire Rescue Victoria (FRV), Burnley.

NFPA 2023, *NFPA 855: Standard for the installation of stationary energy storage systems*, National Fire Protection Association (US), Massachusetts, USA.

NSW Planning 2011, *Hazardous Industry Advisory Paper 2: Fire safety study guidelines*, NSW Department of Planning, Sydney.

WorkSafe 2019, *The role of fire studies at major hazard facilities*, WorkSafe Victoria, Melbourne.

CFA Fire Safety Studies for Battery Energy Storage Systems v1, dated 4/6/2025
CFA Supplementary Guide RE02