Lime Down Solar Park

Applicant's Detailed Response to Stop Lime Down Deadline 1 Submission on BESS Fire Emissions

May 2026

Revision 1

Planning Inspectorate Reference: EN010168

Document Reference: EXAM/9.25

The Infrastructure Planning (Examination Procedure) Rules 2010

List of Contents

List of Tables

1 Introduction

1.1.1 This Technical Note has been prepared on behalf of the Applicant in response to the Written Representation submitted by Stop Lime Down at Deadline 1 (**Written Representation, Appendix I2 (Air Pollution Modelling from a BESS Fire at Lime Down) [REP1-181]**).

1.1.2 The submission raises concerns regarding the assessment of air quality impacts associated with a potential Battery Energy Storage System (BESS) fire. This note clarifies the assessment approach set out in **Environmental Statement (ES), Volume 3, Appendix 15-2: BESS Fire Emissions Modelling [EN010168/APP/6.3 (Rev 2)]** which has been updated at Deadline 2 and addresses the points raised, demonstrating that the assessment has been undertaken using a proportionate and precautionary methodology consistent with relevant guidance.

2 Response to Specific Points Raised

2.1 Fire Scenario Definition and Reasonable Worst Case

2.1.1 Issues were raised in relation to:

- **Assumption of single-container fire vs full-site involvement;**
- **Potential for fire spread between containers; and**
- **Application of the precautionary principle.**

Fire Propagation Risk

2.1.2 The Applicant notes that the examples cited (Moss Landing and the Cirencester Solar Farm fires) relate to legacy BESS designs which are not directly representative of the type of system proposed for the Scheme.

2.1.3 The Moss Landing fire involved older-generation systems that pre-date the National Fire Protection Association (NFPA) 855 standard (Ref 1) and utilised Nickel-Manganese-Cobalt (NMC) cell, air-cooled battery configurations (Ref 2). These systems were installed within a repurposed gas plant, incorporating 99,858 battery modules across over 4,539 racks (Ref 2). In many locations, battery racks were double stacked and, in some parts of the building, arranged across multiple floors (Ref 2). This configuration is materially different from the illustrative design for the Scheme, which comprises significantly smaller, discrete, non-combustible enclosures containing approximately 40–60 battery modules.

2.1.4 Similarly, the Cirencester example relates to a container-based battery storage proposal originally consented 11 years ago in 2015 (with subsequent amendments) (Ref 3), prior to the development of current industry guidance and testing requirements, including those set out in NFPA 855 (2026) (Ref 1). As such, it does not reflect the design and performance standards applicable to contemporary BESS installations and is not directly comparable to the Lime Down Solar Scheme. In contrast, modern BESS proposals incorporate defined battery chemistries, advanced thermal management systems and validated fire performance testing, all of which are embedded within the design basis for the Scheme.

2.1.5 These distinctions are reflected in the **Outline Battery Safety Management Plan (BSMP) (Rev 2) [REP1-110]**, which sets out key design principles for the Scheme, including:

- Section 4.1.30: requiring battery liquid cooling systems with automated fail-safe operation (air-cooled systems will not be considered); and
- Section 4.1.22: establishing an indicative layout that conforms to the latest NFPA 855 (2026) (Ref 1) spacing requirements, including separation

between BESS enclosures and equipment, informed by Large Scale Fire Testing (LSFT) outcomes and consistent with National Fire Chiefs Council (NFCC) latest 2026 guidance (Ref 4).

2.1.6 Modern BESS installations are designed as integrated systems in which fire propagation risk is addressed through the combined application of battery chemistry selection, enclosure design, thermal insulation, spacing, and validated performance testing. LSFT is a critical component of this approach. It involves deliberately initiating a full-scale fire within a BESS enclosure to measure thermal exposure, heat release, burn duration, peak temperatures, and, most importantly, the potential for fire propagation to adjacent units.

2.1.7 Recent LSFT (2024–2026) for contemporary ~5 MWh BESS designs, including multiple independent system tests, has demonstrated that, where appropriate design measures and spacing are applied, fire can be contained within the initiating enclosure without propagation to adjacent units (Ref 5) (Ref 6). These enclosures are specifically engineered to prevent the transfer of heat sufficient to trigger thermal runaway in neighbouring units, with thermal insulation designed to maintain internal temperatures of adjacent systems below critical thresholds (typically below 100°C).

2.1.8 NFPA 855 (2026) (Ref 1) now requires LSFT to demonstrate the behaviour of BESS installations under worst-case conditions. As such, the Applicant will only select a BESS design that has been validated through LSFT. At the detailed design stage, the selected system-specific LSFT data will be used to inform detailed risk assessment, consequence modelling, and emergency response planning, as required by Section 6 of the **Outline BSMP (Rev 2) [REP1-110]**.

2.1.9 The **Outline BSMP (Rev 2) [REP1-110]** is secured through Requirement 6 (Battery Safety Management) in Schedule 2 of the **Draft DCO(Rev 2) [REP1-007]**, which prevents commencement of the BESS works until a detailed Battery Safety Management Plan has been approved by the relevant planning authority, following consultation with Dorset and Wiltshire Fire and Rescue Service and the Environment Agency.

Fire Propagation and Worst-Case Scenario

2.1.10 The Applicant does not consider that a scenario involving fire spread to all BESS containers represents a credible or reasonable worst-case for the purposes of environmental or health impact assessment.

2.1.11 A reasonable worst-case must be based on physically plausible outcomes, informed by empirical evidence, testing, and established standards. LSFT is specifically designed to define the credible failure envelope of modern BESS systems. Where LSFT demonstrates that fire does not propagate beyond a single enclosure under worst-case test conditions, this provides direct empirical evidence that multi-container escalation is not a credible outcome for that system design and configuration.

2.1.12 The illustrative BESS design for the Scheme is based on systems which:

- Have undergone LSFT;
- Have demonstrated no fire propagation to adjacent units; and
- Comply with NFPA 855 (2026) (Ref 1) spacing and design requirements.

2.1.13 These measures form an integrated, performance-tested system rather than a series of independent safeguards. A scenario involving sequential or simultaneous fire spread to up to 270 containers would require the failure of all such design features, in contradiction to LSFT outcomes and current standards. There is no empirical evidence from LSFT or monitored performance of compliant systems to support such an outcome.

2.1.14 By contrast, the incidents referenced in **Written Representation, Appendix I2 (Air Pollution Modelling from a BESS Fire at Lime Down) [REP1-181]** involved legacy systems which were not compliant with current standards and had not undergone LSFT. These events do not provide an appropriate evidential basis for defining credible worst-case scenarios for modern BESS installations.

2.1.15 It should be noted that real-world monitoring from the Moss Landing incident, despite its scale and use of higher-risk NMC chemistries, indicated that air quality impacts in the surrounding area were generally transient and below public health thresholds (Ref 7). Similarly, a 2025 Environmental Protection Agency (EPA) factsheet concluded that air quality monitoring during and after the fire identified no risk to public health (Ref 8). These findings further demonstrate that even where larger-scale fire events occur, off-site concentrations do not scale linearly with total battery inventory due to dispersion and combustion behaviour.

2.1.16 This is consistent with wider industry evidence. A recent review of 35 large-scale BESS fire incidents and associated environmental monitoring data (Ref 9) found that, even where fire events have occurred, contaminant concentrations did not pose a public health concern and impacts were limited to the immediate vicinity of the fire.

2.1.17 The Applicant's emissions assessment is based on a single-container fire, which has been demonstrated to represent the credible worst-case scenario through LSFT and compliance with NFPA 855 (2026) (Ref 1). The modelling has been undertaken in accordance with UK Health Security Agency (UKHSA) requirements and has been reviewed and accepted by UKHSA as a statutory consultee, which confirmed that it is satisfied with the methodology and outcomes. The suggestion that emissions should be scaled to reflect simultaneous involvement of all BESS containers is not supported by empirical evidence or current standards and does not represent a physically plausible scenario. EIA requires consideration of likely significant effects based on credible scenarios, rather than hypothetical scenarios involving multiple independent system failures that are not supported by empirical evidence or design testing. The assessment therefore provides a robust and appropriate evaluation of potential air quality and health effects.

2.2 Representation of Emission Sources in Modelling

2.2.1 Issues were raised in relation to:

- **Use of area source vs point source modelling; and**
- **Implications for plume dispersion and concentration predictions.**

2.2.2 The modelling of the BESS fire as an area source is appropriate and reflects the physical characteristics of the emission. A BESS fire represents combustion occurring across the footprint of the container enclosure, rather than a discrete release point such as a vent or stack. It is therefore more representative of a surface-based emission than a point source.

2.2.3 As set out in **Environmental Statement Volume 3, Appendix 15-2 BESS Fire Emissions Modelling [EN010168/APP/6.3 (Rev 2)]** which has been updated at Deadline 2 of examination , each fire location was modelled as an area source to allow plume rise to be represented, which is more appropriately represented using an area source than alternative source types (such as point, line or volume sources). Given that a BESS fire is buoyancy-driven with significant thermal uplift, this is an important part of the assessment.

2.2.4 The ADMS-6 user guidance (Ref 10) states the following:

"*A point source is a release at the specified height, located at (X,Y). It is assumed to be horizontal and circular in cross-section, with diameter as specified by the user. Sources of large diameter should be modelled as area sources. This is because large point sources are subject to large stack downwash, which may not be physically representative of the source in question.*

2.2.5 The use of an area source is therefore more suitable. As set out in the ADMS-6 user guidance (Ref 10), sources of large diameter should be modelled as area sources, as representing them as point sources can introduce effects (such as stack downwash) that are not physically representative of the emission. This is particularly relevant in the context of a BESS container fire, where emissions arise across the footprint of the enclosure rather than from a discrete release point. The adoption of an area source therefore ensures that the geometry and behaviour of the emission are represented more realistically within the model.

2.3 Dispersion Distance and Extent of the Study Area

2.3.1 Issues were raised in relation to:

- **Limitation of the modelled study area (e.g. 1 km);**

- **Role of plume rise and thermal uplift; and**
- **Interpretation of evidence from large-scale incidents (e.g. Moss Landing)**

2.3.2 As detailed in Section 2.1, there is no direct comparison between a potential BESS fire associated with the Scheme and the incident at Moss Landing, given differences in design, layout, and operational context.

2.3.3 A 1 km study area was selected based on professional judgement and precedent from similar schemes, including published assessments for comparable BESS developments, such as Green Hill Solar Farm. In addition, the NFCC's latest guidance (Ref 4) identifies a 1 km distance as appropriate for emergency planning purposes.

2.3.4 A sensitivity check was undertaken as part of the assessment to confirm the extent of pollutant dispersion. Modelling of maximum 1 hour hydrogen fluoride (HF) concentrations was undertaken across a 5 km x 5 km receptor grid centred over the simulated BESS container fire. The resulting HF pollutant contours are shown in Figure 1 (Annex A). The contours demonstrate that modelled HF concentrations peak within 1km of the BESS and decrease rapidly with distance beyond this. The characteristics of dispersion (relationship between concentration and distance from the fire) is the same for every pollutant emitted and reflects the behaviour of buoyant plumes where initial thermal uplift promotes dispersion and dilution rather than sustained ground-level concentrations at distance. While plume touchdown may occur further from the source under certain meteorological conditions, this is associated with significantly reduced concentrations due to dispersion during transport. The modelling therefore focuses on the zone where concentrations are highest and most relevant to exposure, which is in close proximity to the source.

2.3.5 This behaviour is consistent with published evidence from real-world BESS incidents (Ref 9), which demonstrates that airborne emissions are generally confined to the immediate vicinity of the fire and are subject to rapid dispersion and dilution in open-air conditions, with concentrations reducing to levels that do not pose a public health risk at nearby community receptors.

2.3.6 The use of a 1 km study area is therefore considered appropriate and proportionate, capturing the worst-case concentrations relevant for assessment of human exposure. The dispersion modelling undertaken for the Scheme indicates that concentrations reduce rapidly with distance and beyond 1 km, the effects would be negligible due to atmospheric dispersion and dilution.

2.4 Identification of Receptors and Exposure Extent

2.4.1 Issues were raised in relation to:

- **Consideration of receptors beyond the modelled study area; and**

- **Potential for wider population exposure at greater distances.**

2.4.2 As detailed in Section 2.3, the dispersion modelling undertaken for the Scheme indicates that pollutant concentrations decrease rapidly with distance and reduce to negligible concentrations beyond 1 km. The assessment appropriately focuses on the area within which concentrations are highest and therefore most relevant for potential exposure. Given that the predicted concentrations are below the relevant health thresholds at worst-case receptors within 1km of the BESS, it can be concluded that there would be no risk of adverse effects at receptors beyond this distance. On this basis, the inclusion of receptors beyond 1 km would not alter the conclusions of the assessment. This conclusion is also supported by evidence from real-world incidents (Ref 9), where environmental monitoring in nearby communities has consistently shown that pollutant concentrations do not reach levels of public health concern beyond the immediate vicinity of the fire.

2.5 Selection of Assessment Criteria and Air Quality Standards

2.5.1 Issues were raised in relation to:

- **Use of workplace exposure limits vs ambient standards; and**
- **Applicability to public exposure and vulnerable groups.**

2.5.2 The use of Acute Exposure Guidance Levels (AEGLs) is considered appropriate and robust for assessing short-duration accidental fire events. AEGLs are internationally recognised, health-based thresholds specifically developed for emergency response and short-term exposure scenarios and are therefore more relevant than long-term ambient air quality objectives, which are not designed for accidental, acute releases.

2.5.3 There are currently no short-term health-based assessment criteria for particulate matter (PM_{10}) equivalent to AEGLs. In the absence of such criteria, the Health and Safety Executive Workplace Exposure Limit (WEL) for respirable dust has been used as a pragmatic proxy to provide a benchmark for short-term exposure in the absence of established health-based acute criteria for particulate matter. It is recognised that WELs are derived for occupational settings; however, they provide a useful reference point for short-duration exposure in the absence of established acute public health thresholds for particulate matter.

2.5.4 The use of the WEL in this context is consistent with the overall assessment approach, whereby acute exposure criteria are applied where available, and the most appropriate available proxy is used where such criteria do not exist. The assessment is concerned with short-duration exposure associated with a rare accidental event, rather than long-term population exposure.

2.5.5 The application of a 24-hour mean PM_{10} air quality objective and WHO guideline level is not considered appropriate for this type of assessment. These standards are designed for every day ambient air quality and so consider long-term, repeated exposure (e.g. the air quality objective allows up to 35 exceedances of the 24-hour mean 50 μg/m^3 threshold per year). The main purpose of the air quality objectives and WHO guideline levels is to protect the population over their lifetime. These thresholds do not apply to rare short-term accidental/emergency pollution incidents where acute exposure is more relevant, and where it is more appropriate to consider exposure in relation to toxicological thresholds. It would not be appropriate to expect compliance with air quality objectives or WHO guideline levels during rare emergency/accidental pollution events.

2.5.6 For carbon monoxide, the WHO 1-hour guideline value has been applied in the absence of an AEGL-1 threshold. This represents a precautionary approach to ensure appropriate short-term criteria are applied where no AEGL is available.

2.6 Assessment of Near-Field / Closest Receptors

2.6.1 Issues were raised in relation to:

- **Omission of pollutant concentrations on the railway and Hill Hayes Lane; and**
- **Treatment of transient vs non-transient exposure pathways.**

2.6.2 Human health receptors were not included in the model on Hill Hayes Lane because it has no pavement, and it was considered that Public Right of Way (PROW) 4c WT|HULL|24 would be used by pedestrians rather than using this road. Notwithstanding this, maximum 1-hour modelled pollutant concentrations have been provided in **Table 1** for the Hill Hayes Lane receptors used in the visibility assessment (i.e. the closest points of the road to the BESS) to provide a worst-case indication of the pollutant concentrations that would arise (see **ES Volume 2, Figure 15-5 Battery Energy Storage System Fire Emissions Study Area [APP-166]**). The concentrations presented are the maximum hourly concentration across five years of meteorological data and so assumes that the fire occurs during worst-case conditions for pollution dispersion, at the BESS closest to the road.

2.6.3 **Table 1** shows that the predicted maximum one-hour mean PM_{10} concentrations were all well below the 8-hour WEL (4000 μg/m^3) and the predicted maximum one-hour mean CO concentrations were well below the 1 hour WHO guideline value (35,000 μg/m^3). All other maximum one-hour mean concentrations were well below AEGL level 1 (notable discomfort, irritation, or certain asymptomatic non-sensory effects) for 1-hour, 4-hour and 8-hour exposure periods. Therefore, even if it was assumed that a pedestrian was present on the road for a 1 to 8-hour period during a BESS fire, which is considered highly unrealistic, there would be a low risk of adverse health effects arising from the associated exposure.

Table 1 Maximum Modelled One-Hour Mean Concentration for Hill Hayes Lane (including Backgrounds)

<table>
<tr><th rowspan="2">Receptor</th><th colspan="8">Maximum Hourly Mean Concentration (µg/m^3)</th><th rowspan="2">BESS Location where Maximum Concentration was Modelled</th></tr>
<tr><th>CO</th><th>Formaldehyde</th><th>HCl</th><th>HCN</th><th>HF</th><th>NH_3</th><th>NO_2</th><th>PM_{10}</th></tr>
<tr><td>ROAD1</td><td>2340.5</td><td>72.7</td><td>94.8</td><td>33.2</td><td>260.2</td><td>12.8</td><td>48.4</td><td>161.4</td><td>BESS 1</td></tr>
<tr><td>ROAD2</td><td>3257.3</td><td>97.8</td><td>139.4</td><td>49.0</td><td>383.4</td><td>17.1</td><td>67.6</td><td>228.0</td><td>BESS 3</td></tr>
<tr><td>ROAD3</td><td>3217.2</td><td>96.7</td><td>137.5</td><td>48.3</td><td>378.0</td><td>16.9</td><td>66.6</td><td>223.9</td><td>BESS 3</td></tr>
<tr><td>ROAD4</td><td>1767.6</td><td>57.1</td><td>66.8</td><td>23.4</td><td>183.2</td><td>10.1</td><td>36.4</td><td>120.5</td><td>BESS 1</td></tr>
<tr><td>ROAD5</td><td>2659.8</td><td>81.5</td><td>110.3</td><td>38.7</td><td>303.1</td><td>14.3</td><td>55.1</td><td>185.4</td><td>BESS 3</td></tr>
<tr><td>Maximum</td><td>3257.3</td><td>97.8</td><td>139.4</td><td>49.0</td><td>383.4</td><td>17.1</td><td>67.6</td><td>228.0</td><td>BESS 3</td></tr>
<tr><td>AEGL 1 (1 hour)</td><td rowspan="3">35,000 *</td><td rowspan="3">1105</td><td rowspan="3">2684</td><td>2211</td><td rowspan="3">818</td><td rowspan="3">20,896</td><td rowspan="3">941</td><td rowspan="3">4000**</td><td>-</td></tr>
<tr><td>AEGL 1 (4 hour)</td><td>1437</td><td>-</td></tr>
<tr><td>AEGL 1 (8 hour)</td><td>1106</td><td>-</td></tr>
<tr><td>Maximum as % AEGL 1 (1 hour)</td><td rowspan="3">9.3%*</td><td rowspan="3">8.8%</td><td rowspan="3">5.2%</td><td>2.2%</td><td rowspan="3">46.8%</td><td rowspan="3">0.1%</td><td rowspan="3">7.2%</td><td rowspan="3">5.7%**</td><td>-</td></tr>
<tr><td>Maximum as % AEGL 1 (4 hour)</td><td>3.4%</td><td>-</td></tr>
<tr><td>Maximum as % AEGL 1 (8 hour)</td><td>4.4%</td><td>-</td></tr>
</table>

*No AEGL 1 for CO so WHO 1-hour guideline used. **No AEGL for PM_{10} so 8-hour HSE WEL used.

No background data available for HCN

2.6.4 The railway was not included as a human receptor for pollutant concentration assessment because it is not a publicly accessible location where individuals would reasonably be present for sustained periods, and any interaction between a passing train and a buoyant fire plume would be brief and transient in nature. In addition, outdoor concentrations adjacent to the railway would not necessarily be representative of in-carriage exposure. The railway receptor points were instead included for the purposes of the visibility assessment. It should also be noted that the **Outline BSMP (Rev 2) [REP1-110]** submitted with the application also includes the following measures to reduce the risk of impacts from a potential BESS fire on road and rail users:

- Should there be a BESS fire in close proximity to the road, the site operator to determine wind direction and seek to close the road if deemed necessary; and
- Should there be a BESS fire in close proximity to the rail line, the site operator to determine wind direction and notify Network Rail if deemed necessary.

2.6.5 For the reasons described above, there is considered to be a low risk of adverse air quality effects occurring due to exposure of road and rail users, even if assuming pedestrians were present on Hill Hayes Road during a potential BESS fire.

2.6.6 This conclusion is further supported by recent industry-wide review evidence. A comprehensive 2025 literature review of BESS fire incidents (Ref 9), including 35 large-scale events and associated environmental monitoring data, found that contaminant concentrations from BESS fires did not pose a public health concern at on-site or off-site receptors and did not require remediation. Airborne emissions were consistently observed to be localised to the immediate vicinity of the fire and subject to rapid dispersion and dilution in open-air conditions, with monitoring data in nearby communities confirming that concentrations did not reach levels of concern.

2.6.7 The review also notes that acid gas emissions, such as hydrogen fluoride, generally do not reach concentrations of concern beyond the immediate fire site. This body of empirical evidence supports the modelling approach adopted in the assessment and demonstrates that emissions from BESS fires are short-lived, spatially limited, and unlikely to result in widespread or prolonged impacts at surrounding receptors.

2.7 Emissions Data and Assumptions

2.7.1 Issues were raised in relation to:

- **Use of surrogate emissions data (e.g. diesel fire proxy);**
- **Comparison with published lithium-ion battery emissions data; and**
- **Potential underestimation of particulate emissions.**

2.7.2 The Applicant acknowledges the reference to alternative particulate emission factors (e.g. Claassen et al. (2024) (Ref 11)); however, these do not provide a directly comparable or more appropriate basis for defining emissions from the Scheme.

2.7.3 As set out in the Environmental Statement, emissions data for BESS fires, particularly for particulates, remain limited and highly variable, depending on battery design, chemistry, state of charge, test configuration, and scale.

2.7.4 In the absence of verified enclosure-scale particulate data, the assessment adopted a surrogate approach consistent with industry practice, using emissions data from a comparable fire scenario as advised by the Applicant's Battery Safety and Testing Consultant.

2.7.5 This approach is appropriate and proportionate for the following reasons:

- Consistency with available test data: Gas emissions are derived from large-scale BESS fire testing, anchoring the emissions profile to representative system behaviour.
- Limitations of alternative datasets: The cited values are derived from cell-level or small-scale testing and are not representative of complete BESS enclosures, where containment, combustion efficiency, and particle formation processes differ materially.
- Variability and uncertainty: Emissions vary significantly even between cells of the same chemistry and format; extrapolation from literature introduces additional uncertainty and may not be representative.
- Precautionary framework: Conservative assumptions have been applied, including worst-case meteorology, worst case BESS locations and sustained emissions, reducing the likelihood of underestimating risk.

2.7.6 As outlined in **Environmental Statement Volume 3, Appendix 15-2 BESS Fire Emissions Modelling [EN010168/APP/6.3 (Rev 2)],** sensitivity testing demonstrates that even where emission rates are increased (e.g. doubled), predicted concentrations remain well below relevant health-based thresholds, confirming that the assessment conclusions are robust.

2.7.7 The claimed underestimation factor of 2.5 to 4.66 is derived from scaling cell-level emission data to a full BESS system and does not account for enclosure-scale combustion, thermal containment, venting, or dispersion; the sensitivity testing undertaken shows that the conclusions remain robust even under higher emission rate assumptions.

2.7.8 Furthermore, a Plume Analysis Study would be undertaken at the detailed design stage, as secured through the DCO and set out in Section 5.5.14 of the **Outline BSMP (Rev 2) [REP1-110]**. This would use BESS-specific test data to confirm that emissions remain below relevant public health thresholds and to inform the Emergency Response Plan.

2.7.9 At detailed design, emissions modelling would be based on data from approved LSFT facilities capable of capturing gases and particulates at module, rack, or full enclosure level. These facilities enable quantification of gas species (via gas chromatography and Fourier-transform infrared (FTIR) spectroscopy) and particulate composition (including heavy metals) for use in refined emissions modelling.

2.7.10 Final risk assessments, consequence modelling, and Emergency Response Plans can only be developed once the selected BESS design is defined, including system configuration, operating parameters, and test data.

2.8 Representation of Complex Dispersion Processes

2.8.1 Issues were raised in relation to:

- **Limitations of dispersion modelling tools (e.g. heavy gas behaviour, terrain effects); and**
- **Potential for localised concentration build-up in specific settings.**

2.8.2 The ADMS model is widely recognised as a leading regulatory dispersion model, particularly within the UK. It is accepted by environmental regulators including the Environment Agency, Scottish Environment Protection Agency and Natural Resources Wales for detailed modelling of emissions associated with environmental permits and has an established track record for assessing both routine and accidental releases, including fires. The model was developed by Cambridge Environmental Research Consultants (CERC) in collaboration with other research organisations, including the UK Meteorological Office, and has been extensively verified and validated through comparison with observational datasets, as documented in the CERC model validation literature.

2.8.3 It is acknowledged that standard Gaussian dispersion models do not explicitly simulate dense gas pooling effects, however the Applicant does not consider that the modelling approach fails to represent a credible risk associated with the formation of a dense vapour cloud within the adjacent railway cutting.

2.8.4 As set out in Section 2.6, the railway has not been treated as a static human receptor for the purposes of the assessment. Pedestrians would not be present on the railway infrastructure and, whilst trains may pass through the area, passengers would not be directly exposed to outdoor concentrations due to the physical barrier provided by the train carriage. Any interaction between a passing train and the plume would be brief and transient in nature and does not represent a sustained exposure scenario requiring detailed receptor-based assessment.

2.8.5 Notwithstanding this, the premise that emissions would form a coherent, dense vapour cloud capable of pooling within the railway cutting is not consistent with the physical characteristics of BESS fire emissions. Emissions are generated within a high-temperature combustion plume, characterised by strong thermal buoyancy and vertical momentum. This results in upward transport, rapid entrainment of ambient air, and subsequent dilution, rather than the formation of ground-hugging or slumping gas clouds.

2.8.6 Dense gas dispersion models are typically applied to cold, pressurised releases (e.g. liquefied gases) and are not representative of high-temperature buoyant releases from combustion sources such as BESS fires. Whilst certain gases (including hydrogen fluoride) have a higher molecular weight than air, their behaviour in a fire scenario is governed primarily by release conditions (temperature, turbulence and vertical velocity), rather than molecular weight alone. In addition, hydrogen fluoride is highly reactive and readily interacts with atmospheric moisture, reducing its persistence and potential to accumulate in concentrated form at distance from the source.

2.8.7 It should also be noted that the closest section of the railway lies to the south and south–south-west of the BESS. Meteorological data used within the assessment indicates that wind directions from the north and north-north-east, which would be required to transport emissions toward the railway, occur for a relatively small proportion of the time (approximately 7%). Whilst the assessment has appropriately assumed worst-case meteorological conditions for the purposes of dispersion modelling, this provides additional context that the alignment of plume direction and receptor location is of low likelihood in practice.

2.8.8 Additionally, the modelling undertaken incorporates conservative assumptions and uses five years of meteorological data thereby providing a precautionary representation of potential dispersion characteristics. As demonstrated in Section 2.6, predicted concentrations at the closest publicly accessible locations remain well below relevant health-based thresholds under these conditions.

2.8.9 In practice, any potential interaction between a plume and the railway would be short in duration and would be further managed through operational controls secured within the **Outline BSMP (Rev 2) [REP1-110]**, including monitoring of wind direction and liaison with Network Rail where appropriate.

2.8.10 Furthermore, evidence from real-world BESS fire incidents indicates that emissions are short-lived, highly dispersed, and localised to the vicinity of the fire, with no empirical evidence of hazardous vapour clouds forming or accumulating in low-lying areas at distances relevant to public exposure (Ref 9).

2.8.11 Accordingly, the Applicant considers that the modelling approach provides a robust and proportionate representation of dispersion processes. The assessment does not underestimate risk in relation to terrain effects or vapour cloud behaviour, and the potential for adverse effects to railway workers or passengers is considered to be low.

2.9 Derivation of Emission Rates

2.9.1 Issues were raised in relation to:

- **Approach used to estimate emission rates;**
- **Consideration of alternative methods and datasets; and**
- **Sensitivity to fire duration and intensity assumptions.**

2.9.2 The Applicant does not consider that the approach used to derive emission rates is "convoluted" or less accurate than the alternative suggested. The methodology set out in **Environmental Statement Volume 3, Appendix 15-2 BESS Fire Emissions Modelling [EN010168/APP/6.3 (Rev 2)]** is based on measured concentrations from large-scale BESS fire testing and derives emission rates consistent with enclosure-scale behaviour, which is the relevant scale for dispersion modelling and assessment of human exposure.

2.9.3 As set out in Section 2.7, the alternative values referenced in Claassen et al. (2024) (Ref 11) are derived from cell-level testing undertaken under controlled laboratory conditions. While these data provide useful insight into cell combustion processes, they are not directly representative of emissions from a complete BESS enclosure, where combustion behaviour, ventilation, thermal containment, and interaction between modules and enclosure structures materially influence emission rates.

2.9.4 The suggestion that a shorter burn duration (e.g. 3 hours) would result in a proportionally higher emission rate assumes that total emissions are released uniformly over time and that peak release rates scale inversely with duration. This approach is not representative of BESS fire behaviour. As set out in **Environmental Statement Volume 3, Appendix 15-2 BESS Fire Emissions Modelling [EN010168/APP/6.3 (Rev 2)]**, emission rates used in the assessment are derived from the maximum recorded concentrations observed during large-scale fire testing and therefore reflect peak fire conditions, rather than a time-averaged emission profile.

2.9.5 For the purposes of dispersion modelling, a conservative assumption has been applied whereby these peak-derived emission rates are assumed to be sustained over an extended duration (up to 8 hours), consistent with comparison against 4-hour and 8-hour AEGL exposure periods. This is a simplifying assumption for modelling purposes and does not imply that emissions are constant in reality. Rather, it represents a worst-case scenario in which peak emission intensity is maintained for significantly longer than would be expected in practice.

2.9.6 Accordingly, the approach distinguishes between realistic fire behaviour, which is characterised by a transient peak followed by a decay phase, and the conservative modelling assumption adopted for assessment, which applies sustained peak emission rates. On this basis, the assessment does not rely on uniform emissions to represent actual fire dynamics and does not support the application of simple duration-based scaling. Instead, it intentionally overestimates emissions by combining peak emission rates with extended duration assumptions.

2.9.7 Furthermore, the assessment adopts a precautionary framework. As set out in Paragraph 2.9.4, emission rates are based on peak conditions and are conservatively assumed to be sustained over an extended duration (up to 8 hours). Sensitivity testing as set out in **Environmental Statement Volume 3, Appendix 15-2 BESS Fire Emissions Modelling [EN010168/APP/6.3 (Rev 2)]** demonstrates that even where emission rates are further increased, predicted concentrations remain well below relevant health-based thresholds (see Paragraph 2.7.6), confirming that the conclusions are robust. It should also be noted that the concentrations presented in **Environmental Statement Volume 3, Appendix 15-2 BESS Fire Emissions Modelling [EN010168/APP/6.3 (Rev 2)]** are the maximum modelled concentrations at each point over five years of meteorological data for the worst case BESS location.

2.9.8 At the detailed design stage, the selected BESS system would be subject to further LSFT and emissions characterisation, and these data would be used to refine the plume analysis and emergency response planning, as secured through the **Outline BSMP (Rev 2) [REP1-110]**.

2.10 Consideration of Additional Pollutants

2.10.1 Issues were raised in relation to:

- **Inclusion of ultrafine particles ($PM_{2.5}$ and below); and**
- **Consideration of additional chemical species (e.g. organophosphorus compounds).**

2.10.2 The Applicant acknowledges that lithium-ion battery fires can generate ultrafine particulates (e.g. $PM_{2.5}$ and below) and a range of chemical species; however, it is not agreed that the omission of explicit modelling of ultrafine particles or specific trace compounds undermines the robustness of the assessment.

2.10.3 With respect to particulate matter, it is important to note that there are currently no health-based acute exposure criteria for ultrafine particles (including $PM_{2.5}$ or PM_1) equivalent to Acute Exposure Guideline Levels (AEGLs). As such, even if such emissions were explicitly modelled, there would be no recognised benchmark against which to assess potential short-term health effects in the context of an accidental fire scenario. In the absence of such criteria, the assessment has appropriately used the most relevant available proxy (i.e. the HSE Workplace Exposure Limit for respirable particulates) to provide a conservative indication of potential exposure.

2.10.4 The assessment of PM_{10} is also considered appropriate and proportionate in this context. $PM_{2.5}$ forms a subset of PM_{10}, and therefore modelling PM_{10} provides a reasonable representation of the total particulate mass relevant to exposure. Given the short-term and transient nature of the scenario assessed, this approach is considered sufficient to characterise potential impacts.

2.10.5 In addition, there are currently significant limitations in the availability of robust, representative emissions data for ultrafine particles and trace compounds from BESS enclosure-scale fires. As noted in the literature cited in **Written Representation, Appendix I2 (Air Pollution Modelling from a BESS Fire at Lime Down) [REP1-181]**, experimental results vary widely depending on battery chemistry, configuration, scale, and test conditions, and there is no standardised dataset that can be directly applied to dispersion modelling for full-scale BESS installations.

2.10.6 The same considerations apply to the identification of specific trace compounds (e.g. organophosphorus species). While such compounds may be observed in laboratory studies, there is insufficient evidence to define representative emission rates or to undertake meaningful dispersion modelling and assessment against recognised health-based criteria.

2.10.7 Notwithstanding this uncertainty, it is important to note that evidence from real-world BESS fire incidents (Ref 9) indicates that the presence of additional trace compounds has not resulted in measurable off-site impacts of concern. Environmental monitoring across multiple incidents has not identified contaminant concentrations requiring remediation or posing a public health risk.

2.10.8 In this context, the approach adopted in **Environmental Statement Volume 3, Appendix 15-2 BESS Fire Emissions Modelling [EN010168/APP/6.3 (Rev 2)]** is consistent with the application of the precautionary principle. Conservative assumptions have been applied in relation to emission rates, fire duration, and meteorological conditions, and the assessment has been undertaken against appropriate short-term exposure criteria where these exist. Sensitivity testing further demonstrates that the assessment conclusions are robust to reasonable variation in emission assumptions.

2.10.9 Finally, it should be noted that a further Plume Analysis Study would be undertaken at the detailed design stage, based on BESS-specific fire testing data for the selected system. This would allow refinement of emissions characterisation (including particulates and trace compounds where measurable) and ensure that the Emergency Response Plan is informed by the most up-to-date and representative data available.

3 Conclusion

3.1.1 In summary, the Applicant does not consider that the assessment is flawed or that it materially underestimates potential effects. The modelling has been undertaken using a proportionate and precautionary approach consistent with relevant guidance and current industry practice, taking account of the limitations of available BESS fire emissions data. Conservative assumptions have been applied throughout. The modelling assumes:

- Worst case BESS fire locations within the BESS area, positioned closest to sensitive receptors;
- Worst case release height, temperature and plume parameters; and
- The use of five years of hourly meteorological data, with the maximum predicted concentration extracted at each receptor, assuming the fire coincides with the poorest dispersion conditions.

3.1.2 As set out in **Environmental Statement Volume 3, Appendix 15-2: BESS Fire Emissions Modelling [EN010168/APP/6.3 (Rev 2)]**, emission rates used in the assessment are derived from the maximum recorded concentrations observed during large-scale fire testing and therefore reflect peak fire conditions, rather than a time-averaged emission profile. For the purposes of dispersion modelling, a further conservative assumption is applied whereby these peak-derived emission rates are assumed to be sustained over an extended duration (up to 8 hours), consistent with comparison against 4-hour and 8-hour AEGL exposure periods.

3.1.3 Given the inherent uncertainty in available BESS fire emissions data, a sensitivity test was also undertaken whereby emission rates were doubled. Even under this highly conservative sensitivity test, predicted concentrations remained well below the relevant health-based thresholds.

3.1.4 The assessment therefore adopts a deliberately precautionary framework, combining conservative assumptions in relation to fire location, fire duration, plume parameters, emissions rates, meteorological conditions and receptor location, and demonstrating that the predicted effects remain well below levels of concern.

3.1.5 The assessment has appropriately defined a credible worst-case scenario based on current BESS design principles and LSFT evidence, rather than hypothetical scenarios which are not supported by empirical data. The study area, receptor selection, and modelling approach are consistent with established guidance and precedent, and the selection of assessment criteria reflects the short-term, accidental nature of the scenario.

3.1.6 Whilst there is acknowledged uncertainty in this evolving field, this has been addressed through the application of conservative assumptions and sensitivity testing, which demonstrate that results remain well below relevant health-based thresholds. The commitment to further refinement at the detailed design stage, using BESS-specific test data, provides an additional safeguard to ensure that the assessment and emergency planning remain robust and evidence-based.

3.1.7 This is supported by wider industry evidence, which consistently demonstrates that real-world BESS fire events result in localised, short-term emissions that do not pose a public health concern beyond the immediate vicinity of the site.

3.1.8 On this basis, the Applicant considers that the Environmental Statement provides a sound and defensible assessment of the potential air quality and health effects of a BESS fire, and that there is no evidence to support the suggestion that widespread impacts or large-scale evacuation would be required.

4 References

Ref 1 National Fire Protection Association (NFPA) (2026) NFPA 855: Standard for the Installation of Stationary Energy Storage Systems. Quincy, MA: NFPA.

Ref 2 Western Electricity Coordinating Council (WECC) (2025), Moss Landing BESS Fire Report.

Ref 3 Cotswold District Council (2026) Planning portal. Available at https://www.cotswold.gov.uk/residents/planning-building/planning/planning-applications-register/.

Ref 4 National Fire Chiefs Council (NFCC) (2026), Grid scale energy storage system planning - Guidance for fire and rescue services.

Ref 5 Energy Storage News (2025), Fluence, Hithium, Canadian Solar BESS units undergo Large-Scale Fire Testing without flames spreading. Available at: https://www.energy-storage.news/fluence-hithium-canadian-solar-bess-units-undergo-large-scale-fire-testing-without-flames-spreading/

Ref 6 PV Magazine (2026), Sunwoda completes large-scale fire test for '5 MWh Liquid Cooling ESS'. Available at: https://www.pv-magazine.com/2026/05/09/sunwoda-completes-large-scale-fire-test-for-5-mwh-liquid-cooling-ess/

Ref 7 County of Monterey (2026), Webpage detailing Moss Landing air quality monitoring/sampling results. Available at: https://www.readymontereycounty.org/emergency/2025-moss-landing-vistra-power-plant-fire/testing/air

Ref 8 EPA (2025) Battery Energy Storage Systems: Main Considerations for Safe Installation and Incident Response.

Ref 9 Fire & Risk Alliance (2025), Assessment of Potential Impacts of Fires at BESS Facilities

Ref 10 Cambridge Environmental Research Consultants Ltd (2023), ADMS 6 Atmospheric Dispersion Modelling System User Guide Version 6.0

Ref 11 Claassen, M., Bingham, B., Chow, J.C., Watson, J.G., Chu, P.B., Wang, Y. and Wang, X.L. (2024) Characterization of lithium-ion battery fire emissions – Part 2: Particle size distributions and emission factors. Batteries, 10(366)

5 Glossary

Term	Acronym	Definition
Acute Exposure Guideline Level	AEGL	Health-based exposure thresholds for short-term exposure to airborne chemicals, used to assess potential effects in emergency situations.
Atmospheric Dispersion Modelling System	ADMS	A regulatory-approved dispersion model used to estimate the transport and dilution of pollutants in the atmosphere.
Battery Energy Storage System	BESS	A system that stores electrical energy using batteries, typically comprising modules, racks, and containerised enclosures.
Battery Safety Management Plan	BSMP	A document setting out measures for the safe design, operation, and management of a BESS facility, including fire prevention and response procedures.
Carbon Monoxide	CO	A colourless, odourless gas produced during combustion, assessed due to its potential health effects at high concentrations.
Emergency Response Plan	ERP	A plan that sets out procedures and actions to be taken in the event of an incident, including coordination with emergency services.
Fourier-transform infrared	FTIR	FTIR spectroscopy is a powerful analytical technique used to obtain the infrared spectrum of absorption or emission of a sample, providing a unique molecular fingerprint for identification and analysis.
Hydrogen Cyanide	HCN	A toxic gas that may be released during combustion of materials containing nitrogen, assessed in fire scenarios.
Hydrogen Chloride	HCl	An acidic gas that can be produced during combustion of chlorine-containing materials and may cause respiratory irritation.
Hydrogen Fluoride	HF	A highly reactive, acidic gas that may be emitted during lithium-ion battery fires and is assessed due to its toxicity.
Large Scale Fire Testing	LSFT	Full-scale testing of BESS installations to assess fire behaviour, including heat release, duration, and fire propagation risk.
Lower Explosive Limit	LEL	The lowest concentration of a gas in air at which it can ignite and propagate a flame.
National Fire Chiefs Council	NFCC	A UK body providing guidance on fire safety, including planning considerations for energy storage systems.
National Fire Protection Association	NFPA	An international organisation that develops fire safety codes and standards, including guidance for the design, installation, and operation of energy storage systems.

Term	Acronym	Definition
Ammonia	NH_3	A colourless gas that may be produced during combustion and thermal decomposition processes and is assessed due to its potential respiratory and irritant effects at elevated concentrations.
Nickel-Manganese-Cobalt	NMC	A type of lithium-ion battery cell that uses a nickel-manganese-cobalt cathode chemistry.
Nitrogen Dioxide	NO_2	A combustion-related pollutant used as an indicator of air quality and assessed in dispersion modelling.
Outline Battery Safety Management Plan	OBSMP	A framework document submitted at the application stage, setting out principles and requirements for the final BSMP at detailed design.
Particulate Matter (≤10 µm)	PM_{10}	Airborne particles with a diameter of 10 micrometres or less; includes a proportion of finer particles such as $PM_{2.5}$.
Particulate Matter (≤2.5 µm)	$PM_{2.5}$	Fine particulate matter that can penetrate deep into the respiratory system; a subset of PM_{10}.
Particulate Matter (≤1 µm)	PM_1	Fine particulate matter that can penetrate deep into the respiratory system; a subset of PM_{10}.
Plume	–	The visible or invisible cloud of gases and particles emitted from a source, such as a fire.
Precautionary Principle	–	An approach to assessment where conservative assumptions are used where uncertainty exists, to ensure risks are not underestimated.
Public Right of Way	PROW	A legally designated route over which the public has a right to pass.
Thermal Runaway	–	A failure mode in batteries where increasing temperature leads to uncontrolled energy release and potential fire.
World Health Organisation	WHO	An international body providing health-based guidance values for exposure to pollutants such as carbon monoxide.
Workplace Exposure Limit	WEL	Health-based exposure limits set by the Health and Safety Executive for workplace environments, used as a proxy where no acute public criteria exist.

Annex A Air Quality Supporting Information

Figure 1 Contour of Modelled Maximum 1-Hour Hydrogen Fluoride Concentrations (μg/m³)