

Appendix A – City Hall Battery Fire Risk Mitigation

1.0 Introduction

- The City Hall Battery project is a key first step for the council and Bristol Energy in the smart, decentralised energy revolution. With increasing electrification of core infrastructure and the need to move to renewable generation, there is a growing need to balance demand so that we are more efficient and sustainable in the way we use electricity.
- The battery will allow us to avoid expensive and carbon intensive peak electricity demand periods, and for Bristol Energy to explore new revenue streams through flexibility trading and fast frequency response. The combined savings/income is estimated to be £33k/year
- This is a pilot project which if successful would result in the installation of batteries across the BCC estate and all over the city as part of City Leap. The project is on the Mayoral priority list because it is a key component of Bristol's strategy to achieving carbon neutrality.
- An H&S assessment of the desired location of the battery, basement room B6 in City Hall, has been flagged as high risk by Building Practice. This paper aims to clarify why this location is preferred and proposes countermeasures/responses to address the risk.

2.0 Location assessment

- Considerations:
 - A key requirement for the battery is that any installation be in an enclosed, dedicated space so that the environment can be controlled.
 - Planning and Historic England have stipulated that the project must not change the aesthetic of the building as it is grade 2 listed.
 - The installation of the battery needs to minimise any disruption to BCC staff and existing infrastructure/processes
 - The battery needs to be operated in a safe manner that addresses fire risk of Lithium ion batteries
- Possible locations:
 - External, Rear Car Park
 - A container in the car park at the rear of City Hall was considered. This would require the installation of a fixed structure and would pass an electrical cable through the wall and to the electrical panel for connection
 - This option proved infeasible because Planning and Historic England would not allow such a significant change to the aesthetic of the building.
 - External, Under-croft
 - The Under-croft in the rear car park was considered as a possible location. As it would need to be an enclosed space, this option would require a dedicated room to be built in the Under-croft and a cable to run from there to the electrical panel for connection.

- This option is possible but has a number of significant problems which will be very difficult to overcome:
 - There would be significant civil works and disruption required to install the battery, which would also likely result in problems with Planning and Historic England. Disruption compounded as the area is frequently used by council staff and will need to be closed during works
 - This location would require the removal of a number of bike storage spots which would be counterproductive for a sustainability project.
 - The battery would be located next to the generator, meaning that two sources of resilience for City Hall are located in the same space.
- Internal, Ground floor
 - Near the ground floor main electrical panel was considered as an option. This would require a dedicated room to be built and would connect to the main panel
 - This option is possible as avoids planning and disruption issues. However the need to build a dedicated room will add additional civil works.
- Internal, Basement Room B6
 - Basement room B6 is located next to the basement sub panel and has been considered the most feasible location for the battery because:
 - It is an enclosed and dedicated space for the battery. This allows for environment control and does not have to be built especially.
 - The connection point is in the adjacent room thus minimising civil works for cabling and reducing complexity of install.
 - The installation process would not cause any substantial disruption to the normal operation of City Hall
 - No proposed significant changes to City Hall make this the preferred option for Planning and Historic England.
 - Whilst a basement location is recognised as being a risk for firefighting, the enclosed space is also ideal to mitigate this. The following section will address the likelihood and impact of a fire in this location.

3.0 Addressing the likelihood of a fire:

- Case studies:
 - Lithium ion as a technology is established worldwide, in 5.1m electric vehicles and millions more in phones, laptops and other electrical devices. What is new is the use of this technology for large scale balancing services.
 - There are many examples of different buildings around Europe where lithium Ion has been used in this way, please see below for a few case studies
 - Johan Cruijff Stadium
 - 2.8Mwh system, fire risk and public safety very important, visible case study [here](#)

- Their mitigations were – a fire resistant room, additional sensors, local fire service involved to determine plan
 - Woodman Close substation in Leighton Buzzard – the largest UK system at 10MWh is internal, more information [here](#)
 - AJ & RG Barber Ltd, a manufacturing company in Somerset – open to a site visit
 - Bislett Stadium in Norway, Catholic University of Lille, a church in the City of Malaunay – all features in the attached 'Energy Storage Success Stories'. The University project also has a video seen [here](#)
- Project Specification
 - We will use the tender process to select contractors with:
 - Experience – we will ensure that we work with experienced contractors who have demonstrable experience delivering lithium ion batteries within buildings
 - Quality assurance – we will ensure that the battery packs that make up the installation will be high quality and meet the IEC 62619 standard. This means the batteries have been tested for: Propagation resistance, Overcharge control of voltage, Overcharge control of current, Overheating control.
 - Materials – we will specify a non-volatile ion of Lithium such as Lithium ion Phosphate, which are far less likely to catch fire
 - The battery system itself will be specified to have a number of different safeguarding procedures that will limit risk of fire and alert BCC to any issues, including:
 - Battery Management System (BMS) and Shut Off – the BMS will continuously measure the voltage of every cell and a number of temperature readings across the system to make sure the battery is staying within its normal operating range. If the operating parameters indicate that the battery is approaching a safety boundary, the BMS will disconnect the battery from the load so the system will be shut off before a failure can escalate
 - Remote monitoring – the battery will be monitored 24/7 to ensure that the battery is being used within tolerances and there are no failures. BCC will receive regular reports on battery health which will highlight any issues
 - Tolerances – the operation parameters of the battery will be contractually defined as the known tolerances of the battery. This will ensure that the system is used as it's designed to.
 - Off gas sensor – an additional sensor will be installed which will provide an additional detection method for battery failure. Before event of fire, LI polymers release a detectable gas which can be detected and initiate a system shut down.

4.0 Addressing the impact of a fire:

- Severity of impact
 - The use of non-volatile materials that have been properly tested for overcharge, overheating and propagation resistance will result in a system that is more resistant to thermal runaway. This with a high standard of detection methods will mean that should there be an issue, the severity of it will be limited and addressed quickly.

- Firefighting methodology
 - In the unlikely event of a fire located in the battery room, we will have an agreed methodology in place that will limit the impact to BCC. This includes:
 - Collaboration – we will work with the Property H&S officer and Avon Fire to establish an agreed methodology and plan to fight a fire should it occur
 - Fire resistance – all manufacturers have recommended that the battery be located in a sealed dedicated fire resistant room. The basement room has concrete floors and ceilings which are ideal and we will retrofit doors and walls to ensure fire resistance for 60 minutes, or to a resistance defined by Avon Fire or Property H&S officer.
 - Fire detection – a fire detection system will be installed and will integrate with the alarm system at City Hall
 - Fire suppression – a fire suppression system will be installed in the room as part of the project and will be specifically tailored to fighting lithium ion fire (e.g. Novac 1230 Gas or equivalent)
 - Ventilation – a ventilation system will be installed to ensure a consistent internal environment for the battery and allowing the controlled release of any noxious fumes in the event of fire

5.0 Corporate H&S and Property response

“There has been ongoing consultation regarding the proposed installation of the Lithium-ion battery system at City Hall. A general risk assessment has been undertaken (*“The installation of 3 x 50kW / 59kWh modular Lithium-ion Battery Energy Storage Systems (BESS). This is to be located in the basement area of City Hall. 2019”*) in order to identify the foreseeable hazards, to quantify the risks and to identify proportionate mitigation.

The risk assessment has identified that such an installation would present a low risk to the health and safety of the building’s occupants provided that the precautions, identified in the risk assessment, are implemented.

A significant consideration is the fact that the installation introduces a fire hazard (due to the electrical and chemical hazard constituents of the batteries) which could create a significant risk to property protection and the on-going operation of the building – especially given that the proposed location is in the basement area. It is appreciated that the risk of fire starting may be unlikely however, if it should start the potential impact on the building could be significant. The risk assessments identifies that the first consideration should be to find an alternative location for the batteries. This has been investigated and, as summarised in the Energy Service’s report ‘City Hall

Battery - Fire Risk Mitigation', the alternatives were found not to be viable. In this case the risk assessment has identified a significantly increased level of mitigation which would be needed in order for the risks to be managed. This increased mitigation has been agreed and accepted going forward - also summarised in the Energy Service report.

It has to be said that there is still some residual concern regarding the location of the battery installation and this is associated with the response to a fire by the fire & rescue services. It should be understood that fires involving Lithium-ion technology can be challenging due to the chemical make-up of the batteries (although it is appreciated that the intended installation is reported to be adopting materials which are less volatile). Avon Fire & Rescue Service have visited the site and broadly accepted what is being proposed however, they also cautioned that the proposed location (in the basement) may present them with significant difficulties with firefighting operations. As life safety (of City Hall occupants) is of a low risk order rescue activities are not likely to be needed. They will therefore, balance the property protection issues against the risk to firefighters. They may be unwilling therefore, to initiate 'robust' firefighting activities if the only benefit is property protection."

Aidan Cleary, Fire Safety & Property Compliance Manager