GBEP Appendix B – Written Representation (WR4) on Water Environment 5: Applicant Response to Roy Clegg Submission.

Written Representation (WR4) on Water Environment 5: Water Environment

Questions REP-089	Applicants Response	Response from Roy Clegg
Some of the key issues of BESS incidents involve management of toxic and flammable gases and containment of contaminated fire water run off – none of which can be contained within a building or security fence. Thermal runaway cannot be controlled like a regular (air-fuel) fire. The only way to mitigate “reignition” (a regular report of eyewitnesses) is by thorough cooling. Water is the only firefighting material with the necessary thermal capacity. Sprinkler systems, though with good records in conventional building fires, are likely to be completely inadequate. The purpose of the water is absorbing a colossal release of energy. The Hill/DNV report [8] called for so-called “dry pipe” systems allowing first responders to connect very large water sources to the interior without having to access the interior. It is critical to appreciate that all parts of the battery system must be cooled down. Playing water on a battery “fire” may cool the surface, but so long as Li-ion cells deep inside the battery remain above about 150°C,”re-ignition” events will continue. It is not sufficient to estimate water requirements based on calculations assuming water reaches everywhere, uniformly. For example, in the recent Tesla car fire [2] the BEV battery kept re-igniting, took 4 hours to bring under control and used 30,000 (US) gallons of water (115 m3). This was for a 100 kWh BEV battery, designed with inter-cell thermal isolation barriers. In the case of Sunnica, the Local Authorities have suggested that water supplies of 1900 litres per minute for 2 hours (228 m3) will be needed. But this is grossly inadequate. Using the above in the Tesla BEV fire experience, this amount of water would suffice for just two Tesla Model S car fires. Scaling this up to even the smallest 2 MWh BESS such as that in McMicken, which contains thermal runaway cannot be controlled like a regular (air-fuel) fire. The only way to mitigate “re-ignition” (a regular report of eyewitnesses) is by thorough cooling. A liquid coolant leak caused thermal runaway in battery cells which started a fire at the	**Water volume** For a fire In terms of the volume of water required, the Applicant intends to **either** build their own water supply to the Battery Energy Storage System, connecting into Anglian Water’s 7” AC water main located in the A156 **or provide tanks on site**. The Applicant has been in discussions with the Lincolnshire Fire and Rescue Service who have advised that a water supply with a flow of 1900 litres per minute or 32 litres per second would be required to put out a battery fire should this occur. **Sufficient space has been allowed for in the BESS area for these tanks should this be the option selected.** LFRS could request an increase in this volume if the site location creates difficulties to bring supplementary water supplies to site in an acceptable incident response timeframe. The actual **site supply requirement will be decided at the detailed design stage,** LFRS will request to see the BESS system fire test data and specify that an **independent Fire Protection Engineer should validate the final water supply requirements. BESS design and site layout should minimise the requirement for direct FRS intervention in a thermal runaway incident** i.e., direct hose streams or spray directly on BESS battery systems. **LFRS intervention in worst case scenarios should be limited to boundary cooling of adjacent BESS / ESS units to prevent the fire from spreading.** This strategy should be finalised with the LFRS and be clearly communicated in the Emergency Response Plan (ERP). On top of this supply requirement of **20-30% additional capacity** should be allowed for storage in the water run-off retention facility (**legislation requires 10%).** The proposed additional capacity allows for potential increases to rainfall volume from climate change and reduces BESS fire water	The highlighted areas shown in the Applicants response clearly identify the shortcomings in the submissions made. At this stage, it should be possible to confirm that the applicant will build their own water supply or provide tanks or bring supplementary water supplies on site. Any of these options will affect the infrastructure on the site and information should have previously been determined by the applicant. To suggest that LFRS could bring supplementary water supplies to the site in an acceptable incident response time frame is **unacceptable!** It is also **unacceptable** that the validation of water supplies by an independent Fire Protection Engineer should minimise the requirement for direct FRS intervention in a thermal runaway incident. Will the Applicant determine specifically, the legislation referred to and the amount of additional capacity. Cases of fires in solar projects are becoming common place and a few have been identified in the WR’s. Below is a response that should also not be noted. **Fire Fighting and Tactical Response by West Yorkshire Fire & Rescue Authority to a 49.9 MW/99.9 MWh BESS, Solar Project.** The risks of vapour cloud, thermal runaway and explosion are unfortunately very real and are becoming more common as we see an increase in the number of BESS installations rise. There is currently no definitive or ‘preferred’ way of putting out a lithium ion/lithium iron fire. There are in effect two main options, one being to let it burn, the other being

300MW/450MWh Victorian Big Battery in Australia in which 900,000 litres of water was disposed of from the site. Water is the only fire-fighting material with the necessary thermal capacity. Sprinkler systems, though with good records in conventional building fires, are likely to be completely inadequate. The purpose of the water is absorbing a colossal release of energy. The Hill/DNV report, called for so called “dry pipe” systems allowing first responders to connect very large water sources to the interior without having to access the interior. “Clean agent” fire suppression systems are a common fire suppression system in BESS but are totally ineffective to stop “thermal runaway” accidents. The McMicken explosion was an object lesson in this. The installed “clean agent” system operated correctly, as designed, on detection of a hot fault in the cabin. There was no malfunction in the fire suppression system, but it was completely useless because the fire was not a conventional fuel-air fire, it was a thermal runaway event. Only water will serve in thermal runaway. Indeed, in the McMicken explosion the “Novec 1230” clean agent arguably contributed to the explosion by creating a stratified atmosphere with an air/Novec 1230 mixture at the bottom and inflammable gases accumulating at the cabin top. A significant volume of water will be required to cool a BESS fire. It will be contaminated with highly corrosive hydrofluoric acid and other hazardous chemicals. It is suggested that those responsible for Fire Services, study the Hill/DNV report and the related Underwriters Labs report, act upon their recommendations. Then make realistic, physics-based, calculations of the water quantities required and be available at every single BESS cabin. **Water Contamination** It is important to recognise that the rivers Trent and Till run through the proposed site raising significant questions about the amount of water required and contamination control that a critical event of a fire would result in environmental damage from toxic run-off. In addition, the field adjacent to the site is an area of flooding which will potentially further increases toxic run-off risk and critical event control. The following statements from the Developers Submission are noted for reference:	run-off pollution concerns from a BESS fire. The Applicants water storage and drainage strategy are based upon a baseline 2 hours supply at 1900 Litres per minute as per the **National Fire Chief Council's guidelines**. At the detailed design stage then water storage and drainage requirements will be agreed with the Lincolnshire Fire & Rescue Service based upon unit or installation level UL 9540A testing and / or 3rd party fire & explosion test data as specified in NFPA 855 (2023) for the selected BESS system. **A specialist BESS independent Fire Protection Engineer will analyse all the BESS test data work with LFRS to agree on sufficient firefighting water supplies for the site.** **The drainage system designed at the detailed design stage will be capable of retaining the agreed volume of firefighting water.** A specific fire water management plan will be produced and include the detailed plans for containment, monitoring and disposal of contaminated fire water. **Infrastructure shall be provided for the containment and management of contaminated fire water runoff from BESS. This can include bunding, sumps, and purpose-built impervious retention facilities.** **Discussions with Anglian Water are ongoing and progress on discussions on a mains supply will be reported in future iterations** of the Statement of Common Ground with Anglian Water, the first iteration of which is provided at D1 [4.3J]. To retain flexibility, the current application documents allow for either option to be pursued. **Water Contamination** An Outline Drainage Strategy is provided in Appendix 9-C [APP-139 to 141/3.3]. Surface water runoff across the Solar and Energy Storage Park will be discharged to ground through the use of sustainable drainage systems (SuDS) to provide attenuation	to use significant amounts of water for a protracted period. In this case, should the let it burn approach be taken, it may create a chain reaction from one unit to the next. Therefore, even in this case, there is a high possibility that attending crews will require large amounts of water to protect the exposure risks and disperse the vapour cloud (to ensure it remains below the explosive thresholds). This is likely to continue for the period of multiple hours whilst the unit(s) burns itself out. There are minimal alternative options, however due to the amounts of water we would use the Environment Agency will need to consider the impact of run off into the local water. Due to the risk involved in these types of energy storage systems, we would deploy minimum staff into the risk area for the shortest amount of time to place ground monitors, with a view that two or three of these would be used to apply water from multiple sides (where possible). Guidance suggests that lithium ion/lithium-ion batteries should be doused with significant amounts of water, and ideally subject to full submersion of the batteries for a period of 24 hours. Taking a two-ground monitor attack for 24 hours, would apply 5,472,000 litres of water (to confirm that is approx. 5.5 million litres). The runoff of these tactics would likely have a significant impact on the surrounding area, we recommend the Environment Agency consider this impact. There are many questions raised in the WR’S submissions which have been unanswered by the Applicant: Will the penstock valve be able to automatically detect contaminated fire runoff water and rainwater and then divert either to an appropriate channel? How will the runoff water be contained, tested /treated and discharged to the SuDS?

9.4.13 Should there be a fire in the BESS Compound, then water would be obtained from a mains connection at the A4156. It has been determined that a supply of 1,900 litres per minute of water would be required. Given that this supply would be for an emergency event for which the probability of occurrence would be low given best practice management of the Scheme, it is assumed that this would not have a significant impact on Anglian Water's potable water resource. At the time of writing (January 2023), a Point of Connection (PoC) application is being progressed with Anglian Water for this connection and to confirm the availability of supply. Should this approach not be suitable, then tanks of water would be located within the Solar and Energy Storage Park to store the necessary volume needed for firefighting purposes within the BESS Compound. 9.9.54 The BESS Compound will require fire water tanks to supress a fire, in the unlikely event that one breaks out in the BESS containers. Fire water runoff may contain particles from a fire. In the unlikely event of fire water being discharged, the runoff must be contained and tested/treated before being allowed to discharge to the proposed SuDS and then infiltrating to ground. 9.9.55 It is proposed to contain the fire water runoff within a bunded lagoon structure where it can be held and tested before either being released into the SuDS system or taken off site by a tanker for treatment elsewhere. The lagoon will then be cleaned of all contaminants. 9.9.56 The lagoon will be controlled by a penstock valve that can be **automatically** closed during a fire, i.e., under normal circumstances rainfall will be allowed to drain through the lagoon into the SuDS system. 9.10.67 In the instance there is a small fire within the BESS area which cannot be directly contained, there may be potential for contaminated firewater runoff into the SuDS system. To mitigate this, the Outline Drainage Strategy (ES Volume 3: Appendix 9 -C [EN010131/APP/3.3]) indicates that firewater would be contained in a bunded lagoon structure with a penstock The penstock will then enable potentially contaminated suppression waters to be isolated and extracted in order to be suitably tested and disposed of offsite without entering the surrounding hydrological network. Following a fire event, the drainage network will require an assessment to confirm the absence of any contaminants prior to the penstock being released. The Scheme operator will be responsible for conducting a controlled flushing of the drainage network prior to the release of	(both in terms of storage capacity and water quality treatment). Emergency Response Plan (ERP) document stands separate from the Battery Safety Management Plan (BSMP). The ERP will be in place prior to construction, developed through construction and set out as fixed for operation. It will be written in conjunction with Lincolnshire Fire and Rescue Service and will include the battery OEMs advices/manuals, best practice guidance (NFPA), practical limitations of the site and with best practice around the equipment installed and layout, details of contaminants and how these need to be managed. The commitment to provide an ERP is secured through the **Outline Battery Fire Safety Management Plan [APP-222/7.1]** The Applicant has embedded mitigation within the Scheme design and has included an **Outline Battery Fire Safety Management Plan in its DCO application [APP-222/7.1].** This outline plan sets out how the Scheme proposes to mitigate and manage the potential fire risk posed by the BESS. **Module spacing** In terms of module spacing, The NFCC FRS guidance document states: " **A standard minimum spacing between units of 6 metres is suggested unless suitable design features can be introduced to reduce that spacing.** If reducing distances, a clear, evidence based, case for the reduction should be shown." The Applicant can confirm that **6m separation will be observed unless UL 9540A unit or installation level testing and / or 3rd Party Fire & Explosion testing has demonstrated through heat flux data that distances can be reduced.** Separation specifications must be in accordance with **legislative code requirements available at detailed design stage.** This will be provided within the detailed Battery Fire Safety Management Plan. Site specific CFD scenario and consequence modelling will be conducted to see if **additional spacing is required**.	If the lagoon is already full of rainwater how will the contaminated fire water, be disposed of? If a fire occurs in a battery, will the site be shut down and will it shut down until such time as the contaminated water has been filtered and disposed of to ensure that a further fire can be satisfactorily and safely dealt with? In the event of a fire and shut down of the solar farm will the developer be confident of continuing and is there a risk of failure and closure of the solar farm permanently?

the penstock. This approach to mitigation is secured within the Outline Drainage Strategy (ES Volume 3: Appendix 9 -C [EN010131/APP/3.3]). 9.10.68 Should there be any other spillages on the BESS Compound such as battery leakage or spillage of fuel from the transformers then any contaminated run off would be managed and intercepted by the penstock system, as with the firewater outlined above. This is not so!! 9.10.69 During operation, the Solar and Energy Storage Park would operate using best practice and comply with environmental legislation through the application of an Outline Landscape and Ecological Management Plan (OLEMP) [EN010131/APP/7.10], including appropriate maintenance of SuDS and other drainage infrastructure. 9.10.92 There are no residual significant effects (this suggests that some effects have been identified but not revealed in the submission) on the water environment expected following the implementation of mitigation. 9.10.93 non-significant effects are listed in ES Volume 3: Appendix 9-E [EN010131/APP/3.3]. 9.10.94 As there are no significant effects following the implementation of the embedded mitigation measures. On this basis, no additional mitigation measures are identified. See above!! The above statements leave unanswered questions: Will the penstock valve be able to automatically detect contaminated fire runoff water and rainwater and then divert either to an appropriate channel? How will the runoff water be contained, tested /treated and discharged to the SuDS? If the lagoon is already full of rainwater how will the contaminated fire water, be disposed of? If a fire occurs in a battery, it is likely that there will be a closure of the solar farm and will remain closed until such time as the contaminated water has been filtered and disposed of to ensure that a further fire can be satisfactorily and safely dealt with? In the event of a fire and shut down of the solar farm will the developer be confident of continuing and is there a risk of failure and closure of the solar farm permanently? It will be useful at this stage to consider the comments from Professor Sir David Melville CBE a global leading expert, on the document: Grid Scale BESS - Guidance for FRS which gives useful information requirements in terms of system design and construction (pp3,4) as well as Detection and Monitoring (pp4,5)	Test data and separation distances will be assessed by an independent Fire Protection Engineer. A BESS fire suppression system, if integrated by the BESS OEM should conform to NFPA 855 (2023) guidelines, and the suppression system should be tested to UL 9540A latest standard or significant scale 3rd Party fire & explosion testing. **The trend for BESS cabinet systems is not to integrate fire suppression systems and to demonstrate that a worst-case scenario is the safe burn out of a single BESS cabinet without fire brigade intervention,** decommissioning is an easier process if stranded energy (live battery modules) risks are removed. If a BESS enclosure is a container design (20ft, 40ft, 53ft) then a fire suppression system will probably need to be integrated unless a full free burn test has shown that both fire and explosive events can be safely contained. **If the BESS enclosure is a walk-in design, then a fire suppression system must be installed. Fire suppression system performance as best practice should be benchmarked against free burn testing.** **An independent Fire Protection Engineer specialising in BESS should review all UL 9540A test results and any additional fire and explosion test data which has been provided and validate the suppression system design.**	

On Suppression Systems (pp5,6) it provides clarity that copious levels of water cooling is the only means of limiting the spread of fire and rules out alternative approaches. A recommended standard minimum spacing of 6m between units (containers) is an improvement on much current practice but is lower than the flames recorded in the Arizona fire of over 16m. On the issue of Water Supplies the guidance is substantially inadequate. The suggestion of a water-cooling system capable of delivering 'no less than 1,900 litres per minute for at least two hours' would deliver a total of only 228,000 litres. There is limited data on the measurement of water volumes deployed in previous BESS fires; the best comparison being the report quoted on the July 2021 Victoria Big Battery (VBB) fire where 900,000 litres were required over six hours to extinguish it. The fire was in two units, spreading from the first to the second after 2 hours and involved an estimated BESS size of 4.25 MWh. Moreover, the volume of water required will be proportional to the size of the BESS on fire, so it is not possible or helpful to suggest a single figure for total water requirement as stated in the NFCC Guidance. It is suggested that the total water requirement should be expressed as X litres per MWh of energy storage. From the VBB experience, X= 900,000/4.25 = 211,765 litres per MWh. It is more difficult to specify the rate of delivery required since larger fires will certainly take much longer to extinguish. It is suggested that a rounded figure for guidance might be: 'at least 200,000 litres per MWh of storage delivered over up to 12 hours. Very large BESS fires will require longer to extinguish and will need longer-term surveillance to monitor any signs of reignition'. Finally, the fact that water run-off is highlighted on p6, but there should be greater emphasis on the toxicity of very large volumes of fire run-off water and the need for its storage and treatment., linking also to the Environmental Impacts section. Using the recommended figure above, a 20 MWh BESS fire such as that at Basing Fen would require the delivery and storage of 4 million litres of water whilst a complete fire at the proposed 700MWh BESS at Cleve Hill, Kent would involve 140 million litres of cooling water.		