GBEP Appendix B – Summary BESS Safety Risks, Regulations and Guidelines when using Lithium-ion Batteries. - Applicant Response to Roy Clegg Submission.

Written Representation (WR2) on Safety Risks, Regulations and Guidelines when using Lithium-ion Batteries.

Questions REP-089	Applicants Response		Response from Roy Clegg
Safety Risks, Regulations and Guidelines when using Lithium-Ion Batteries 1. From the manufacturer to the dealer to the consumer, back to the manufacturer, or to the remanufacturer / recycler, Lithium-ion batteries have a long journey to make in their lifetime. 2. Yet, with many people's safety at stake, on every move and stop they need to be handled with the utmost care. That's why lithium-ion batteries come with many regulations the Inspector is asked to consider. 3. Even though their battery chemistry is considered one of the safest, lithium-ion batteries still pose significant risks when not handled carefully. 4. The high-voltage nature of a lithium-ion battery comes with electrical hazards, such as short circuit, electrocution, electric shock or burning, whereas the chemical component inside the battery (the electrolyte) could leak out and cause intoxication or corrosion. Lithium-ion batteries are prone to thermal runaway. 5. If the temperature exceeds a certain threshold, the cells begin to vent hot gasses, which increases the temperature even further, and ultimately leads to ignition, explosion, and significantly dangerous fires. The larger the battery storage, the greater the risk of a runaway fire. 6. In the event of a fire, lithium-ion batteries emit a cloud of highly toxic and dangerously high Hydrogen Fluoride, which can spread over distances of 1-2 miles, potentially causing death or permanent visual defects, blindness or chronic lung disease and longterm illnesses to residents. 7. Hydrogen fluoride goes easily and quickly through the skin and into the tissues in the body. There it damages the cells and causes them not to work properly. The gas, even at low levels, can irritate	1-7 – No response required. 8. The Applicant disagrees that there is a significant and unacceptable danger to health and indeed human life; as well as to farm animals and agricultural crops in the food chain. Health and Safety is a core principle for the Applicant whose group company is both an asset owner and operator. The Applicant has brought in Dr Paul Christensen from Newcastle University to advise on the latest worldwide safety protocols associated with Lithium-Ion technology, along with the Lincolnshire Fire and Rescue Service to advise on design and a safety management plan and to provide the emergency services with relevant information if requested. This will be refreshed prior to construction to ensure the highest safety standards are incorporated in the design and ensure minimal impact on the environment. The Applicant has had a virtual meeting with Lincolnshire's Fire and Rescue team and this engagement will continue throughout the development, construction and operation of the Scheme. 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. 9-19 No response required. 20. An Outline Battery Safety Management Plan [APP-222/7.1] is included within the DCO application which includes a description of the measures to be implemented to ensure all safety requirements are met. A detailed Battery Safety Management Plan		1-7. No response other than to repeat what is said in the WR's 8. In the applicants Environmental Statement 1.2.8. it is noted that the Fire Suppression system to be used is the Novec1230 extinguishment system. it will be useful to note that in the Liverpool BESS, fire was theoretically protected by a suppression system that failed to activate and would not have had any effect anyway, as the investigator states: Although there was a fire suppression system in the container, the speed of propagation indicated that this hadn't activated. 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. This begs the question is the applicant still confident about using a suppression system? 9- 26. No further responses other than those

the eyes, nose, and respiratory tract. Breathing in hydrogen fluoride at high levels can cause death from an irregular heartbeat or from fluid build-up in the lungs. At lower levels breathing hydrogen fluoride can damage lung tissue and cause swelling and fluid accumulation in the lungs (pulmonary oedema). Eye exposure to hydrogen fluoride may cause prolonged or permanent visual defects, blindness, or destruction of the eye. People who do survive after being severely injured by breathing in hydrogen fluoride may suffer lingering chronic lung disease. 8. Will the Planning Inspector now decide against the proposals on the grounds of the significant and unacceptable dangers to health and indeed human life; as well as to farm animals and agricultural crops in the food chain? 9. Safety regulations in every phase of lithium-ion batteries' life cycle There appears to be no updated information in respect of regulations and guidelines for lithium-ion batteries, but the following three documents appear to be those in use awaiting updates: • Batteries Directive 2006/66/EC: This is an EU-Directive that provides guidelines to the member states concerning the manufacture and disposal of batteries in the EU. Its aim is to improve the environmental performance of batteries and accumulators. This directive will soon be replaced with a new Regulation, that will level the playing field for all EU member states. • General Product Safety Directive (GPSD): The GPSD provides standards for product safety to protect consumers from potential hazards, by means of EN standards. The relevant EN standard for pg. 4 lithium-ion batteries is EN 60086-4. It serves as a reference point for specifications and technical solutions at the product design stage. Following EN standards is not mandatory but highly recommended. • ADR (International Carriage of Dangerous Goods by Road) The	(BSMP) will be submitted to and approved by the relevant planning authorities and local fire and rescue services. This must be substantially in accordance with the Outline Battery Safety Management Plan [APP-222/7.1] which is secured by requirement 6 of Schedule 2 of the draft DCO. With regard to other environmental and safety aspects, the Framework CEMP [APP-224/7.3], Framework OEMP [APP-225/7.4], and Framework DEMP [APP-226/7.5], secure the mitigation measures required throughout the lifetime of the Scheme. Local authorities, the local fire and rescue services, and Health and Safety Executive has been consulted during EIA Scoping and Statutory Consultation, to allow integration of their feedback into the design for which consent is being sought. This consultation will carry on during detailed design post-consent, as required in particular by the Outline Battery Safety Management Plan [APP-222/7.1]. Health and safety of the site would also be managed by the contractor and site operator through management plans, required by law to be in accordance with the Health and Safety at Work Regulations. 21. In terms of how long a battery will last, as stated within the Outline Battery Safety Management Plan [APP-222/7.1] different battery systems have different topologies of control and safety systems that extend all the way to, in some measures, cell level. It is likely that the selected system will have a Battery Management System (BMS) which predicts the ageing of the cells in the LiBESS and alerts the operator when modules need maintenance or replacing. As stated in Appendix 2-A Bess and Substation Description [APP-113/3.3], it is assumed that the batteries would be replaced approximately every 15 years. In terms of what will happen to the spent batteries, as stated within the Outline Battery Safety Management Plan [APP-222/7.1] The Applicant will follow the		contained within the WR2 and these responses.

ADR is a UN document, adopted by the European Union, which regulates the transport of hazardous goods over land. Following ADR rules is mandatory for transportation of lithium -ion batteries. The specific requirements for this type of battery can be found under article 2.2.9.1.7. All lithium -ion batteries are Class 9 and get the UN number 3480. 10. Based on the above; depending on a battery's condition and the phase in its life cycle, the risks and thus the safety rules vary. 11. What type of battery are you transporting? Let's look at the different options and their ADR requirements. 12. New lithium -ion batteries 13. New batteries at the beginning of their journey are in their most stable state (except for manufacturing defects), as they are charged up to 60 to 70% to ensure stability. The risks are relatively low, but caution is still required during transport and handling. Moving the batteries could pose minor thermal and mechanical risks, which is why all ADR requirements, including labelling and packing, are to be always taken seriously. ADR labelling: • Class 9, • UN 3480, • "LI -ION BATTERY" ADR packing: packing instructions P903 or LP903 14. Used lithium -ion batteries for reuse. 15. Battery Directive 2006/66/EC states that every battery producer has a take -back obligation. The most desirable options are re -use or remanufacturing, meaning that the battery maintains the status of 'product' (as opposed to 'waste'). However, in practice, recycling is currently still the most common option. In case of reuse or remanufacturing, Li -ion batteries on their way to their new purpose are labelled and packed the same way as new Li -ion batteries. 16. ADR labelling: • Class 9, • UN 3480, • "LITHIUM -ION BATTERY" ADR packing: • packing instructions P903 or LP903	hierarchy of waste management throughout the life of the Scheme as follows: • Reduce – lithium ion batteries have a finite life based on a number of factors, primarily the total number of cycles undertaken. The operation will attempt to manage the degradation by the selection of services and cycling that maximises the overall life. Consideration will be given to supplementation of the equipment or operation at a lower output. • Recycle – The supplying manufacturer will have obligations under the Waste Batteries and Accumulators Regulations 2009 (as amended) (or such equivalent regulations in force at the time of decommissioning) and will be contractually obliged to offer a recycling service. • Recovery – The recycling should allow any useful materials to be recovered and re-enter the supply chain. • Disposal – Any disposal of batteries shall be undertaken in compliance with all applicable Laws and all regulatory requirements, product stewardship, registration disposal and recycling or take back requirement.		

Undamaged waste lithium -ion batteries 17. When a used battery can't be remanufactured or reused for a different purpose, it gets the 'waste' status and its ADR specifications change. An undamaged waste battery will be taken to the recycler, following these labelling and packing rules: ADR labelling: • Class 9, • UN 3480. • "LITHIUM -ION BATTERY FOR RECYCLING" ADR packing: • packing instructions P909, •SP 377 Damaged and defective lithium -ion batteries 18. Damaged lithium -ion batteries pose the biggest risk, as they are transported in a potentially highly unstable state. For packing, there is a distinction to be made between critical and non -critical damaged batteries. Damaged batteries in a critical state need to be packed in the safest way possible, to avoid accidents. ADR labelling: • Class 9, • UN 3480, •"DAMAGED/DEFECTIVE LITHIUM -ION BATTERIES" ADR packing: • Packing instructions P908 or LP904 if not critical, • Packing instructions P911 or LP906 if critical, • SP 376 Safe storage of lithium -ion batteries 19. After the batteries have safely arrived at their destination, sometimes they need to be stored for a while. Some countries have specific regulations concerning storage, others don't. There appears to be no up to -date requirements in the form of Standards for use of lithium batteries, no guidelines for the manufacture and disposal, and no regulations for the transport of batteries in the UK. 20. Given this situation it would seem reasonable to expect the proposed solar farm developers to have included Risk Assessments and Method Statements for dealing with every phase of a battery's life. 21. Will the Planning inspector recognise these missing significant elements in the developer's submissions? How long will a battery last? 3 years, 10 years or 15 years? specification what will the effect be on supply to the			

grid, how long will it take to replace the batteries and what will happen to the spent batteries? 22. This is the main question that everyone wants to know. Unfortunately, it is not easy to give a definitive answer. There are many variables involved. 23. Items such as the temperature under which they are used, whether they have been stored, how quickly they have been charged and discharged, whether they have been left discharged for any period, and a whole number of other factors. 24. Another big variable is the question of what counts as a charge / discharge cycle. Sometimes the battery will have undergone a deeper charge cycle than others, sometimes it may be a 20% to 80%, other times it may only be a top up, say 30% to 60% and whether this counts as a cycle. 25. The Environmental Statement, Volume 3, Appendix 2-A Bess and Substation states at 1.2.5. Batteries and inverters would be replaced approximately every 15 years suggesting that the batteries will last much longer. 26. The proposed specification for a LFP 280Ah cell type battery, from 1.2.4., taken from many sources on the internet suggest a Cycle life of 2,000 which at best would be 1000 charges and discharges per day, or just under 3 years			