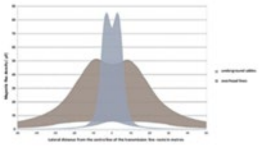
Applicant's and Roy Clegg Responses to ExA First Written Questions Cottam Solar Park.

13. Other Planning Matters

ExQ	Respondent	Question	Applicants Response	Response by Roy Clegg
1.13.20	Applicant	With regard to paragraph 11.8.2 of ES Chapter 11: Ground Conditions [APP-046] and Contamination, please clarify how potential leakage from fire water storage will be mitigated in order to prevent ground contamination.	With reference to C7.9 Outline Battery Storage Safety Management Plan [APP-348], paragraph 5.5.4 details how the battery storage area will be contained by local bunding and attenuated within gravel subgrade of lined permeable SuDS features prior to being passed forward to the local land drainage network. In the event of a fire, a system of automatically self-actuating valves at the outfalls from the battery storage areas will be closed, isolating the battery storage areas drainage from the wider environment. The water contained by the valves can then be tested and either treated and released or tankered off-site as necessary and in consultation with the relevant consultees at the time. The potential release of stored water via leakage is not considered a potential source of contamination. The outline Plan is secured through requirement 6 in Schedule 2 to the draft DCO [EX2/C3.1_C].	The Applicants response identifies shortcomings in the submissions made. At this stage, it should be possible to confirm that the applicant will build their own water supply, provide tanks or supplementary water supplies on site. Any of these options will affect the infrastructure on the site and should have been determined by the applicant by now. Cases of fires in solar projects are now becoming common place and some have been identified in the WR's. Below is a response that should also be noted. Guidance suggests that There are many questions raised in the WR'S submissions which have been unanswered by the Applicant: Will the self-actuating automatic valves be able to 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 water storage tanks, are already full how will the contaminated fire water, be disposed of? If a fire occurs in a battery, will the site be shut down or 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?

ExQ	Respondent	Question	Applicants Response	Response by Roy Clegg
1.13.31	Applicant	Please explain why paragraph 21.2.8 of ES Chapter 21: Other Environmental Matters [APP-056] considers that the transient use of Public Rights of Way crossing three 400kV circuits does not require any further investigation to exposure. ICNIRP reference levels in particular, would be exceeded (paragraph 21.2.7). Please refer to ICNIRP guidance, as appropriate.	The ICNIRP 1998 guidelines provide a reference level of 100µT (for magnetic field) for the general public to protect against indirect effects from Extremely Low Frequency EMF exposure. These guidelines were used to form the policy basis set out in EU Council Recommendation 1999/519/EC, which states at paragraph (9) that “This recommendation has as its objective the protection of the health of the public and it therefore applies, in particular, to relevant areas where members of the public spend significant time in relation to the effects covered by this recommendation”. UK exposure limits comply with the EU Recommendation in that the basic reference levels should be applied where the time of exposure is significant. The Department of Energy and Climate Change’s 2012 Code of Practice for Power Lines: Demonstrating compliance with EMF public exposure guidelines, clarify that locations where time of exposure is significant practically refers to residential properties, other habitations such as hostels, and schools, crèches and nurseries. Furthermore, where the ICNIRP reference levels are exceeded, the Code of Practice recommends a calculation of measurement at the location of the closest property at which the exposure guidelines apply. In this instance, para. 21.2.7 of C6.2.21 ES Chapter 21 Other Environmental Matters [APP056] estimates this to be 2.6µT if the nearest property is 25m from the centre of the Shared Cable Corridor.	**The developer has chosen to comment on human life and has not made any consideration of the significant impact of EMF on marine life, flora and fauna with wildlife, and biodiversity, where all the later are intrinsically linked to each other.** A myriad of cable runs in the project resulting in connections carrying up to 400Kv to transport electricity from the solar panels to the National Grid at Cottam Power Station using transformers, inverters etc., all of which transmit EMF’s. The WR shows that the magnetic fields created on the development site will be significantly stronger, and the effect of EMF will be distanced further away by at least 7 metres. A magnetic field measuring 57.5 milligauss immediately beside a 230 kilovolt transmission line measures just 7.1 milligauss at 100 feet, and 1.8 milligauss at 200 feet, according to the World Health Organization in 2010. An Electromagnetic Field is a circular vector field that radiates out centrally from its stronger central core with a magnetic influence on moving electric charges, electric currents, and magnetic materials. The electromagnetic fields will not be mitigated or stopped by covering over or burying. in effect the EMF will at its core be distanced 2.9 metres and have an effective band width

				across the River Trent calculated at 12 metres. **The diagram, when enlarged will show the effect of EMF field strength set against underground and overhead cables and lateral core.**  So how do you mitigate? Revert to using overhead cable lines for water crossings and other buried large power lines on site.

ExQ	Respondent	Question	Applicants Response	Response by Roy Clegg
1.13.32	Applicant	Applicant: Why has the ES not considered the potential effects of electromagnetic fields on biodiversity interests, including the lamprey and therefore the potential for effects on the Humber Estuary Special Area of Conservation in this regard? Please also explain why the Information to Support a Habitats Regulations Assessment [APP-357] rules out the likelihood of significant effects, given that this document also acknowledges that this species may be found within the River Trent (paragraph 5.1.6). Your attention is directed towards the Environment Agency's WR [REP-093] in this regard.	The potential effects of electromagnetic fields were scoped out of the Environmental Impact Assessment (see section 3.13 of C6.3.2.2 ES Appendix 2.2 EIA Scoping Opinion [APP-064]). Furthermore, such impacts on ecological features were not identified during the scoping exercise carried out with PINS and consultation (pre-application and statutory) with bodies such as Natural England and the Lincolnshire Wildlife Trust. With regard to the presence of lamprey in the River Trent and the potential linkage with the Humber Estuary SAC/Ramsar, it was considered that, on the basis the majority of the Humber lamprey population breed in rivers other than the Trent, the likelihood of significant effects arising from construction phase pollutions events was very low (paragraph 5.1.6 of APP-357]).	The Impact of EMF on Marine Life, Flora and Fauna and BioDiversity are well researched, documented and detailed in the WR's submitted previously. The Water Framework Directive, the IUCN Red List, the OSPAR, the European Eel Regulations (100/2007), the Eels(England and Wales) Regulations, the Canal Rivers Trust and the Notts Biological & Geological Records Centre list threatened, endangered and protected marine species including the Allis Shad, Brook Lamprey, Bullhead, Common / European Sturgeon, Crucian Carp, Eel, River Lamprey, Sea Lamprey, Smelt, Spined Loach, Twaite Shad, White Clawed Crayfish, Brown Trout and the Atlantic Salmon all found in the Rivers Trent and Till. Many species of flora and fauna, because of unique physiologies and habitats, are sensitive to exogenous

				EMF in ways that surpass human reactivity, are highly variable, largely unseen, and a possible contributing factor in species extinctions. EMF has an adverse effect on orientation, migration, food finding, reproduction, mating, nest and den building, territorial maintenance, defence, vitality, longevity and survivorship itself. Wildlife loss is often unseen and undocumented until tipping points are reached. Is the Developer, Examiner and the Secretary of State satisfied that there is no risk to any protected species from the effect of EMF and its features because of this and other similar Project?

Major Accidents and Disasters

ExQ	Respondent	Question	Applicants Response	Response by Roy Clegg
1.13.41	Applicant	Paragraph 1.1.7 of the Outline Battery Storage Safety Management Plan [APP348] states that the LeBlock modular battery system by LeClanché has been used for assessment. Please provide the following information for this battery type: • detailed Specification, Testing and Certification; • metal content in the batteries, type of wafer insulation and testing conditions, Manufacturers Warranties, specific failure rates; and the lifecycle of battery, how often it would need to be changed and the associated procedure for this.	The Applicant has revised both the Outline Battery Storage Safety Management Plan (OBSSMP) [C7.9_A] and ES Appendix 17.4 BESS Fire Technical note [C8.4.17.2_A], and these documents have been submitted at Deadline 2. The generic system used for indicative planning purposes is a 750 KWh BESS “cabinet” system integrating two battery racks, this is a designation used by several BESS Original Equipment manufacturers. The BESS design, technology and system chemistry type **is still to be determined,** but it will be a lithium-ion battery system. The popular types of this chemistry for BESS systems within the lithium-ion family are Lithium Nickel Manganese Cobalt Oxide ($LiNiMnCoO_2$) known as “NMC” or Lithium Iron Phosphate ($LiFePO_4$) known as “LFP”. The final battery chemistry **will be** confirmed as part of the detailed design prior	Thermal Runaway has very few means of Mitigation once started. The main concerns regarding large scale Li-ion BESS are: The potential for failure in a single cell (out of millions) to propagate to neighbouring cells by the process known as “thermal runaway”. Believed to be initiated by lithium metal dendrites growing internally to the cell, a cell may simply discharge internally releasing its stored energy as heat. Even sound Li-ion cells will spontaneously discharge internally if heated to temperatures which can be as low as 150 °C, releasing their stored electrical energy, thus overheating neighbouring cells and so on. Temperatures sufficient to melt aluminium (660 °C) at least have been inferred

			to the commencement of construction, as secured through Requirement 5 in schedule 2 to the DCO [EX2/C3.1_C]. For the purposes of the OBSSMP, a concept design has been considered that uses a BESS specification based upon several LFP BESS systems. This is considered to be a reasonable worst case for the purposes of the assessment in terms of BESS toxic gas emission potential (Hydrogen fluoride production) and explosion risk (significant levels of hydrogen produced during thermal runaway). At the detailed design stage the selected BESS system **will be** designed to address prevailing industry standards and good practice at a time of design and implementation. BESS system and components used to construct the facility will be certified to UL 9540 (2023) standards. As a minimum, the battery system will have completed unit or installation level UL 9540A testing, **demonstrating that thermal runaway propagation will not spread between modules or** **between battery racks and the generation of explosive gases will not threaten container structural integrity.** This offers a high level of protection against fire and explosion risk.	from analyses of such thermal runaway accidents. The potential for thermal runaway in one cabin propagating to a neighbouring cabin. In Arizona there were reports of "fires with 10-15 feet flame lengths that grew into 50 - 75 feet flame lengths appearing to be fed by flammable liquids coming from the cabinets". The significant volumes of water required to thoroughly cool the system in the event of a "fire", and how this water will be contained and disposed of (since this will be contaminated with highly corrosive hydrofluoric acid and, therefore, must not be allowed to drain into the surrounding environment). Thermal runaway events are uncontrollable except by cooling all parts of the structure affected – even the deepest internal parts – below 150 °C. This basically requires water, in large volumes. The lithium metal deposits will react with air moisture, causing overheating and smoke. Battery swelling, electrolyte degradation, and internal short circuits are all possible modes of failure with internal discharge and generation of locally intense heat. Because of the known thermal breakdown of even non-faulty cells, above a threshold temperature (which can be as low as 150 °C), the loss of even a single individual cell can rapidly cascade to surrounding cells, resulting in a larger scale "fire." This is "thermal runaway" in which failures propagate from cell to cell within "modules" and from

				module to module within a "rack". The basic issue is simple: It is therefore essential to address prevention as a priority. No current engineering or industry standards require the Prevention of thermal runaway events by thermal isolation barriers. Nothing in existing standards prevents runaway incidents happening again, requiring for initiation only single-cell failures from known common defects in cell manufacture. A large BESS can pass all existing engineering design and fire safety test codes and still fail in thermal runaway – by now a well-known failure mode. **This must be urgently addressed.** 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 on the basis of calculations assuming water reaches everywhere, uniformly. Firewater will be contaminated with, inter alia, highly corrosive Hydrofluoric Acid. Contamination of water supplies and waterways must be prevented. For example, in the recent Tesla car fire 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.

				"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 problem 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.

ExQ	Respondent	Question	Applicants Response	Response by Roy Clegg
1.13.44	Applicant	With regard to paragraph 1.1.12 of the Outline Battery Storage Safety Management Plan [APP-348], please provide further information on how the BESS would deal with thermal runaway.	The detailed design phase of the Scheme will consider the lifecycle of the battery system from installation to decommissioning. **At the detailed design stage,** risk assessment tools will be utilised together with detailed consequence modelling to provide a comprehensive site operations and emergency response safety audit. The battery system mitigation measures adopted in a final Battery Safety Management Plan, **will reflect the latest BESS safety codes and standards applicable at that stage.** Mitigation measures will be discussed and coordinated with	No engineering standards are currently applied to pre-empt future accidents in grid-scale BESS, the most critical of which would be design features aimed at preventing the phenomenon of "thermal runaway", the process whereby failure in single cell causes over-heating and hen propagates to neighbouring cells so long as a temperature (which can be as low as 150 °C) is maintained. The engineering standards NFPA 855, UL 1973 and UL9540/9540A. UL 9540A is a US standard that is widely

			Lincolnshire Fire and Rescue Service (LFRS). Preparation and approval of the final Plan, substantially in accordance with the outline Plan is secured through requirement 6 in Schedule 2 to the draft DCO [EX2/C3.1_C]. A Failure Modes and Effects Analysis (FMEA) of the BESS (BS EN IEC 60812) will be conducted to lay the foundation for predictive maintenance requirements and complement the fault indicator capabilities of the BMS data analytics system. Comprehensive Hazard Mitigation Analysis (HMA) **will be conducted by a BESS specialist independent Fire Protection Engineer following NFPA 855 (2023) guidelines and recommendations.** Additional risk assessments **likely to be conducted** at the detailed design stage are Fire Risk Analysis (FRA), Explosion Risk Analysis (ERA), Hazard and Operability Analysis (HAZOP). BESS 3rd Party risk analysis **is sometimes automatically provided by Tier one BESS manufacturers and / or BESS integrators.** **If** the BESS system supplied differs from the specification considered for risk assessments and consequence modelling, then a full safety audit will be repeated for the new BESS system specification. These studies will be completed and signed off before construction commences. **The BESS will be designed to address prevailing industry standards and good practice at a time of design and implementation.** BESS system and components used to construct the facility will be certified to UL 9540 (2023) standards. As a minimum, the battery system will have completed unit or installation level UL 9540A testing, **demonstrating that**	used in grid-scale BESS engineering, is routinely recommended by insurance and risk consultants and was appealed to by the developer of the Cleve Hill. The problem is that UL9540A is fundamentally a test procedure. It mandates no design features. It requires absolutely nothing that would prevent thermal runaway in any BESS design. This means that an operator can say truthfully that a given BESS is “fully compliant” with UL9540A, yet this would provide no assurances at all regarding thermal runaway prevention. It is therefore wholly insufficient as a safeguard to either the operator, the public, or to emergency services. NFPA 855 [21], uniquely, requires evaluation of thermal runaway in a single module, array or unit and recognises the need for thermal runaway protection. However, it assigns that role, with complete futility, to the Battery Management System (BMS). Thermal runaway is an electrochemical reaction which once started cannot be stopped electrically. It is uncontrollable by electronics or switchgear. A BMS can locate faults, report and trigger alarms, but it cannot stop thermal runaway. Nothing in UL 9540A addresses thermal runaway, and as a test method standard, it can provide no “safety certification” for Li-ion BESS. UL 1973 allows for the complete destruction of a BESS and the creation of an explosive atmosphere so long as no explosion or external flame is observed.

			thermal runaway propagation will not spread between modules or between battery racks and the generation of explosive gases will not threaten container structural integrity. This offers a **high level** of protection against fire and explosion risk. NFPA 855 (2023) currently provides the most comprehensive guidelines for BESS design and site installation specifications. BESS design structural integrity will be demonstrated through full-scale fire and explosion testing or by integrating NFPA 69 (explosion prevention) and NFPA 68 (Explosion protection through deflagration venting) features. A BESS fire suppression system, **if** integrated by the BESS OEM, will conform to NFPA 855 (2023) guidelines, and the suppression system **should** be tested to UL 9540A latest standard or significant scale 3rd Party fire and explosion testing. **If** a BESS enclosure is a container design (20 ft, 40 ft, 53 ft), a fire suppression system will **probably** need to be integrated . If the BESS enclosure is a walk -in design, a fire suppression system must be installed. As best practice, fire suppression system performance **should** be benchmarked against free burn testing and a minimum of three suppression tests **should** be conducted. **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. NFPA 855 (2023) confirms water is the most effective battery fire suppression agent and, therefore if a BESS Fire Suppression System (FSS) is integrated, a water based system **will be considered** for each BESS enclosure designed to control	An installation can do all these things but still “pass” UL 1973. At McMicken one rack was completely destroyed and an explosive atmosphere created but no flame or explosion occurred until first-responders opened the cabin door. UL 9540A is merely a test method for generating data. It does not define any “pass/fail” criteria for interpreting results. Specifically, it does not address cell-to-cell cascading in thermal runaway, nor the evolution of a potentially explosive atmosphere. It does not even prescribe that the cell-to-cell cascading rate be measured. It allows that thermal runaway may proceed to an entire rack (as at McMicken) and offers testing of fire suppression systems (which operated correctly at McMicken but cannot prevent thermal runaway, and did not prevent an explosion). Presentation of data generated under UL 9540A to an “AHJ” (Authority Having Jurisdiction) does not translate to a succinct understanding of potential risks. NFPA 855 does require evaluation of thermal runaway in a single module, array or unit and does acknowledge the need for thermal runaway protection. However, it assigns that role to the Battery Management System (BMS). Yet thermal runaway is an electrochemical reaction that once started cannot be stopped electrically. It is uncontrollable by electronics or switchgear, only by water cooling.

			or fully suppress a fire without the intervention of the Fire and Rescue Service. The suppression system must be capable of operating effectively in conjunction with a gas exhaust/ventilation system to minimise deflagration risks. System design and water supply requirements must be fully agreed with the Fire and Rescue Service. The BESS enclosure **will be** designed to withstand overpressures generated by the battery system during thermal runaway. An explosion prevention system to NFPA 69 standards and / or explosion protection system to NFPA 68 and EN 14797 standards will be integrated. Further, the BESS enclosure will have completed UL 9540A unit and / or installation testing or large-scale 3rd Party Fire and Explosion testing without pressure waves occurring or shrapnel being ejected. **An independent Fire Protection Engineer specialising in BESS will review all UL 9540A test results** and any additional fire and explosion test data which has been provided.	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 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 stored energy equivalent to twenty Tesla Model S cars, it is clear to see that a much greater amount of water would be needed. **COMAH** There are growing concerns about the use of Lithium-ion batteries in large scale applications, especially as Battery Energy Storage Systems (BESS) linked to renewable energy projects and grid energy storage. These concerns arise from the simple consideration that large quantities of energy are being stored, which if released uncontrollably in fault situations could cause major damage to health, life, property and the environment. BESS are not currently regarded by HSE as regulated under the COMAH The reason the COMAH regulations should apply is the scale of evolution of toxic or inflammable gases that will arise in BESS “fires”. In the Drogenbos incident (2017, Table 1), the inhabitants of Drogenbos and surrounding towns were asked to keep all windows and doors shut; 50 emergency calls were made from people with irritation of the throat and airways1.

				A chemical cloud which “initially had been enormous”, was charted by helicopter. The Belgian Fire Services could not control what was described as “the chemical reaction” and filled the cabin with water. Fears of an explosion with 20 metre flames kept people confined for an hour. Although the initial visible flames were controlled quickly, cooling continued over the next 36 hours. Applicability of the COMAH (Control of Major Accident Hazard) Regulations 2015 The governing criteria for application of the COMAH Regulations [17] are: 1. The presence of hazardous materials, or their generation, “if control of the process is lost.” 2. The quantity of such hazardous materials present or that could be potentially generated. There is no doubt that hazardous substances such Hydrogen Fluoride (an Acute Toxic controlled by COMAH) would be generated in a BESS accident (i.e., in “battery fires”). Similarly highly Inflammable Gases (also controlled by COMAH) would be evolved even if the atmosphere remained oxygen-free. Depending on the size of the “establishment” these could be produced in sufficient quantities to be in the scope of COMAH.

Roy Clegg