D8 Comments on Submissions at D7 : Dr Edmund Fordham

Dated: 13th March 2023

Annexes EF54 – EF57 uploaded separately

THE PLANNING INSPECTORATE

EN010106 – Sunnica Energy Farm

APPLICATION BY SUNNICA Ltd for an Order Granting Development Consent for the Sunnica Energy Farm Project pursuant to The Planning Act 2008

To the Examining Authority (ExA)

COMMENTS (at Deadline 8) on Deadline 7 Submissions

EurIng Dr Edmund John Fordham MA PhD CPhys CEng FInstP

Interested Party – Unique Reference: 20030698

Please note:

1. These comments are being submitted as required by Deadline 8 (13 March 2023).

2. The new material responded to is

(i) the letter from HSE dated 1 March being a Late Submission in response to Qus 3.1.5. and 3.1.6 from the ExA (REP7-112);

(ii) the joint Councils' responses REP7-072;

3. I point out the provisions of R.26 P(HS)Regs 2015 in transposing the requirements of Article 13(3) of *Seveso*.

Conventions for colour highlighting:

Quotations from legislation are shown in blue

Quotations from policy documents, or competent authorities are shown in magenta

Quotations from Applicant are shown in ochre

Quotations from Government Statements are shown in green

SUMMARY

[*Please refer to the Glossary following, for a list of abbreviations.*]

1. The HSE letter REP7-112 asks to be removed from consultation/approval of the BSMP. This comes just 6 weeks after prior HSE letters in Appendix B of REP7-056 indicated HSE did wish to comment but that quantity details in the OBFSMP were required. The HSE letter fails to answer Qu.3.1.5 at all;

2. HSE does confirm however that "major accident potential" (as defined in law) is one of the "main considerations" in giving advice. The Letter fails to recognise the major accident potential of Li-ion BESS;

3. However HSE's advice given at EIA, s.42 and s.56 stages all long pre-dates the Applicant's disclosure at ISH1 of the unprecedented scale of the BESS proposal (2400 MWh, never previously disclosed). All long pre-dated the Applicant's ISH1 size disclosure so no more than general advice could be given;

4. Lacking both a size disclosure and a declaration of chemical type, it would be unreasonable for the regulators to have identified a major accident hazard at those consultation stages;

5. The "major accident potential" of grid-scale Li-ion BESS is shown from the catalogue of "major accidents" from around the world. These are matters of record. Paras. 14 – 38 demonstrate in detail that these satisfy the legal definition of "major accident", by reference to HSE's own Guidance Notes;

6. Please accept this submission as formal notice to the ExA that I believe the evidence shows beyond reasonable doubt that the Sunnica BESS do present a "major accident hazard" as defined in law;

7. The "loss of control" provisions in the COMAH Regs 2015 are completely independent of the nature of any installation *before* the loss of control occurs, howsoever they may be regarded by the CLP Regulation or other Regulations;

8. The "loss of control" provisions have been rehearsed explicitly by the Applicant and are clearly recognised in HSE's own Guidance Notes, with a decision chart for "Do the COMAH Regulations apply to me ?", abstracted herein;

9. I reject the Applicant's position that "we cannot tell at this stage if HSC/COMAH are required" as indefensible for a proposal of this size. For a much smaller BESS, which might be "borderline" in terms of Qualifying/Controlled Quantities, this could be a defensible position, but not at 2400 MWh total;

10. My WR (REP2-129), Annex EF16 (REP2-129e), and latterly my D7 Comments REP7-094, show beyond reasonable doubt that it almost inconceivable that HSC/COMAH are *not* obligations, even without the full design that the Applicant has consistently to refused to provide. The sheer scale of the proposal drives this conclusion (though reasons may be different for different cell chemistries);

11. To contest this credibly would require the Applicant to have engaged with the technical evidence at the same scientific level as that presented in Annex EF16 REP2-129e. They have not done so;

12. The duty to determine whether or not COMAH notification is required lies with the operator, and in the Planning context, with the Applicant, as the party seeking development consent to build the facility. If in doubt, it would have been open to the Applicant at any stage to have sought a determination from the COMAH CA as to whether or not the Sunnica BESS, at 2400 MWh storage, with either NMC or LFP cells, would or would not constitute a COMAH site, but this was not done;

13. Prior correspondence with the Applicant (**Annex EF57**) shows that explicit questions on COMAH compliance were not answered at the consultation stage;

14. Further details are provided of the 10-minute Rule Bill of Dame Maria Miller MP are provided to supplement those in the Joint Councils' response REP7-072;

15. The position of ECDC, that the ExA are not in a position to make a reasoned decision based on "Rochdale Envelope" doctrines, is endorsed;

16. WSC's response Qu 3.1.7 is endorsed and amplified. I concur completely that it is unreasonable to expect any Local Authority, even with access to professional fire service advice, to apprise with any confidence or responsibility the particular hazards presented Li-ion BESS. Thermal runaway incidents in Li-ion BESS are not "fires" and may proceed without flame until a Vapour Cloud Explosion occurs. To regard thermal runaway incidents as "fires" is scientifically incorrect and for serious industrial safety planning fails to identify the true nature of the hazard;

17. In addition to the Policy requirement in Sect. 4.11 NPS EN-1 for a safety appraisal by the COMAH CA, the parallel legal obligation is found in R.26 P(HS)Regs 2015 which governs PA 2008 applications and DCOs, and also Section 12(2B) Directions of "deemed HSC". This Regulation (as UK law in force) transposes the "plain language requirements" of Article 13(3) of *Seveso*, whose relevance the Applicant rejects elsewhere. The Regulation requires the safety appraisal from the COMAH CA at the time of Application and for comment from the public within the Examination. This clearly has not happened.

(Summary 807 words) EJF, 13/03/23

GLOSSARY

Abbreviations used in the interests of brevity.

Legislation and statutory permissions:

CLP	– the Classification, Labelling and Packaging Regulation
COMAH Regs 2015	– the Control of Major Accident Hazards Regulations 2015
CQ	– Controlled Quantity (of a HS as defined in P(HS)Regs 2015)
DCO	– Development Consent Order
dDCO	– draft Development Consent Order
DS	– Dangerous Substance (as defined in the Schedule to COMAH Regs 2015). Usually synonymous to HS
GHS	– Globally Harmonised System (see UN GHS)
HS	– Hazardous Substance (as defined in the Schedule to P(HS)Regs 2015). Usually synonymous to DS
HCS	– Hazard Communication Standard (USA)
HSC	– Hazardous Substances Consent
PA 2008	– The Planning Act 2008
P(HS)A 1990	– The Planning (Hazardous Substances) Act 1990
P(HS)Regs 2015	– The Planning (Hazardous Substances) Regulations 2015
QQ	– Qualifying Quantity (of a "dangerous" substance) in the COMAH Regs 2015; similar to CQ in the P(HS)Reg 2015
REACH	– Registration, Evaluation, Authorisation and Restriction of Chemicals Regulation
S or "S"	– any "substance used in processes" which on its own or in combination with others may generate HS defined in Parts 1 or 2 of the Schedule to the P(HS)Regs 2015
Seveso	– the "Seveso III Directive" 2012/18/EU of 4 July 2012
UN GHS	– United Nations Globally Harmonised System
UN MTC	– United Nations Manual of Tests and Criteria

Direct quotations from legislation are shown in blue

Policy documents:

NPPF	– National Planning Policy Framework
NPS	– National Policy Statement
EN-1	– Overarching National Policy Statement for Energy (EN-1)

Direct quotations from policy documents are shown in magenta

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GLOSSARY (cont.)

Competent authorities:

CA	– COMAH Competent Authority
DHCLG	– Department for Housing Communities and Local Government
DECC	– Department of Energy and Climate Change
DWP	– Department for Work and Pensions
EA	– Environment Agency
ECDC	– East Cambridgeshire District Council (LPA)
ExA	– Examining Authority
FRS	– Fire and Rescue Service
HSA	– Hazardous Substances Authority
HSE	– Health and Safety Executive
HSE(NI)	– Health and Safety Executive for Northern Ireland
IPC	– Infrastructure Planning Commission (now abolished)
LPA	– Local Planning Authority
NII	– Nuclear Installations Inspectorate
ONR	– Office for Nuclear Regulation
OSHA	– Occupational Safety and Health Administration (USA)
SoS	– Secretary of State
WSC	– West Suffolk Council (LPA)
UKAEA	– United Kingdom Atomic Energy Authority

Parties:

Sunnica	– the Applicant, or the proposal under Examination
SNTSAG	– Say No To Sunnica Action Group Ltd

Documents

OBFSMP	– Outline Battery Fire Safety Management Plan
BFSMP	– Battery Fire Safety Management Plan
LIR	– Local Impact Report

(continued)

GLOSSARY (cont.)

Technical:

AEGL-3	– Acute Exposure Guideline Levels
BESS	– Battery Energy Storage System(s)
CAS	– Chemical Abstracts Service, maintains a catalogue of unique chemical substances with reference numbers
CDFR	– Commercial Demonstration Fast Reactor
EV	– Electric Vehicle
GCMS	– Gas Chromatography Mass Spectrometry
IChemE	– Institution of Chemical Engineers
IDLH	– Imminent Danger to Life and Health
IUPAC	– International Union of Pure and Applied Chemistry
Li-ion	– Lithium-ion
M-factor	– Multiplying Factor used for certain substances Toxic to the Aquatic Environment in eco-toxicity classifications
NFPA	– National Fire Protection Association (USA)
PPSE	– Professional Process Safety Engineer
PM	– Particulate Matter
$PM_{2.5}$	– Particulate Matter of diameter less than 2.5 μm
SoC	– State Of Charge of cells, usually given as percentage, between fully charged (100%) and completely discharged (0%)
SLOT	– Specified Level of Toxicity
SLOD	– Significant Likelihood of Death
STEL	– Short Term Exposure Limit, i.e. limiting allowed concentration for short-term exposures (typically 15 minutes)
SVHC	– Substance of Very High Concern
VCE	– Vapour Cloud Explosion
UHI	– Urban Heat Island

(continued)

GLOSSARY (cont.)

Chemical substances:

CH_4 – Methane
C_2H_4 – Ethylene
C_2H_6 – Ethane
CO – Carbon Monoxide
CO_2 – Carbon Dioxide
Co – Cobalt (as metal) (not to be confused with CO)
CoO – Cobalt (II) Oxide
Cu – Copper (as metal)
CuO – Cupric (or Copper (II)) Oxide
Cu_2O – Cuprous (or Copper (I)) Oxide
H_2 – Hydrogen
HCN – Hydrogen Cyanide
HF – Hydrogen Fluoride
Mn – Manganese (as metal)
MnO – Manganese (II) Oxide
Ni – Nickel (as metal)
NiO – Nickel Monoxide
ONiO – Nickel Dioxide
Ni_2O_3 – diNickel triOxide
POF_3 – Phosphoryl Fluoride

Li-ion cell types:

NMC – Nickel – Manganese – Cobalt; a popular Li-ion cell type, with cathodes based on complex oxides of those elements
LFP – Lithium – Iron [chemical symbol Fe, hence “F”] – Phosphate; another type of Li-ion cathode chemistry
LCO, NCA, LATP – other cell cathode chemistries mentioned in text
LMO – Lithium Manganese Oxide
LNO – Lithium Nickel Oxide

(continued)

GLOSSARY (cont.)

Measurement units:

GW – gigawatt, or one billion watts, or one thousand megawatts 1000 MW

MW – megawatt, or one million watts, a unit of *power*, i.e. *rate* of transfer of *energy*

MWh – megawatt-*hour*, or one million watt-hours, a unit of *energy* e.g. the *energy* transferred by a *power* of 1 MW acting for 1 *hour*

m^2 – square metre (area)

ha – 1 hectare = 10,000 m^2

MWh ha^{-1} – energy storage density (on the land) in the BESS compounds, as MWh energy storage capacity, per hectare of land allocated

MWh / tonne or MWh $tonne^{-1}$ – energy density of the BESS cells themselves, as MWh energy storage capacity, per tonne of cells

Wh / kg or Wh kg^{-1} – energy density of the BESS cells themselves, as Wh energy storage capacity, per kg of cells
1 MWh / tonne = 1000 Wh / kg

mg / Wh or mg $(Wh)^{-1}$ – gas generation from cells in failure, in milligrams gas per watt-hours of energy storage capacity

tonne – 1 metric tonne or 1000 kg or 1 Mg

$\mu g\ m^{-3}$ – trace concentrations of highly toxic gases, in micrograms of toxic contaminant per cubic metre of air

μm – 1 micrometre or 10^{-6} metre

Scope and Purpose of these Comments

1. These Comments respond primarily to

(i) the letter from HSE being a Late Submission in response to Qus 3.1.5. and 3.1.6 from the ExA (dated 1 March 2023) (REP7-112);

(ii) the Answers from the Joint Councils to the ExQ3 at Deadline 7 (REP7-072)

2. The Applicant having objected to my citation of Article 13(3) of *Seveso*, an outline is provided of its transposition into R.26 of P(HS)Regs 2015, as UK law remaining in force irrespective of EU Exit.

QUs. 3.1.5 and 3.1.6 – the HSE letter REP7-112

3. The letter says it responds to Qus 3.1.5 and 3.1.6 from the ExA. Qu 3.1.5 from the ExA reads:

Qu. 3.1.5 (to HSE UKHSA and EA) **BESS: unplanned atmospheric emissions** Please comment on the Applicant's response to our Qu2.1.15. Do you think undue reliance is placed on the detailed consequence modelling to be undertaken post-consent ?

On this question, no commentary at all is apparent in the HSE letter.

4. Qu 3.1.6 from the ExA reads:

Qu 3.1.6 (to HSE and EA) **BESS: consent under COMAH and P(HS)**

- Please confirm you were consulted on the proposed development, and the BESS in particular, and when (ie at what stage in the planning process);
- Please comment on Requirement 7 in the revised draft DCO [REP6-013] and the adequacy of the Applicant's OBFSMP as updated at Deadline 5 [REP5-050]; and
- Please comment on the need or otherwise for a Requirement in the DCO that the Applicant will seek consent for the BESS elements of the proposed development, in terms of transport to site, construction, operation, decommissioning and transport away from the site following decommissioning.

5. The letter says that there is no requirement to consult HSE on a BSMP, that HSE does not provide comments on such, and requests that "Requirement 7 and any other references to HSE consultation/approval of the BSMP" be removed from the DCO.

6. If Requirement 7 is removed entirely there is no Requirement for a BFSMP. Presumably removal of the need to consult the HSE is meant.

7. The letter is in contradiction with a previous HSE letter in Appendix B of "8.96 Applicant's Response to Other Parties' D6 Submissions" REP7-056. The letter from HSE (page 68) dated 16 January 2023 says *inter alia*:

The Outline Battery Fire Safety Management Plan currently does not contain details of quantities involved which are yet to be determined. We will have the opportunity to comment when the final Outline Battery Fire Safety Management Plan is published.

Hence the 1 March letter REP7-112 saying HSE does not comment on fire safety plans reverses advice just 6 weeks previously implying they would be able to comment.

8. Though headed “Consent under COMAH and P(HS)” the bullet items are not explicit on the aspects of COMAH and HSC referred to. The ExA should note that if the BESS are a COMAH site, the required consultations with the COMAH CA are required by both Policy (NPS EN-1 Sect.4.11) and law (R.26 P(HS)Regs 2015) to take place *before* any development is consented, and that the legal requirements in R.26 P(HS)Regs 2015 require the opportunity for public comment on the consultations received, *before* any decision is taken. These Policy and legal obligations cannot be satisfied by post-consent Requirements. In any event, the HSE letter provides no commentary on the third “bullet” in the ExA’s Question, but rehearses only general approaches taken.

9. Qu 3.1.6 covers three different things, the BFSMP (broadly speaking, *mitigation* measures), COMAH controls (which are focussed on *prevention* measures), and HSC (a Planning control, designed to examine off-site hazards). In particular, a BFSMP focussed on *mitigation* measures is no substitute for COMAH controls requiring *prevention* policies, and neither COMAH nor the BFSMP concerns the fundamental Planning issue of whether the site proposed is appropriate in the first place, having regard to proximity to other development, amenity and sites of natural sensitivity. Those issues are the purpose of HSC in the Planning process.

10. Given the scale of the major accident hazard represented by BESS on the scale proposed, attempting to ensure public safety by means of any “Fire Safety Management Plan”, or BFSMP, alone, is beside the point. Thermal runaway incidents in Li-ion are *not* “fires” as conventionally understood and it is an abuse of language to refer to them as such. There may be no flame until a substantial vapour cloud has built up, leading ultimately to a Vapour Cloud Explosion. Any measures to contain or control a “fire” are likely to fail to control thermal runaway for reasons cited in multiple places. Furthermore, even if assisted by fire service professionals, LPAs do not necessarily have the expertise to advise on the management of such events. Grid-scale Li-ion BESS present a “Major Accident Hazard” which is both dimensionally and qualitatively different from an ordinary “fire”. Focussing on the *mitigation* measures of a BFSMP alone misdirects attention from the real issues, which are in *prevention*, the focus of COMAH controls.

11. The ExA should also note that the COMAH CA comprises the HSE plus the Environment Agency EA “acting jointly” (R.2(1) P(HS)Regs 2015 and R. 4(b) COMAH Regs 2015). To my knowledge, no formal submission by, or consultation with, the COMAH CA *acting as such* has been made anywhere in the Examination.

Qu. 3.1.6 (bullet 1) – consultations with HSE and stages; size and chemistry of BESS not disclosed

12. The letter answers Bullet 1 of Qu. 3.1.6 as follows: "HSE has provided statutory advice on this basis in relation to this development at Environmental Impact Assessment, Section 42 and Section 56 stages". In this advice existing COMAH sites (H W Coates Ltd, a chemicals warehouse) and gas pipelines are correctly identified by HSE but the major accident potential of the Application has not been.

13. The EIA advice is dated 10 April 2019. Section 42 advice is dated 15 October 2020. These have been disclosed to me by prior direct enquiry to HSE and are annexed as **new Annex EF54**.

14. The s.56 stage advice is not included in Appendix B "HSE Correspondence" of 8.96 Applicant's Response to Other Parties' Deadline 6 Submissions" REP7-056 but would have been expected around April 2022.

15. Regardless of the exact date, all these consultation stages long pre-date the declaration of energy storage capacity finally made orally by the Applicant at ISH1 (PHS on ISH1 REP2-082a) in November 2022. Therefore, there is no evidence at all that HSE has *ever* been advised by the Applicant of the proposed scale of the Sunnica BESS (2400 WMh, around 15,000 tonnes of functional chemicals), which is unprecedented. The Moss Landing Energy Storage Facility, Monterey County, California CA, is currently the world's largest at 1600 MWh; Sunnica would be 50% larger.

16. Given that both COMAH and HSC obligations are required for establishments only above *size* thresholds (in terms of inventory of dangerous/hazardous substances), it would not be possible for either HSE or the EA to comment on COMAH/HSC obligations without a size or inventory specification that the Applicant steadfastly refused to provide until much later. The HSE letter 16 January 2023 in Appendix B of REP7-056 implies that no quantity specifications have been provided to HSE even now.

17. It cannot be too strongly emphasised that the scale of the hazard is in proportion to the energy stored in the system and the inventory of functional chemicals in the cells. If the stored energy breaks loose in BESS accidents, the damage potential increases in proportion to the stored energy released uncontrollably.

18. In the both the EIA and S.42 advice HSE advises explicitly on the need for HSC, but again the Applicant has still not declared, at the present stage, which of two cell chemistry types are proposed. The regulators could reasonably decline to produce advice on multiple different options.

19. There is no evidence that HSE has ever been consulted by the Applicant on the BESS, at the scale now proposed, with any specific chemistry declared, even narrowed down to a choice of two (NMC or LFP).

Failure by HSE to recognise Major Accident Hazard of Li-ion BESS

20. The HSE letter goes on to summarise their leading concerns:

When offering advice, the two main considerations for HSE are:
1. does the Proposed Development have the potential to cause a major accident or could the development impact on a site with major accident potential and
2. is the Proposed Development vulnerable to potential major accidents due to its proximity within a consultation zone of a major hazard site or pipeline).

A footnote is provided to define a major accident:

As defined by criteria set out in the Control of Major Accident Hazard Regulations

21. It is the Major Accident Hazard that is the central industrial safety concern with BESS and HSE correctly notes their responsibility to identify such hazards. However HSE has not been adequately consulted by the Applicant and in consequence has failed to identify the Major Accident Hazard involved.

22. The term "major accident" has a formal definition

(i) in the COMAH Regs 2015:

"major accident" means an occurrence such as a major emission, fire, or explosion resulting from uncontrolled developments in the course of the operation of any establishment to which these Regulations apply, and leading to serious danger to human health or the environment (whether immediate or delayed) inside or outside the establishment, and involving one or more dangerous substances;

(ii) in the Directive itself, the definition is identical except for the words "covered by this Directive" replacing "to which these Regulations apply".

(iii) in the HSE's own Guidance Notes "L111" (**new Annex EF55**), which affirm this definition in the following terms:

34 An occurrence will be a major accident if it meets the following three conditions:

(a) it results from uncontrolled developments at an establishment to which the Regulations apply; and

(b) it leads to serious danger to human health or to the environment, inside or outside the establishment; and

(c) it involves one or more dangerous substances defined in the Regulations, irrespective of the quantity involved.

23. There is no doubt that grid-scale Li-ion BESS have "major accident potential" as thus defined. The "major accident hazard" is established from the documented occurrence, worldwide, in Li-ion BESS, of major explosions, or major fires, leading to loss of life or permanent disablement, and environmental emissions both atmospheric (toxic gases and carcinogenic smokes) and run-off of water used in fire-suppression or fire-fighting, contaminated with substances toxic to the aquatic environment.

24. More than 60 such incidents have been catalogued in various places, in the database maintained by the independent institute EPRI (footnote 5 of my WR REP2-129), by Professor Christensen in his Annexes to the submissions of the SNTSAG, and by HSE(NI) in their report from consulting engineers Atkins (see pages 3-6 of Annex EF28 REP2-129p). My WR featured just 3 particularly relevant examples:

(i) the major explosion in Arizona in 2019 leading to the permanent disablement of three first-responders, and emissions of toxic gases including Hydrogen Cyanide;

(ii) the fire and unsuspected explosion in Beijing in April 2021 leading to the deaths of two fire-fighters;

(iii) the fire and explosion in urban Liverpool in September 2020, in which the report noted concerns over potentially toxic but undetermined contamination of fire-fighting water run-off.

25. Because the HSE letter emphasises in its foonote the definition of a "major accident" in the COMAH Regs 2015, let us examine systematically the three tests in HSE's own Guidance Note 34, in the order (c), (b) and (a).

26. There is no doubt whatever that all of these incidents, without exception, involved "dangerous substances" as defined in Parts 1 and 2 of the COMAH Regs 2015. The technical literature is absolutely clear that flammables (flammable gases or aerosols), health hazards (toxic gases and carcinogenic smokes) and hazards to the aquatic environment are indeed generated in BESS accidents. My WR REP2-129 and my Annex EF16 (REP2-129e) co-authored with Professor Sir David Melville CBE documented these extensively. My recent Comments at Deadline 7 (REP7-094) emphasised the importance of the stringently-controlled "Nickel Oxides in Inhalable Powder Form" which are known to be generated in thermal runaway events from cells of the "NMC" type (one of the two chemistries stated to be under consideration for Sunnica). They are Named Dangerous Substances under Part 2 of the Schedule.

27. HSE's own Guidance Note 34(c) emphasises that the *quantity* of such substances involved is not relevant in determining if an incident is a major accident:

34 (c) it involves one or more dangerous substances defined in the Regulations, irrespective of the quantity involved.

The definition in the COMAH Regs says: "involving one or more dangerous substances".

28. It is therefore clear that HSE's Guidance Note 34 criterion (c), is satisfied.

29. There is no doubt that all of the catalogued BESS incidents have led to "serious danger to human health or the environment" as the second test in HSE's own Guidance Note 34 (b):

34 (b) it leads to serious danger to human health or to the environment, inside or outside the establishment;

The definition in the COMAH Regs says: "serious danger to human health or the environment (whether immediate or delayed), inside or outside the establishment".

30. The Beijing incident (Annex EF13 REP2-129b) led to fatalities. The Arizona 2019 incident (Annexes EF11 REP2-082l and EF12 REP2-129a) led to permanent disablement of first-responders. The Liverpool fire and explosion of September 2020 (Annex EF14 REP2-129c) led to emergency "sealed doors and windows" orders. The toxic quality firewater runoff was not established at Liverpool, but Nickel, Cobalt and Manganese compounds contaminating firewater from fires involving NMC cells

are known to be up to 90 times (Nickel compounds) or 360 times (Cobalt compounds) in excess of industrial effluent limit values set by the “Waters Protection Ordinance” in Switzerland (see Annex EF26, REP2-129n, Table 13, page 10).

31. It is similarly clear that HSE’s Guidance Note 34, criterion (b), is satisfied.

32. The Definition in the COMAH Regs says a major accident means: an occurrence such as a major emission, fire, or explosion resulting from uncontrolled developments in the course of the operation of any establishment to which these Regulations apply;

The HSE’s own Guidance Note 34(a) applies the test:

(a) it results from uncontrolled developments at an establishment to which the Regulations apply;

33. The catalogue of Li-ion BESS incidents all involved major fires or explosions with unquantified emissions of toxic gases and smokes or contaminated water run-of. They plainly satisfy the description in the Definition.

34. Thermal runaway is uncontrollable once started, by any electrical means, and by most conventional fire suppression means other than extravagant water cooling. They therefore satisfy the “uncontrolled developments” test in Guidance Note 34 (a).

35. The general question of whether Li-ion BESS are “establishments to which these Regulations apply” (or in the originating Directive, “covered by this Directive”) will be summarised once more below, as showing that the final aspect of the definition of a “major accident” in HSE’s Guidance Note 34(a) is satisfied, and that the worldwide experience shows definitively that grid-scale Li-ion BESS present a “major accident hazard” as defined in law**.**

36. Given the catalogue of accidents satisfying in all other respects the definition of a “major accident”, it would be perverse to argue that the evidence must be disregarded, either because the BESS were not in a *Seveso* jurisdiction, or because the size of the BESS involved had inventories below the specified thresholds.

37. Many of the Li-BESS in the accident catalogue were in BESS *small* in scale relative to those proposed for Sunnica. Small BESS may fall outside the scope of the COMAH Regulations if the Qualifying Quantities are not exceeded. Yet in much larger BESS, the accident potential is, *a fortiori,* the more serious. If existing experience in some cases would have been outside the scope of *Seveso* by reason of size, it does not follow that the experience is not relevant to *larger* BESS. Larger BESS have larger major accident potential than smaller ones, because the inventory of functional chemicals and stored energy capacity are both higher.

38. This submission gives notice to the ExA, that I believe, for the reasons given above and elsewhere throughout my submissions, that Li-ion BESS, above a size threshold to be determined by the Qualifying Quantities, without any reasonable doubt, do present a Major Accident Hazard as defined in law.

COMAH Regulations 2015 and grid-scale Li-ion BESS

39. Contrary to the assertion in the Parliamentary Answer (Annex EF38 REP4-090) on which the Applicant has previously relied, Li-ion BESS are unambiguously subject to the COMAH Regs 2015 under the loss of control provisions, as practice with HSE(NI) clearly indicates (Annex EF48, REP6-085). The Parliamentary Answer has overlooked the loss of control provisions in the COMAH Regs 2015, which are central to the major accident hazard presented by grid-scale Li-ion BESS.

40. This is confirmed by an EC Memorandum to Stakeholders (**new Annex EF56**) which would in 2012 have been directed to HSE themselves as drafters of the COMAH Regs 2015. The Memorandum makes clear that the intention of the Directive's "loss of control" provisions was that they should apply to any establishment whatever, whether controlled dangerous substances (in normal operation) are (a) present above their thresholds, (b) present but below their thresholds, or even if (c) no controlled dangerous substances are present at all. See the section of Annex EF56 headed:

Sev III – Article 3(11) – "Presence of dangerous substances"

This has in fact been cited in my Annex EF40 (REP4-092) but is included here for completeness of the record.

41. The loss of control provisions in the COMAH Regs 2015 have now been cited by the Applicant in their REP6-036 (8.86 Responses to Deadline 5 submissions) where they quote verbatim (please see page 67, end of Table, and page 68 top) the definition of "presence of a dangerous substance" from R.2(1) COMAH Regs 2015:

"presence of a dangerous substance" means
the actual or anticipated presence of a dangerous substance in an establishment,
or of a dangerous substance which it is reasonable to foresee may be generated during loss of control of the processes, including storage activities, in any installation within the establishment, in a quantity equal to or in excess of the qualifying quantity listed in the entry for that substance in column 2 of Part 1 or in column 2 of Part 2 of Schedule 1, and "where a dangerous substance is present" is to be construed accordingly;

The segment quoted by the Applicant is:

the actual or anticipated presence of a dangerous substance in an establishment,
or of a dangerous substance which it is reasonable to foresee may be generated during loss of control of the processes, including storage activities,

This makes clear that the Applicant is now fully aware of the "loss of control" provisions in the COMAH Regs 2015.

42. There is no restriction at all on the nature of the "installations" from which the dangerous substances may be generated *before* the loss of control occurs. The phrase is "any installation". In particular, there is no restriction whatsoever excluding any objects which might satisfy the definition of an "article" under the CLP Regulation. The CLP Regulation has no bearing on the nature of the "installations" in normal operation. The test is only whether dangerous substances (under hazard categories defined in the CLP Regulation) are generated "*during* loss of control of the processes". In the case of Li-ion BESS, this is certain knowledge.

43. HSE recognises the “loss of control” provisions in their own Guidance Notes “L111” (new Annex EF55) which summarise the considerations in a decision flowchart, on page 117 in Appendix 1: “Do the COMAH Regulations apply to me ?”. The chart is abstracted in the following Figure. The decision tree includes the question: “Could loss of control of that process generate any Schedule 1 dangerous substances?” If the answer is Yes, then the next step is to: “Aggregate quantities according to rules in Schedule 1”. Subsequent questions ask: “Does the sum equal or exceed one of the thresholds in column 2 [or] column 3 of Part 1 or Part 2 of Schedule 1?” If either threshold is exceeded, the COMAH Regs 2015 apply to that establishment in “lower-tier”, or “higher-tier”, depending on which threshold is exceeded. Annotations with yellow arrows show a typical route through the chart for NMC cells generating Inhalable Nickel Oxides in loss of control accidents.

44. The responsibility to consider loss of control accidents, and to quantify them, based on risk assessments, “to determine as accurately as possible, the quantities likely to be produced” is also endorsed by Guidance Note 61 in “L111” (new Annex EF55):

61 Existing risk assessments produced under health and safety or environmental legislation could be used as a starting point in considering scenarios, as these should indicate what substances are likely to be produced during an accident. If these include dangerous substances the operator will have to determine, as accurately as possible, the quantities likely to be produced and compare these against the thresholds in Schedule 1.

45. An establishment can only escape the obligations of COMAH if the operator or Applicant can show that the Qualifying Quantities cannot be exceeded. For a BESS proposal of the unprecedented size of Sunnica, this is most improbable.

46. Notwithstanding the refusal by the Applicant to declare more than outline details and the refusal to declare an energy storage capacity until ISH1 (November 2022), my Annex EF16 (REP2-129e), summarised in my WR (REP2-129), performs scoping calculations in pursuit of the “risk assessment” as advised in Guidance Note 61, for both metal-oxide (including NMC) and LFP cell types, as proposed for Sunnica. These were expanded (with regard to Nickel Oxides in Inhalable Powder Form, a Named Dangerous Substance in Part 2), in my Comments at Deadline 7 (REP7-094). In effect these calculations trace the HSE’s decision tree shown in the Figure, for “loss of control of that process”, including the application of the Aggregation Rule in Part 3 Note 4 (“Aggregate quantities according to the Rules in Schedule 1”).

47. My submissions cited do what is properly the responsibility of the Applicant. The legal responsibility to determine if a site is a COMAH establishment or not lies firmly with the operator. This is unequivocal in the regulatory law inherited from *Seveso*. The responsibility lies with the operator to *notify* i.e. make full disclosures without prompting. At the Planning stage, the responsibility to determine if a proposal is or is not a COMAH establishment surely lies with the Applicant, as the party seeking development consent to build the proposal. As a Planning control, the responsibility to seek HSC certainly does.

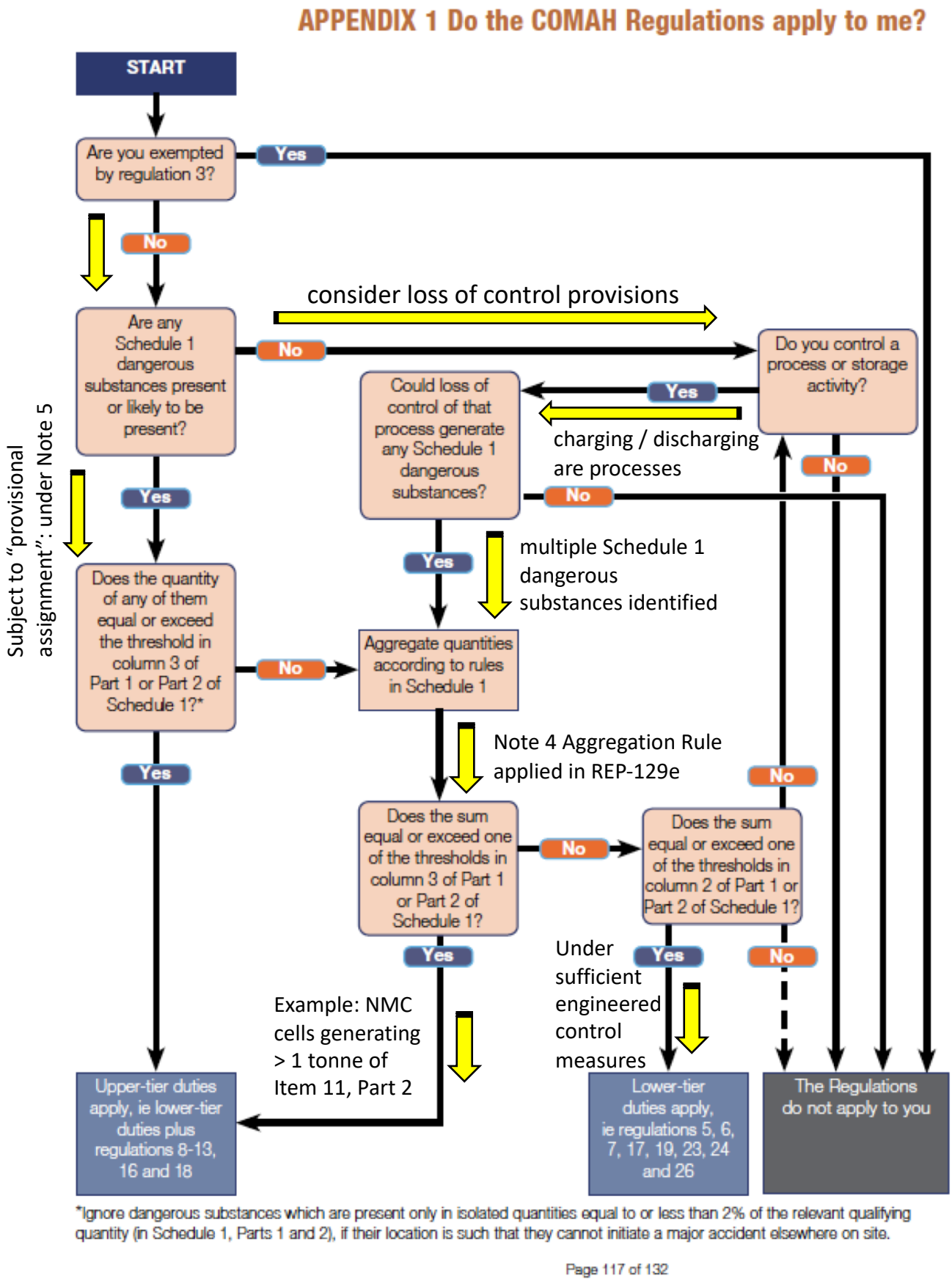

Figure above abstracted from HSE Guidance Notes "L111" Annex EF55, with annotations to show decision routes through the chart. Item 11 in Part 2 is "Inhalable Nickel Oxides".

48. The scoping calculations shown in Annex EF16 REP2-129e and in REP7-094 show that Qualifying Quantities of Health Hazards are so far below the size proposed for Sunnica (in terms of energy storage capacity or, equivalently, tonnage of functional chemicals) that it is inconceivable that the QQs would not be exceeded.

49. For example, for NMC cells I show that even a single-cabin BESS accident could generate the QQ of Inhalable Nickel Oxides, making a single cabin "upper tier" COMAH on those grounds alone. For LFP cells the leading driver of COMAH notifiability is probably Hydrogen Fluoride, because generation of HF is known to be the highest from LFP cells (see sources in Annex EF16 REP2-129e). Moreover aggregation with other Health Hazards (for example Carbon Monoxide, CO) using the Aggregation Rule is necessary for deciding on COMAH notifiability. For LFP cells, thresholds in Table 13 of Annex EF16 REP-129e are exceeded for BESS between 16 and 22 MWh of energy storage capacity, depending on the quantity of CO generation appraised. The storage capacity of 2400 MWh proposed far exceeds these threshold estimates.

49. Following the HSE's decision chart, I have shown why the BESS are almost certainly COMAH establishments and require HSC*, without* a finalised design. Although the criteria differ for different chemistries, *viz.* NMC cells or LFP cells, the conclusion is driven by the sheer size of the proposal, irrespective of the cell chemistry chosen. The conclusion cannot credibly be reversed by uncertainties in literature data because the proposed size is so far beyond the threshold estimates.

50. To contest this credibly would require the Applicant to have engaged with the scientific evidence presented in my Annex EF16 (REP2-129e) co-authored with Professor Sir David Melville CBE, at the same technical level. They have not done so. Challenging errors of fact or interpretation are part and parcel of normal scientific discourse. Blanket assertions such as "we do not accept this" are not, unless evidenced at the same level. No evidence comparable to Annex EF16 REP2-129e has been advanced by the Applicant.

51. The Applicant's position that "we don't know if HSC/COMAH are required or not" is unsustainable in view of the evidence submitted. Considering the volume of such evidence, it is not for Interested Parties to prove any further that the proposal comprises a COMAH establishment requiring HSC; it is surely for the Applicant to prove that it does not.

52. Beyond the "loss of control" provisions, there is also the Schedule 1 Part 3 Note 5 obligation for a "provisional assignment" of the chemicals in BESS cells to the "most analogous" hazard category listed in the Schedule where the "major accident potential" is recognised. I have shown above (paras. 22 – 35) that Li-ion BESS thermal runaway incidents satisfy the legal definition of a "Major Accident". The Note encompasses substances *not* covered by the CLP Regulation and includes waste, which frequently contains "articles". I have discussed this issue in my Comments at Deadline 6 (REP6-060).

53. In respect of the loss of control provisions in the COMAH Regs (though not the “provisional assignment” provisions under Note 5), the Applicant could in theory show by engineered preventive measures that it was *not* “reasonable to foresee” the QQs being exceeded in accidents. This policy is endorsed in another UK jurisdiction (Northern Ireland) and EU jurisdictions (e.g. Germany) and details are in Annex EF48 REP6-085 and Annex EF52 REP7-094e. But design details and analysis of the accident scenario sufficient to justify any such claim would be needed. Precisely because of the Applicant’s refusal to provide a finalised design, this route is not available to them. Moreover, on the German precedent the measures would need to result in the conclusion that exceeding the QQs could “reasonably be excluded” i.e. essentially impossible except by deliberate agency. Nothing in the industry so far has conclusively shown that Li-ion BESS accidents can be controlled at that level.

54. The Applicant’s insistence that a finalised design is needed to determine whether or not the Sunnica BESS are a COMAH establishment is therefore rejected. The Applicant has not sought any determination from the COMAH CA and has not consulted HSE with any adequate size or chemistry details. Nothing comparable to my Annex EF16 REP2-129e has been advanced by the Applicant. At this point, it is surely for the Applicant to prove, on technical grounds, endorsed by the COMAH CA, that the Sunnica BESS are *not* a COMAH establishment, before the ExA can properly proceed on the basis that COMAH notification or HSC are not required.

55. It would have been open to the Applicant at any stage to seek a determination from the COMAH CA, based on the size (energy storage capacity) and/or quantities (tonnage of chemicals) as to whether the Sunnica BESS would, or would not, constitute a COMAH establishment, for either or both of the cell chemistries proposed. No such determination has been sought. As we have seen, HSE has not been consulted with any quantity or size advised, as the HSE letter of 16 January 2023 in Appendix B of REP7-056 (page 68) makes explicit. Nor has any specific chemistry been advised to HSE, and the COMAH CA, acting as such, does not appear to have been consulted at all.

56. Annexed as **new Annex EF57** is an exchange of letters between myself and the Applicant in November – December 2020 in which I specifically asked, at two points, about compliance with the COMAH Regs 2015. The Applicant did not address COMAH compliance at either point. Item 17 (explicitly on COMAH) refers back to item 11, which contains nothing regarding COMAH. The Applicant failed to answer my questions regarding COMAH compliance even at consultation stages.

Answers from the Joint Councils to the ExQ3 at Deadline 7 (REP7-072)

Qu 3.1.2: 10-minute Rule Bill of Dame Maria Miller MP

57. The Councils note the 10-minute Rule motion of Dame Maria Miller MP which was included in my Annex EF9 (REP2-082j) with a verbatim transcript of Dame Maria's speech. The reference in *Hansard* is Volume 719 Columns 275-277. The practice with "10-minute Rule" Bills is that the First Reading is an introductory speech only. There is no draft text until the Second Reading, scheduled for 24 March 2023. The Bill number given in *Hansard* is Bill 152. In her speech Dame Maria makes reference to both the COMAH Regs 2015 and the P(HS)Regs 2015 and says "we simply need to better use the regulations we have" and: "My Bill would correctly apply those regulations to battery storage sites."

58. The Councils note that the Bill would provide *inter alia* for Li-ion batteries to be declared unambiguously within the scope of the relevant Regulations and resolve mis-readings such as those on which the Applicant relies. However this does not mean, as the Councils note, that particular BESS developments do not already fall within scope of the Regulations, as I have maintained throughout this Examination. There is simply nothing to exclude them. I made the same point already in my PHS on ISH1 (REP2-082a); see paras. 23–24 of that submission.

Qu3.1.4: Rochdale envelope doctrines

59. The ECDC note (correctly in my view) that the ExA is not in a position to make a reasoned decision based on Rochdale Envelope doctrines. There is no "envelope". For two years the Applicant refused to disclose even a range for the energy storage capacity proposed. That would have provided an "envelope" for that single unspecified parameter, but was refused throughout. The cell chemistry remains undetermined; there is no question of any "envelope" being available for the likely hazardous substances generated in loss of control accidents.

60. Different chemical elements have different compounds. Even given a choice of two cell chemistries (NMC or LFP as disclosed) there is no "envelope". From my own submissions, "Nickel Oxides in Inhalable Powder Form" emerge as the leading substance driving obligations for HSC and COMAH – if NMC cells are chosen. If LFP cells are chosen, these contain little or no Nickel, hence Nickel compounds are not a hazard. However Hydrogen Fluoride emissions are known to be the highest from cells of the LFP type, and HF toxic gas emissions become the leading driver of COMAH-HSC obligations. There is no "envelope".

61. Consulting the Planning Inspectorate advice on the Rochdale Envelope[1] one finds the principles from R. *v* Rochdale MBC *ex parte* Milne (No. 2) [2000] as follows:

- the assessment should be based on cautious 'worst case' approach:
  "such an approach will then feed through into the mitigation measures envisaged […] It is important that these should be adequate to deal with the worst case, in order to optimise the effects of the development on the environment" (para 122 of the Judgement);

[1] https://infrastructure.planninginspectorate.gov.uk/legislation-and-advice/advice-notes/advice-note-nine-rochdale-envelope/

- the level of information required should be:
  "sufficient information to enable 'the main,' or the 'likely significant' effects on the environment to be assessed […] and the mitigation measures to be described" (para 104 of the Judgment);
- the need for 'flexibility' should not be abused:
  "This does not give developers an excuse to provide inadequate descriptions of their projects. It will be for the authority responsible for issuing the development consent to decide whether it is satisfied, given the nature of the project in question, that it has 'full knowledge' of its likely significant effects on the environment. If it considers that an unnecessary degree of flexibility, and hence uncertainty as to the likely significant environmental effects, has been incorporated into the description of the development, then it can require more detail, or refuse consent" (para 95 of the Judgment);

62. Nothing in the Application provides the ExA with anything like "sufficient information to enable 'the main,' or the 'likely significant' effects on the environment to be assessed […] and the mitigation measures to be described" where BESS accidents are concerned.

63. From the outset the Applicant has been evasive on absolutely fundamental aspects of the BESS specification, and has consistently refused to declare even very basic parameters such as the energy storage capacity (until ISH1, when already too late for most Interested Parties to obtain independent advice). The applicant's appeal to the Rochdale Envelope is clearly an attempt to use it as "an excuse to provide inadequate descriptions of their projects" which is expressly forbidden in the Judgment.

64. Nothing in the application demonstrates a "cautious 'worst case' approach" to BESS safety". There is no independent appraisal from the COMAH CA on this issue.

65. The Planning Inspectorate advice also includes on pre-application consultation:

3.1 The process introduced by the PA2008 places a duty upon applicants to engage meaningfully with affected communities, local authorities and other statutory consultees over their proposals at Pre-application stage. The Applicant must produce and publicise a Statement of Community Consultation (SoCC). In preparing this, they must consult with and have regard to the views of any relevant local authority on the content of the SoCC.

66. There is no sense in which the pre-application consultations by the Applicant were meaningful, with the consistent refusal to declare either size or chemistry of the BESS, and with, as the exchange in new Annex EF57 shows, a failure to answer my direct questions on COMAH compliance, which I raised in November 2020.

67. I agree with ECDC that it is readily conceivable that the BFSMP is discharged based on fire service comments (by the CCs) but HSC is refused (by the DCs) based on independent consultations. Reference is made to myself as a local expert. As a resident and elector of ECDC I would press for Refusal of HSC, in the current state of the technology, based on all the material in these submissions.

68. I have pointed out in several places that involving all four Councils in discharge of related conditions or consents would create administrative chaos. Both policy and law require the BESS safety issues and at least preliminary consideration of HSC to be addressed at the present stage.

Qu3.1.7 BESS and Hazardous Substances Consent

69. **Qu3.1.7** The ExA's question (to WSC) is highly pertinent. S.6(1) P(HS)A 1990 provides just two routes for an Applicant to gain HSC for a proposal:

(i) to seek a Direction (from the SoS) under S.12(2B) P(HS)A 1990 that HSC is "deemed" to be granted. This would require consideration of HSC within this Examination so that the ExA could correctly advise the SoS pursuant to Sect. 4.12 of NPS EN-1. Such Directions fall under R.26(6)(h) P(HS)Regs 2015 so would also require the safety appraisal from the COMAH CA to have been submitted with the Application, by R.26(2)(b – d) P(HS)Regs 2015. No such safety appraisal is available, hence neither is the route of a S.12(2B) Direction;

(ii) to seek HSC post-consent from the LPAs (the District Councils acting as Hazardous Substances Authorities) under the procedures in P(HS)Regs 2015. NPS EN-1 however requires (Sect. 4.12.1 and footnote 94) that "details in their DCO" should be provided as a Policy requirement for this route.

70. The Applicant declined to seek "deemed consent" in the form of a S.12(2B) Direction, and as noted above this would have required by law the safety appraisal from the COMAH CA to do so. As the DCs note, the footnote 94 details have not been provided. The Applicant failed to consult the LPAs (in their rôle as HSAs) on the question of Hazardous Substances, and failed to consult the public affected on Hazardous Substances. Only latterly within the Examination has the Applicant acknowledged the loss of control provisions in Schedule 1 Part 3 of the P(HS)Regs 2015 although the DLUHC letter Annex EF47 (REP6-083) makes clear the importance attached by DLUHC to those provisions.

71. Seeking "deemed HSC" from the SoS once the Examination has closed but prior to or as part of the SoS's decision would be unlawful by R.26(2)(d-e) P(HS)Regs 2015, lacking public participation.

72. The Applicant's position that "we can't tell at this stage if HSC is required" I reject on evidenced scientific and technical grounds in my WR REP2-129 and Annex EF16 REP2-129e. It is virtually inconceivable that HSC is *not* required.

73. The Applicant is saying "we will seek HSC post-consent, if required", but says nothing about how such a requirement would be determined, if not by fault scenario analyses of the kind already provided in my Annex EF16 REP2-129e.

74. If, notwithstanding the lack of "details in their DCO" required by footnote 94 NPS EN-1, the approach to HSC is a post-consent application to the HSAs, then a formal notice to the COMAH CA is triggered at that point. This would almost certainly result in assessing the BESS as a potential COMAH site.

75. A defect in the Examination process would then be revealed, because for projects subject to the COMAH Regulations, the report from the COMAH CA should have been sought in the first place by the Applicant, pursuant to Sect. 4.11 of NPS

EN-1, as I have maintained throughout. Such input is also legally required at the time of the Application, by R.26(2) P(HS)Regs 2015.

76. I endorse completely the Councils' view that they do not have the technical expertise to assess such information. They should not be expected to. BESS safety is a highly technical area which even the local Fire Services cannot realistically be expected to be expert in, as the wiser counsels within the profession recognise.

77. HSE, for example, has its own in-house modelling codes for technical issues such as explosion hazards or plume dispersal. They should be used or at least made available. It should not be up to members of the public, or even the local Fire Services, to initiate such highly technical appraisals though they should of course be allowed to question them.

R.26 P(HS)Regs 2015

78. In previous submissions REP6-036 the Applicant has objected to my citation of Article 13(3) of *Seveso*, a plain language description of the intentions of the Directive for sufficient information on risk to be provided *before* decisions are taken.

79. The ExA should note that this Article of the Directive was transposed not only into those Regulations relating to HSC obtained from HSAs, but also into R.26 P(HS)Regs 2015 relating to approvals under S.114 PA 2008 (R.26(6)(f)(v) P(HS)Regs 2015). See the Table of Transposition in the Explanatory Memorandum Annex EF6 REP2-082g. R.26 applies also to S.12(2B) Directions of "deemed HSC" (R.26(6)(h) P(HS)Regs 2015). It is thus UK law in force independently of EU Exit.

80. References to Article 13(3) of the Directive anywhere in these submissions may therefore be read as if they were references to R.26 P(HS)Regs 2015.

81. *Inter alia* the following obligations arise:
R.26(2)(b) the COMAH Competent Authority is consulted about the project;
R.26(2)(c) the main reports and advice issued to the ExA "at the time when the public concerned was informed pursuant to paragraph (2)(a)" are made available to the public concerned at that time;
R.26(2)(d) the public concerned is entitled to express comments and opinions on the advice, to the ExA, *before* a decision is taken.

82. As in paras. 46-54 above, the evidence submitted makes it almost inconceivable that the Sunnica BESS are not an "establishment" satisfying the definition of a "relevant project" in R.26(5) P(HS)Regs 2015.

83. Thus under R.26 the legal requirement for a report by the COMAH CA is required *at the time of application,* and public commentary must be allowed *before* decisions are taken. Concerning timing, this is actually a stronger requirement than the Policy requirement for the safety appraisal in Sect. 4.11 of NPS EN-1.

84. The safety appraisal by the COMAH CA to assess whether the "inherent features of the design are sufficient to prevent control and mitigate major accidents" is required by Policy in Sect. 4.11 of NPS EN-1. This requires "inherent features" to be assessed but does not necessarily require a fully finalised design.

85. The Policy requirement in NPS EN-1 is for the SoS to be satisfied by a report from CA before taking a decision. The legal requirements under R.26 P(HS)Regs 2015 are actually stronger, requiring the consultation with the COMAH CA to be supplied to the public as part of the Application, and that public commentary thereon is allowed within the Examination.

86. The consultation with the COMAH CA has not taken place and there has been no opportunity to comment on a non-existent report.

(6849 words) EJF, 13/03/2023

List of Annexes referred to: – Comments at Deadline 8: Dr Edmund Fordham (dated 13th March 2023)

EF1 – Personal details

EF2 – "Safety of Grid Scale Lithium-ion Battery Energy Storage Systems"
by E J Fordham (Interested Party), with
Professor Wade Allison DPhil and
Professor Sir David Melville CBE CPhys FInstP

EF3 – "Hazardous substances (Planning) Common Framework"
CP 508 Presented to Parliament by the SoS for DHCLG August 2021

EF4 – Directive 2012/18/EU of the European Parliament and of the Council on the Control of Major-Accident Hazards involving dangerous substances commonly known as the "Seveso III Directive"

EF5 – The Planning (Hazardous Substances) Regulations 2015

EF6 – Explanatory Memorandum to the P(HS)Regs 2015

EF7 – The Planning (Hazardous Substances) Act 1990

EF8 – Overarching National Policy Statement for Energy (NPS EN-1)

EF9 – Speech of Dame Maria Miller MP, House of Commons, 7 September 2022
Hansard, (House of Commons) Volume 719, Columns 275-277

EF10 – Battery Storage Guidance Note 1: Battery Storage Planning. Energy Institute, August 2019, ISBN 978 1 78725 122 9

EF11 – D. Hill (2020).
"McMicken BESS event: Technical Analysis and Recommendations"
Technical support for APS related to McMicken thermal runaway and explosion.
Arizona Public Service. Document 10209302-HOU-R-01
Report by DNV-GL to Arizona Public Service, 18 July 2020.

EF12 – Underwriters Laboratories incident report into McMicken explosion

EF13 – (5 items) News items and English translation from Chinese of official accident investigation into April 2021 BESS fire and explosion in Beijing

EF14 – (3 items) Reports from Merseyside Fire and Rescue Service into September 2020 BESS fire and explosion in urban Liverpool

EF15 – Larsson *et al.* (2017), *Scientific Reports*, **7**, 10018,
DOI 10.1038/s41598-017-09784-z

EF16 – Paper with Professor Sir David Melville CBE: “Hazardous Substances potentially generated in “loss of control” accidents in Li-ion Battery Energy Storage systems (BESS): storage capacities implying Hazardous Substances Consent obligations.

In public domain on *Research Gate* preprint server
DOI 10.13140/RG.2.2.35893.76005

EF17 – Golubkov *et al* (2014) *RSC Advances* DOI 10.1039/c3ra4578f

EF18 – Research Technical Report by *FM Global:* Flammability characterization of Li-ion batteries in bulk storage”

EF19 – Bergström *et al* (2015) Vented Gases and Aerosol of Automotive Li-ion LFP and NMC Batteries in Humidified Nitrogen under Thermal Load

EF20 – (2 items) Victorian Big Battery Fire, July 2021. Report of technical findings. Also compendium of news items with aerial photography.

EF21 – (2 items) Letter from Commissioner Sandra D. Kennedy, Arizona Public Service Company, August 2019, regarding McMicken explosion.

Also letter with Fire Department report into earlier 2012 BESS fire with eye-witness reports on flame length.

EF22 – Technical Memorandum from Golder Associates re composition of BESS at Kells, Northern Ireland

EF23 – Ouyang *et al.* (2018), *J. Thermal Analysis and Calorimetry,*
DOI: 10.1007/s10973-018-7891-6

EF24 – Essl *et al.* (2020), *Batteries*, **6**, 30 DOI: 10.3390/batteries6020030

EF25 – Chen *et al.* (2020), *J. Hazardous Materials*, **400,** 123169
DOI: 10.1016/j.jhazmat.2020.123169 (Citation only: article copyright)

EF26 – Held *et al.* (2022) *Renewable and Sustainable Energy Reviews,* **165***,* 112474
DOI: 10.1016/j.rser.2022.112474

EF27 – Wang *et al.* (2019) *Energy Science and Engineering*, **7**, 411-419
DOI: 10.1002/ese3.283

EF28 – Hazard Assessment of BESS, Technical Report by Atkins (Consulting Engineers) for Health and Safety Executive for Northern Ireland HSE(NI)

EF29 – Letter 13/05/2022 from HSE(NI) to Ards and North Down Borough Council

EF30 – Letter 22/09/2022 from HSE(NI) to Derry City and Strabane District Council

EF31 – Letter 10/09/2021 from HSE(NI) to Armagh City, Banbridge & Craigavon Local Planning Office

EF32 – Letter 18/07/2022 from HSE(NI) to Derry City and Strabane District Council

EF33 – Letter 20/05/2021 from HSE(NI) to to Armagh City, Banbridge & Craigavon Local Planning Office

EF34 – Research Technical Report by *FM Global*: “Development of sprinkler protection guidance for Lithium-ion based energy storage systems”

EF35 – P. Andersson *et alia*, “Investigation of fire emissions from Li-ion batteries”, SP Technical Research Institute of Sweden, 2013.

EF36 – Barron-Gafford *et al.* (2016). The photovoltaic heat island effect: Larger solar power plants increase local temperatures. *Scientific Reports* **6**, 35070, DOI: 10.1038/srep35070

EF37 – Armstrong *et al.* (2016). Solar park microclimate and vegetation management effects on grassland carbon cycling*. Environmental Research Letters* **11**(7) 074016 DOI: 10.1088/1748-9326/11/7/074016

EF38 – Parliamentary answer

EF39 – BAILII case

EF40 – Fordham and Swords (2022). Application of the COMAH and Hazardous Substances Consents Regulations to Battery Energy Storage Systems (BESS): Does classification as “articles” exempt a technology ?

EF41 – Letter 17 December 2015 from Occupational Safety and Health Administration (OSHA) of the USA regarding classification of Li-ion batteries.

EF42 – Paper by Mr Pat Swords (2009) “Implementing EU industrial safety legislation in Central and Eastern Europe” Symposium Series No. 155, Hazards XXI, Institution of Chemical Engineers, 2009 pp 256 – 262.

EF43 – transcript of timed and recorded remarks made at OFH2

EF44 – transcript of final interview with the late Professor Sir David MacKay FRS, April 2016

EF45 – The Control Of Major Accident Hazards Regulations 2015

EF46 – United Nations Manual of Tests and Criteria, 7th edition

EF47 – Letter from DLUHC regarding operation of Part 3 of the P(HS)Regs 2015

EF48 – Letter from HSE(NI) to Armagh City, Banbridge and Craigavon Borough Council regarding application of COMAH and HSC to BESS

EF49 – Buston, J E H *et al.*, (2023) Energy Advances **2**, 170

EF50 – Revised Golder Memorandum,19 Dec 2022

EF51 – Jensen Hughes memorandum, 3 March 2023

EF52 – Advice letter from HSE(NI), 12 January 2023

EF53 – KAS-43 Guidance Notes from German “Commission of Plant Safety” with English translation of Section 3.

New Annexes added this submission (13 March 2023)

EF54 – HSE advice to Applicant at EIA and S.42 stages

EF55 – Guidance Notes “L111” on the COMAH Regs, Health and Safety Executive

EF56 – EC Memorandum to stakeholders transposing the Seveso III Directive

EF57 – exchange of letters with Applicant, November 2020