

Comments on Applicant Submissions at Deadline 5 : Dr Edmund Fordham

Dated: 30<sup>th</sup> January 2023

Annex EF46 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 on Applicant Submissions made at Deadline 5**

**Eurling 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 6 (30 January 2023). They are responses to the following documents:

(a) Applicant's Response to the Second Written Questions EN010106/APP/8.71  
(Deadline 5 Submission, 13 January 2023)

(b) Applicant's Response to Dr Edmund Fordham Deadline 3A Submissions  
EN010106/APP/8.60 16 December 2022 REP4-034

2. They are supplemental to the analysis of REP-034 above already made in my  
"Comments on Applicant Submissions at Deadline 4" now indexed as REP5-093  
which should be read in conjunction with this Commentary

**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 Applicant's responses to Qu 2.1.2 in Second Written Questions does not answer the question put, but answers a different one. No legal authority is advanced to the ExA's question regarding the claimed exemption of BESS from the scope of the COMAH Regs 2015 and the P(HS)Regs 2015. The Applicant replies they are not "seeking to exclude" the Regulations (from their DCO), a different question, and that no "disapplication" under S. 120 PA 2008 is sought.
2. At this stage, I contend that the ExA can only proceed on the basis that there is no legal authority which excludes the COMAH Regs 2015 and P(HS)Regs 2015 from application to BESS. The Applicant cites none and my position is explicitly endorsed by ECDC.
3. The Applicant rehearses "disapplications" under S.120 PA 2008 but fails to appreciate that the scope for doing so is limited. The COMAH Regs would be impossible to "disapply" whilst they remain specifically endorsed by a S.5 designated Policy in Sect. 4.11 NPS EN-1.
4. The Applicant's position on consenting requirements is helpfully summarised:
  - (i) they do not know if HSC or COMAH notification will be legal obligations, without a detailed design;
  - (ii) necessary consents will be applied for at "the relevant time", presumably meaning "post-consent" i.e. *after* the granting of a DCO, a wish made explicit by the Applicant elsewhere.
5. Both aspects are untenable.
  - (i) As analysed extensively in my REP5-093, it is *not* necessary to have a detailed design to decide, with reasonable certainty, if HSC or COMAH notification are legal obligations;
  - (ii) The deferment of a safety appraisal by the COMAH CA until after the granting of a DCO would violate both Policy and law.
6. Both the COMAH Regs 2015 and the P(HS)Regs 2015 exercise their regulatory control by the mere *presence* of Hazardous/Dangerous Substances as an aggregate total in the establishment, above prescribed thresholds. Containment, engineering controls, fire suppression etc are not relevant to determination of the legal obligations. They would be highly relevant to actual *decisions* on HSC or safety appraisals by the COMAH CA, but that is a different matter from the legal obligations.

7. Recognising the known major accident potential of grid-scale Li-ion BESS, Notes 5/6<sup>1</sup> of both Regulations require (relating to the chemical content of the BESS) “provisional assign[ment] to the most analogous category or named hazardous substance falling within the scope of these Regulations”. This has not so far been done either by the Applicant or by the COMAH CA, although in my Annex EF16<sup>2</sup> we note that BESS cells in a high SoC can fail consistently with the qualitative descriptions of an Explosive Article in Divisions 1.3 or 1.4.

8. A “provisional assignment” as a P6a or P6b Self-Reactive Mixture as the “most analogous category” would be consistent with the known chemical nature of the phenomenon of “thermal runaway” which is responsible for the major accident potential presented by Li-ion BESS. The Qualifying Quantities are identical to those prescribed for P1a or P1b Explosives, reflecting the similar nature of the Physical Hazards presented in accidents by either category (Self-Reactives or Explosives). Hence there is no difference in the regulatory consequence, whichever is chosen.

9. The detailed category (P1a, P1b, P6a, P6b) is immaterial to deciding if the Sunnica BESS require COMAH notification. The tonnages of BESS cell chemicals are so far in excess of the largest QQ than the Sunnica BESS are “upper-tier” COMAH in all cases.

10. The prescribed tests in the UN MTC to confirm a Self-Reactive Mixture assignment would be difficult to perform, but the tests for Explosive Articles are practical for BESS cells in a high State of Charge.

11. Assignments to a Hazard category in Part 1 of the Schedule to both COMAH Regs 2015 and to P(HS)Regs 2015 refer to the Dangerous or Hazardous Substances present in normal operation. The “loss of control” provisions of both Regulations remain applicable in addition, and have been extensively analysed in my WR<sup>3</sup> and Annex EF16<sup>4</sup>.

12. There is little room for doubt that the Sunnica BESS require HSC and COMAH notification. These being a duty on the Applicant, it behoves the Applicant to show that COMAH notification is *not* required, either (i) because Dangerous Substances are not present (ii) the quantities involved are below the relevant QQs. Neither is credible for the proposed BESS of 2400 MWh capacity involving around 15,000 tonnes of functional chemicals.

13. Accordingly the Policy requirements of Sect 4.11.4 of NPS EN-1, regarding a safety appraisal by the COMAH CA, do apply to the Sunnica BESS. Similarly the Policy requirements of Sect. 4.12.1 and footnote 94 of NPS EN-1, regarding HSC, also apply.

14. As in my REP5-093, a “full consequence model” is essential to appraise the issues of siting, safety distances, and “protection of areas of particular natural

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<sup>1</sup> In Schedule 1, Part 3 COMAH Regs 2015 and in Schedule 1, Part 4 P(HS)Regs 2015, respectively

<sup>2</sup> REP2-129e

<sup>3</sup> REP2-129

<sup>4</sup> REP2-129e

sensitivity or interest” as required by Article 13(2) of Seveso (remaining in force *via* R. 24 P(HS)Regs 2015), and a duty on the SoS by R.24(1)(b).

**15.** Dealing with these issues “post-consent” would violate the legislative intention of P(HS)Regs 2015 to implement Article 13(3) of Seveso, requiring “sufficient information on the risks ... when decisions are taken”.

**16.** The only requirement which Policy allows to be dealt with “post-consent” is HSC, but the conditions<sup>5</sup> of (i) pre-application consultation with HSE, and (ii) providing “details in their DCO”, have not been satisfied. Condition (i) is irreparable at this point.

**17.** The Application does not satisfy the Policy requirements in Sect. 4.11.4 of NPS EN-1 for a safety appraisal by the COMAH CA. It is impossible for the ExA to “be satisfied” on this requirement unless the safety appraisal by the COMAH CA is received at the consenting stage. The Policy being legally protected by R.24(1)(a) P(HS)Regs 2015, there is no provision either in Policy or law for deferment “post-consent”.

**18.** Finalising design and safety appraisal by the COMAH CA “post-consent” would bypass legally-protected Policy requirements for major accident prevention and mitigation to be considered within the consenting process. Granting a DCO on the assumption that a COMAH CA safety appraisal was not required (in spite of the abundance of evidence that it is), secured only by “post-consent” Requirements, would almost certainly result in a safety appraisal by the COMAH CA being required after all, thereby exposing the Examination process to have been improper. Procedural propriety cannot be “secured by requirements in the DCO”.

**19.** In summary:

- (i) Conditions for obtaining HSC “post-consent” have not been satisfied;
- (ii) There is no “full consequence model” to appraise fully the siting matters in Article 13(2) of Seveso;
- (iii) There are no provisions anywhere in Policy or law for the safety appraisal from the COMAH CA to be obtained “post-consent”. Policy is clear that the ExA must receive the safety appraisal from the COMAH CA as part of the consenting process.

Absent such safety appraisal, by the COMAH CA, at the consenting stage, within this Examination, it is impossible for the ExA to “be satisfied” on the safety Policy in Sect. 4.11.4 NPS EN-1; therefore the Application must be rejected.

( Summary 1,178 words )

EJF, 30/01/23

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<sup>5</sup> Footnote 94 in NPS EN-1

## 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 <sub>2.5</sub>	– 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 <sub>4</sub>	– Methane
C <sub>2</sub> H <sub>4</sub>	– Ethylene
C <sub>2</sub> H <sub>6</sub>	– Ethane
CO	– Carbon Monoxide
CO <sub>2</sub>	– 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 <sub>2</sub> O	– Cuprous ( or Copper (I) ) Oxide
H <sub>2</sub>	– 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 <sub>2</sub> O <sub>3</sub>	– diNickel triOxide
POF <sub>3</sub>	– 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 <i>power</i> , i.e. <i>rate</i> of transfer of <i>energy</i>
MWh	– megawatt- <i>hour</i> , or one million watt-hours, a unit of <i>energy</i> e.g. the <i>energy</i> transferred by a <i>power</i> of 1 MW acting for 1 <i>hour</i>
m <sup>2</sup>	– square metre (area)
ha	– 1 hectare = 10,000 m <sup>2</sup>
MWh ha <sup>-1</sup>	– 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 <sup>-1</sup>	– energy density of the BESS cells themselves, as MWh energy storage capacity, per tonne of cells
Wh / kg or Wh kg <sup>-1</sup>	– 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) <sup>-1</sup>	– 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
µg m <sup>-3</sup>	– trace concentrations of highly toxic gases, in micrograms of toxic contaminant per cubic metre of air
µm	– 1 micrometre or 10 <sup>-6</sup> metre

## Scope and Purpose of these Comments

1. These Comments respond to the compact summary of the Applicant's position made in response to the ExA's Second Written Questions, in particular to Qu 2.1.2 put by the ExA. My detailed analysis of the Applicant's Response to my Deadline 3A submissions [REP4-034] (cited in response to Qu 2.1.2, see below) and the many contradictions contained therein has been made in my Deadline 5 submission REP5-093 which should be read in conjunction with these Comments. They crystallise the reasons I believe the Applicant's position is untenable.

## The Applicant's response to Question 2.1.2 (Second Written Questions)

2. In the Applicant's response to the Second Written Questions (Document number EN010106/APP/8.71, Deadline 5 Submission, 13 January 2023) the following question and responses<sup>6</sup> are made.

### **Question 2.1.2 from the ExA:**

Battery energy storage system (BESS): COMAH and P(HS) regulations  
Please comment on the precise legal authority (if any) on which one might rely to exclude the scope of the COMAH and P(HS) Regulations 2015 from application to BESS.

### **Answer by the Applicant:**

The Applicant is not seeking to exclude the scope of the COMAH regulations or the Planning (Hazardous Substances) Regulations 2015.

The Applicant made submissions on this in:

- Paragraph 8.2 of its Written Summary of Sunnica Limited's Oral Submissions at the Development Consent Order Issue Specific Hearing on 1st November Submitted at Deadline 2 [REP2-036]; and
- The Applicant's Response to Dr Fordham's Deadline 3A Submissions submitted at Deadline 4 [REP4-034].

The Applicant's position is set out in more detail in those submissions. In summary it is said that at this stage, without detailed design of the BESS, it is not known with certainty whether Hazardous Substances Consent or authorisation under the COMAH Regulations is required. If, following detailed design, it is determined that consent is required then the Applicant will apply for it at the relevant time.

Section 120 of the Planning Act 2008 does allow an undertaker to seek the disapplication of legislative provisions which could include the above legislation. However, the Applicant has not sought to do this. Article 6 of the Development Consent Order [REP4-005] is the article which provides for disapplication of certain legislation which does not include the provisions referred to in the question.

3. The ExA has asked a highly pertinent question and I am grateful to them for having done so. The question echoes the invitation made in my PHS after ISH3<sup>7</sup> (REP4-089) and is the crux of the matters explored in Annex EF40<sup>8</sup>.

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<sup>6</sup> Page 43 of document, Topic 2.1 Air Quality and Human Health

<sup>7</sup> Summary Para. 11, main text Para. 15

<sup>8</sup> REP4-092

## **Applicant's evasion of Qu 2.1.2 regarding the COMAH and P(HS)Regs 2015**

4. The Applicant's response evades answering the question Qu 2.1.2 put by the ExA. It is not exclusion of the Regulations from the dDCO (the question answered by the Applicant) that is being questioned, but the claimed exclusion of BESS from the scope of the Regulations (the question put by the ExA).

5. Qu 2.1.2 asks: "comment on the precise legal authority (if any) on which one might rely to exclude the scope of the COMAH and P(HS)Regulations 2015 from application to BESS". Instead the Applicant answers a *different* question by saying: The Applicant is not seeking to exclude the scope of the COMAH regulations or the Planning (Hazardous Substances) Regulations 2015.

6. Qu 2.1.2 remains unanswered. I remain unaware of any legal authority that excludes BESS from the scope of the COMAH Regs 2015 or the P(HS)Regs 2015 as enacted. The Applicant does not provide one, but instead says they do not seek to *exclude* those Regulations (from their dDCO). The Applicant also evades the question by saying they do not know whether or not the Regulations would apply.

7. Unless a legal authority can be advanced that excludes BESS from the scope of the COMAH and P(HS)Regs 2015, I contend that by this stage, the ExA can only proceed on the basis that no such authority exists<sup>9</sup>.

8. The response of ECDC to Qu 2.1.2<sup>10</sup> endorses this position:

9. **Fifth**, we have seen that the Applicant appears to pray in aid of a Parliamentary Answer dated July 2021 that BESS is exempt from COMAH Regs [citing REP4-090] on the basis, simply, that Li-ion batteries are considered to be 'articles' and therefore outside of the scope of the COMAH. We are of the view that this is not evidence to support such a conclusion. There is no legal case supporting this conclusion. The ExA simply does not have enough information to rely on such inference.<sup>7</sup>

Footnote 7 reads: The question posed by the ExA at Q2.1.3 on *BESS: design parameters* is quite telling and speaks to the simple fact that the Applicant is unable to 'describe clearly what is proposed' and therefore the ExA, the authorities and other participants are left completely in the dark.

10. In short, if the Applicant wishes to continue asserting that these Regs are excluded, then the ECDC reserves its position to respond at the next Deadline. Finally, this is an issue that requires resolution at the consenting stage rather than post consent.

## **Disapplication of legislation pertaining to Major Accident Prevention ?**

9. Moreover, the SoS would in any case have little or no discretion to "exclude the scope" of the COMAH Regulations, even under the S.120 provisions in PA 2008. Since it was obvious from ISH1 onwards that "disapplication" of the COMAH Regs 2015 and P(HS)A 1990 was *not* being sought, the issues are not of onward relevance. However they do exemplify the lack of clarity in the Applicant's case as to

<sup>9</sup> For all the reasons set out in my PHS after ISH3, REP4-089.

<sup>10</sup> [https://infrastructure.planninginspectorate.gov.uk/wp-content/ipc/uploads/projects/EN010106/EN010106-004805-East%20Cambridgeshire%20District%20Council%20-%20Responses%20to%20ExA's%20Second%20Written%20Questions%20\(ExQ2\)%201.pdf](https://infrastructure.planninginspectorate.gov.uk/wp-content/ipc/uploads/projects/EN010106/EN010106-004805-East%20Cambridgeshire%20District%20Council%20-%20Responses%20to%20ExA's%20Second%20Written%20Questions%20(ExQ2)%201.pdf)

what the law actually requires and what discretion is or is not available to the SoS. They deserve a response for that reason.

10. The PA 2008 itself made amendments to the P(HS)A 1990 contained in Schedule 2, Ss.42-47 of the PA 2008 itself. In particular, the provisions for “deemed HSC” to be granted by the SoS in S.12(2)(2B) P(HS)A 1990 were inserted by Schedule 2 S.45 of the PA 2008, including the provision that any such “deemed HSC” was subject to consultation with the Health and Safety Commission (now merged with the HSE) in S.12(3) P(HS)A 1990.

11. The PA 2008 itself made provision for (i) the consideration and granting of HSC, by the SoS, within the PA 2008 procedures, and (ii) the protection of the public safety by the requirement of consultation with the HSE before any such “deemed consent” is granted (S. 12(3) P(HS)A 1990). It would be absurd to override these explicit protections of the public health and safety by a S.120 “disapplication” of P(HS)A 1990, when provisions for considering the hazardous substances issues have already been made within the PA 2008 itself (Schedule 2, Ss. 42-47). In the present Application, Sunnica have declined to apply for a S.12(2)(2B) Direction and have stated that HSC will be sought if necessary “post-consent” from the HSAs under the procedures in P(HS)Regs 2015.

12. With regard to the COMAH Regs 2015, Policy in Sect. 4.11.3-4 NPS EN-1 (“designated” under S.5 PA 2008) very clearly states that developments subject to the COMAH Regulations require a safety appraisal by the COMAH CA at the consenting stage:

... in order to assess whether the inherent features of the design are sufficient to prevent, control and mitigate major accidents. The IPC<sup>11</sup> should be satisfied that an assessment has been done where required and that the Competent Authority has assessed that it meets the safety objectives described above.

13. It would be impossible for the ExA to observe the S.5 designated Policy at the same time as agreeing to “disapply” the very Regulations specifically endorsed in the Policy (Sects. 4.11.3-4 NPS EN-1). So as long as NPS EN-1 remains a designated Policy under S.5 PA 2008, the COMAH Regs cannot be “disapplied”.

14. Moreover the SoS is under a legal duty by R.24(1)(a) P(HS)Regs 2015 to ensure that any policy “designated” under S.5 PA 2008 takes account of:

R.24(1)(a) the objectives of preventing major accidents and limiting the consequences of such accidents for human health and the environment;

15. Hence the SoS has no freedom to disregard the safety provisions within Sects. 4.11.3-4 NPS EN-1, without the prior repeal of R.24(1)(a) P(HS)Regs 2015.

16. The Applicant thus betrays a belief in the discretion available to the SoS which is wider than the law allows, where major accident prevention and mitigation are concerned.

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<sup>11</sup> Infrastructure Planning Commission; now the ExA advising the SoS

## **Applicant's position regarding consenting requirements**

17. The Applicant says:

In summary it is said that at this stage, without detailed design of the BESS, it is not known with certainty whether Hazardous Substances Consent or authorisation under the COMAH Regulations is required. If, following detailed design, it is determined that consent is required then the Applicant will apply for it at the relevant time.

The Applicant also refers back to its REP2-036 and REP4-034 for details.

18. The many contradictions and misunderstandings in the Applicant's REP4-034 have already been analysed in my REP5-093. In particular the Applicant continues to rely on the alleged exemption from the COMAH Regs 2015 for installations considered "articles" under the CLP Regulation. Though failing to answer the ExA's Qu 2.1.2, the Applicant nevertheless continues to assert an exemption based on the argument that "batteries are articles". Moreover the Applicant extends that argument, without basis, to the P(HS)Regs 2015, when even the DWP Parliamentary Answer cited<sup>12</sup> makes no reference to the P(HS)Regs 2015, only to the COMAH Regulations.

19. The Applicant's position is however helpfully stated in summary form:

- (i) they do not know if HSC or COMAH notification will be legal obligations, without a detailed design;
- (ii) necessary consents will be applied for at "the relevant time", presumably meaning "post-consent" i.e. *after* the granting of a DCO.

20. Both aspects of the Applicant's position are untenable.

- (i) As analysed extensively in my REP5-093, it is *not* necessary to have a detailed design to decide, with reasonable certainty, if HSC or COMAH notification are legal obligations;
- (ii) The deferment of a safety appraisal by the COMAH CA until after the granting of a DCO would violate Policy and law, for reasons detailed below.

## **Deciding if HSC or COMAH notification are legal obligations**

21. Both the COMAH Regs 2015 and the P(HS)Regs 2015 exercise their regulatory control by the *mere presence* of Hazardous/Dangerous Substances as an aggregate total in the establishment, as repeatedly observed throughout my submissions to this Examination. Containment, bunding, engineering controls and warning systems, fire suppression systems and safety policies are completely irrelevant to this. The P(HS)A 1990 is absolutely clear that it is the *mere presence* ("on, over or under land"<sup>13</sup>) that creates the obligation to seek HSC. The COMAH Regs 2015 derive from Seveso, which from the earliest versions of the Directive has been deliberately "technology neutral" or agnostic as to the nature of the technology or "installations" in the "establishment". All that is necessary is that there be potential for a "major accident" involving "one or more dangerous substances" in an establishment holding or using such Dangerous Substances in quantities above

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<sup>12</sup> Annex EF38, REP4-090

<sup>13</sup> S. 4(1) P(HS)A 1990

thresholds. Both sets of Regulations include substances generated in “loss of control of the processes”<sup>14</sup>.

22. A detailed design is therefore *not* required to determine if HSC or COMAH notification is a legal obligation; although a detailed design *is* necessary to decide with reasonable and responsible prudence:

- (i) whether HSC should be granted, whether by the HSAs<sup>15</sup>, or as “deemed consent” by the SoS<sup>16</sup>, or
- (ii) whether the COMAH CA should approve (at the Planning stage)<sup>17</sup> “the inherent features of the design” as being “sufficient to prevent, control and mitigate major accidents”, or
- (iii) whether the COMAH CA should approve (at the operational stage) the Major Accident Prevention Policy<sup>18</sup>.

23. All the above would indeed require a detailed design. But deciding if HSC or COMAH notification are legal obligations does not.

24. My WR<sup>19</sup> sets out reasons that HSC is almost certainly a legal obligation, largely based on Hazardous Substances generated in loss of control of the processes. The size of the proposed BESS is stated to be an unprecedented 2400 MWh, which would correspond to some 15,000 tonnes of high-technology functional chemicals within the BESS cells. It is virtually inconceivable that the thresholds specified in Part 3 Column 2 of the Schedule 1 to the P(HS)Regs 2015 would not be breached. This applies whether NMC cells or LFP cells are selected, although the Hazardous Substances of leading concern (for the purposes of determining the legal obligations) could be different for the different electrochemical types.

25. The estimate of around 15,000 tonnes can be made on the basis of typical BESS energy densities, e.g. as found in the Energy Institute site planning guidance<sup>20</sup> quoting “a mass in excess of 6 tonnes per MWh”<sup>21</sup>. Similarly the composition of an actual BESS abstracted in Annex EF16<sup>22</sup> derived from Annex EF22<sup>23</sup> is about 6.5 tonnes (of functional chemicals) per MWh energy storage.

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<sup>14</sup> In Schedule 1 Part 3 Column 1 of P(HS)Regs 2015, or in R.2 (Interpretation) “presence of a dangerous substance” in COMAH Regs 2015.

<sup>15</sup> Under provisions of the P(HS)A 1990 and P(HS)Regs 2015

<sup>16</sup> By a Direction under S.12(2)(2B) P(HS)A 1990

<sup>17</sup> According to Sect. 4.11.4, NPS EN-1

<sup>18</sup> Required by R. 7 COMAH Regs 2015.

<sup>19</sup> REP2-129

<sup>20</sup> Annex EF10, REP2-082k

<sup>21</sup> p.16, Sect. 4.2 of Annex EF10

<sup>22</sup> Table 7, page 35, REP2-129e

<sup>23</sup> REP2-129j

26. My position in Para. 24 is supported by ECDC in their Deadline 5 Comments<sup>24</sup>

2. ECDC remains dissatisfied with the current position. It is unsatisfactory for the applicant to hedge its bets. It may proceed reasonably in two ways:
  1. (i) Assume a battery type which does require HSC, provide the necessary evidence to the Examination, and obtain HSC;
  2. (ii) Agree a requirement in the DCO which limits battery types to those which do not require HSC.

and also by WSC in their Deadline 5 Comments<sup>25</sup> :

The Council notes the Applicant's response to the Council's request that further information is provided to establish whether Hazardous Substances Consent is required. However, as stated in its Post-Hearing Submission for ISH1 [REP2-086c], the Council maintains its view that the DCO should provide for the granting of HSC in the event that it is required rather than it being subject to a separate consenting process. As previously stated, the DCO process is deliberately designed to provide a streamlined procedure such that any necessary relevant consents can be obtained as part of a single decision-making process. This is to ensure speed and fairness, not just for applicants but also for the communities involved in and impacted by such schemes. In this particular case, the need to have certainty on the HSC is especially important given the inherent and considerable risks involved and it would be wholly unsatisfactory to determine the application in the absence of any relevant information on the HSC issue. The Council endorses ECDC's response to ExQ2 Q2.1.2 in this regard.

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<sup>24</sup> REP5-073 at <https://infrastructure.planninginspectorate.gov.uk/wp-content/ipc/uploads/projects/EN010106/EN010106-004806-East%20Cambridgeshire%20District%20Council%20-%20Comments%20on%20Applicant's%20revised%20draft%20DCO.pdf>

<sup>25</sup> pp 8-9, Sect. 8.61 re HSC issues in REP4-035, from REP5-101 at <https://infrastructure.planninginspectorate.gov.uk/wp-content/ipc/uploads/projects/EN010106/EN010106-004815-West%20Suffolk%20Council%20-%20Comments%20on%20any%20Additional%20Submissions%20accepted%20at%20D4.pdf>

## **Provisional assignment of BESS cell chemicals by Note 5 COMAH Regs 2015**

27. Beyond the question of Dangerous/Hazardous Substances “[generated in loss of control of the processes](#)” there remains the question of whether Dangerous/Hazardous Substances should be considered under Parts 1 or 2 of the Schedules to both Regulations. In Parts 1 or 2, use of listed substances (or substances provisionally assigned to a Part 1 hazard category) above the prescribed Qualifying Quantities define the establishment as a COMAH establishment, even without considering “[loss of control of the processes](#)”. In my REP5-093 (Paras. 33 and 34) I draw attention to the provisions in both COMAH Regs 2015 in Part 3 Note 5 of the Schedule and the parallel provisions in Part 4 Note 6 of the Schedule to the P(HS)Regs 2015:

[5. In the case of dangerous substances which are not covered by the CLP Regulation, including waste, but which nevertheless are present, or are likely to be present, in an establishment and which possess or are likely to possess, under the conditions found at the establishment, equivalent properties in terms of major accident potential, these must be provisionally assigned to the most analogous category or named dangerous substance falling within the scope of these Regulations.](#)

28. Hence the first question to which the ExA must have regard is: do the functional chemicals in the BESS cells have major accident potential? Given the evidence from around the world of major BESS accidents involving major fires and explosions, loss of life, permanent injury, hazards to human health from toxic emissions both gaseous and particulate, and hazards to the aquatic environment from contaminated sprinkler water runoff, one can only answer Yes to this question.

29. Then the Regulations require “[provisional assignment](#)” to the “[most analogous category ... falling within the scope of these Regulations](#)”. Because COMAH notification is a duty upon the Applicant by R.6 COMAH Regs 2015, and the designated authority is the COMAH CA, it is surely a duty on the Applicant to understand enough of the proposed technology to propose what is “[the most analogous category](#)” to which the functional chemicals should be “[provisionally assigned](#)” under Note 5, and to have this agreed by the COMAH CA.

30. In my submissions hitherto I have not sought to do this simply because it is a duty on the Applicant, requiring agreement with the COMAH CA.

31. To assist the ExA in considering what might be the “most analogous category” of Dangerous Substance within the Schedule, I point out the chemical nature of the “thermal runaway” process which gives rise to the major accident potential of Li-ion BESS. In thermal runaway, as explained in many places, including the major forensic accident analysis of the Arizona explosion in 2019<sup>26</sup>, there is no requirement for oxygen. Above the thermal runaway threshold temperature, the chemicals in the cells have become unstable, and break down internally because the chemical mixture is “self-reactive”. In other words, it has the potential to react internally

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<sup>26</sup> See Annex EF11, REP2-082I

requiring no external oxygen for emissions of flammables, or for a fire to arise spontaneously. Professor Christensen's submissions (via SNTSAG) and public lectures also make this clear.

32. Therefore, from the perspective of the chemical nature of thermal runaway in Li-ion BESS, the “[most analogous category](#)[ies]” of Dangerous Substances for the purposes of Schedule 1 Part 3 Note 5 of the COMAH Regs 2015 are arguably the Part 1 categories of P6a or P6b Self-Reactive Mixtures. Li-ion BESS cells (in high States of Charge (SoC)) contain what is in principle a self-reactive mixture. In thermal runaway that self-reactive nature proceeds to completion of the chemical reaction, without external electric current. Such a “provisional assignment” is therefore reasonable and justified, from consideration of the fundamental chemistry of what is involved in “thermal runaway”.

33. Qualifying Quantities for P6a and P6b Self-Reactive Mixtures are 10 tonnes or 50 tonnes respectively, for “lower-tier” COMAH. QQs for “higher-tier” are 50 and 200 tonnes respectively. The total inventory of functional chemicals in the Sunnica BESS (15,000 tonnes) is so far beyond either QQ that there would be no doubt that the Sunnica BESS would be “higher-tier” COMAH establishments on this “[provisional assignment](#)”. The precise type of Self-Reactive Mixture (Types A through F are defined in the CLP Regulation) is immaterial to this conclusion.

34. Confirming the “provisional assignment” of P6a or P6b Self-Reactives by actual tests could be difficult because the prescribed tests in the UN MTC assume availability of small quantities which may not be available for BESS cells. However the prescribed tests for P1a or P1b Explosives *are* practical to perform on Li-ion BESS cells. I have previously noted in my Annex EF16<sup>27</sup> that highly-charged Li-ion cells in failure (whether by overheating, overcharging, or by mechanical damage) demonstrate behaviour consistent with the qualitative description of a Division 1.3 or a Division 1.4 Explosive Article<sup>28</sup>. Explosive Articles are explicitly included as P1a or P1b Explosives<sup>29</sup> in Part1 Schedule 1 COMAH Regs 2015. Should representative BESS cells be confirmed as either P1a or P1b Explosives by actual tests, there would be no remaining doubt as to the applicability of the COMAH Regs 2015.

35. The QQs for these explicitly-included Physical Hazards are in fact the same as for P6a and P6b Self-Reactive Mixtures, 10 and 50 tonnes for P1a Explosives (lower and higher-tier), and 50 and 200 tonnes for P1b Explosives.

36. This is rational and reasonable having regard to the likely Physical Hazard presented in accidents, by Self-reactive Mixtures, or by Explosives. Because the QQs for P6a Self-Reactives are identical to those for P1a Explosives, and those of P6b Self-Reactives are identical to those for P1b Explosives, there is no regulatory

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<sup>27</sup> REP2-129e

<sup>28</sup> As defined by prescribed tests set out in the UN MTC, now annexed as Annex EF46

<sup>29</sup> Division 1.3 Explosives are P1a Explosives in Part 1 of the Schedule; Division 1.4 Explosives are P1b Explosives.

consequence whether a “provisional assignment” as a Self-Reactive Mixture, or as an Explosive Article, is made to satisfy the Note 5 requirements.

37. In the case of the Sunnica BESS, distinguishing between P6a and P6b Self-Reactives, or between P1a and P1b Explosives (i.e. between Division 1.3 and Division 1.4 Explosives), is immaterial. The BESS would comprise an “upper-tier” COMAH establishment in all cases as the tonnage of cells (around 15,000 tonnes) would be so far in excess of the largest QQ for “upper-tier COMAH” (200 tonnes for P6b or P2b) that the BESS would be clearly “upper tier” COMAH.

38. No detailed design is needed to come to this conclusion, which is determined by tonnage of cells, and a rational assignment of a hazard category under Note 5. Whilst the behaviour of NMC and LFP cells in failure is different, in both cases the major accident potential must be recognised, and the provisional assignment required by Note 5 must be made. The Applicant has stated that the BESS technology will be Li-ion, and the electrochemical type will be NMC or LFP. Major accidents are known from both types. Whether they are considered as P6a or P6b Self-Reactives, or P1a or P2b Explosives, or whether NMC or LFP cells are chosen, makes no difference to whether COMAH notification is required, given the unprecedented size of the Sunnica BESS.

39. If the “provisional assignments” are disputed, it is open to the Applicant to propose a different one. What cannot be avoided is the recognition of the major accident potential of BESS, and the requirements of Note 5 to make such a provisional assignment.

40. Provisional assignment as a P1a or P1b Explosive could be confirmed (or rejected) by carrying out tests on representative samples of the actual BESS cells proposed, in a high State of Charge (SoC) according to the UN MTC (which has legal force in the UK via the CLP Regulation). The critical test discriminating Division 1.3 from Division 1.4 behaviour is Test 6(c) of the UN MTC<sup>30</sup>.

41. Once the major accident potential is recognised, and the requirements of Note 5 taken into account, there is very little doubt that the Sunnica BESS would be a COMAH establishment.

42. For the identical reasons, there is very little doubt that the Sunnica BESS require HSC, from the identical provisions in Schedule 1 Part 4 Note 6 of the P(HS)Regs 2015.

43. Part 1 hazard categories refer to behaviour in normal operation. HSC and COMAH notification would be required on those grounds. My WR<sup>31</sup> largely considers the “loss of control” behaviour and the CQs defined in Schedule 1 Part 3 P(HS)Regs 2015, and concluded similarly that HSC was almost certainly a legal obligation on those grounds in addition.

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<sup>30</sup> Section 16.6, page 169, UN MTC, 7<sup>th</sup> edition. Annexed as Annex EF46.

<sup>31</sup> REP2-129

44. In conclusion there must be very little doubt that the proposed BESS require HSC and COMAH notification. This could only be avoided by showing that there was no major accident potential, no propensity to generate listed hazardous or dangerous substances in loss of control of the processes, or that quantities could not exceed the Qualifying Quantities. No such evidence has been advanced by the Applicant.

### **Deferment of HSC or COMAH notification**

45. The Applicant has clearly stated a wish for considerations of BESS fire safety to be dealt with by Requirements, and their discharge of the same “post-consent”. In the latest Deadline 5 submission in their response to Qu 2.1.2 they now clearly state a wish for HSC to be determined “post-consent” and moreover for “**authorisation under the COMAH Regulations**” to be dealt with “**at the relevant time**” which is stated to be “**following detailed design**”. Elsewhere<sup>32</sup> they have made explicitly clear that “**a detailed design has not yet been produced and this will not happen until any Development Consent Order is granted.**”

46. At ISH1 the Applicant declined to seek a S.12(2)(2B) Direction of “deemed” HSC and if required stated that it would seek it from the relevant HSAs under the procedures in P(HS)A1990 and P(HS)Regs 2015. In the present case, this would involve both EDCD and WSC. CCC and SCC would in the meantime be evaluating the BFSMP, involving all four local authorities continuing to consider BESS safety “post-consent”.

47. The application for HSC to HSAs would trigger a formal Notice to the COMAH CA, generating a safety appraisal by the COMAH CA after all. This would involve all four Local Authorities and the COMAH CA, comprising two independent regulatory agencies, acting *after* the grant of a DCO, as already pointed out at ISH1 and my PHS (REP2-082a). The administrative and regulatory chaos resulting would be unconscionable and a perversion of the purposes of the PA 2008 process.

48. To repeat points already made in my REP5-093, my PHS after ISH1 (REP2-082a) and elsewhere, whilst Policy in Sect. 4.12.1-2 NPS EN-1 does permit seeking HSC “post-consent” two conditions<sup>33</sup> are required:

- (i) the Applicant must make pre-application consultation with HSE;
- (ii) they must “include details in their DCO”.

49. As pointed out elsewhere, neither condition has been satisfied. The only pre-application consultation with HSE of which I am aware resulted in advice to consult the relevant HSA(s), which appears to have been disregarded. There are no “**details in their DCO**” and it is not clear whether my proposed declaratory clause<sup>34</sup> (however inadequate to satisfy the “details” requirement) has been agreed or not.

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<sup>32</sup> Applicants Applicant's Response to Dr Edmund Fordham Deadline 3A Submissions EN010106/APP/8.60 REP4-034, pages 16-20 discussed extensively in my REP5-093, Para. 12 (i), quoted Paragraph 2

<sup>33</sup> Footnote 94, NPS EN-1

<sup>34</sup> In my PHS after ISH1, REP-082a

50. Because there has been no effective pre-application consultation with HSE, it is not clear how this defect can be remedied at the present stage of the Examination. There are no “[details in their DCO](#)” regarding HSC or Requirements for seeking HSC “post-consent”. The Policy conditions have not been satisfied.

51. Regarding what the Applicant calls “[authorisation under the COMAH Regulations](#)”, I have repeatedly pointed out that deferment “post-consent” would be in direct conflict with Policy and probably unlawful.

52. The Applicant seems to be unaware of the very clear Policy requirements in Sect. 4.11.3-4 of NPS EN-1 for a safety appraisal by the COMAH CA at the consenting stage (see Para. 6 above) though elsewhere (see Paras. 56-60 in my REP5-093) they quote the relevant Policy sections directly.

53. There is no provision of which I am aware for the safety appraisal by the COMAH CA to be deferred “post-consent”. The duty of the ExA is clear: “[The IPC<sup>35</sup> should be satisfied that an assessment has been done where required and that the Competent Authority has assessed that it meets the safety objectives described above.](#)”

54. As in para. 67 and Summary para. 14. of my REP5-093, it is categorically impossible for the ExA to “be satisfied” unless the safety appraisal is received from the COMAH CA at the consenting stage. And for this of course a stable design would be required, which the Applicant has declined to produce.

55. To deal with COMAH notification “post-consent” is therefore procedurally improper and probably unlawful. It risks the highly likely determination by the COMAH CA that the Sunnica BESS indeed constitute a COMAH establishment, at a stage (“post-consent”) when it is then impossible for the Examination to have received the required safety appraisal. This would expose an improper process.

56. Moreover, the SoS would have failed in his legal duty under R.24(1)(a) to maintain a designated Policy that considers major accident prevention and mitigation. The process would violate the known legislative intentions of the P(HS)Regs 2015 to implement the land-use Planning provisions in Article 13(3) of Seveso requiring “[sufficient information on the risks ... when decisions are taken](#)”.

57. The only way that these improper or unlawful consequences can be avoided is if the BESS are not subject to COMAH at all. For all the many reasons rehearsed in my submissions, this is most unlikely.

58. It must be remembered that COMAH notification is an obligation upon the Applicant. It is for the Applicant to determine, in consultation with the COMAH CA, whether their proposed facilities require COMAH notification. In borderline cases a responsible Operator (or Applicant) should err on the side of caution. In the face of objections from an Interested Party who provides detailed and extensive

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<sup>35</sup> Infrastructure Planning Commission; now the ExA advising the SoS

submissions that the BESS are virtually certain to require COMAH notification, it behoves the Applicant to demonstrate convincingly that, on the contrary, it is most unlikely that the BESS are subject to COMAH notification. No such demonstration contrary to my submissions has been made.

59. Instead, the Applicant says: “without detailed design of the BESS, it is not known with certainty whether Hazardous Substances Consent or authorisation under the COMAH Regulations is required.”

60. For reasons given in multiple places, this is simply wrong. Moreover the Applicant is in default of its obligations under Policy in Sect. 4.11.3-4 NPS EN-1 to establish in advance whether or not COMAH notification is required, before bringing their Application to this Examination.

61. In conclusion, except in the wholly improbable situation that the BESS do not constitute a COMAH site (either by not involving scheduled Dangerous Substances at all, or by their presence only below the Qualifying Quantities), a safety appraisal is required from the COMAH CA at the consenting stage and there is no provision to defer it.

62. The ExA has no discretion to defer the safety appraisal required by Policy, and the SoS would be acting unlawfully if he agreed to, by R.24(1)(a) P(HS)Regs 2015.

## Conclusions

63. Policy in Sect 4.12.1 and footnote 94 of NPS EN-1 regarding deferred HSC requires (i) pre-application consultation with HSE, and (ii) inclusion of “**details in their DCO**”. The Application is wholly non-compliant with these Policy requirements. The claimed exemption (REP4-034) is legally wrong (REP5-093) (as endorsed by ECDC Para. 8 above) and HSE advice to consult with the relevant HSA on HSC has been ignored. The Policy conditions are not satisfied for seeking HSC “post-consent”.

64. Policy in Sect 4.11.4 requires the ExA to “**be satisfied that an assessment has been done where required and that the Competent Authority has assessed that it meets the safety objectives**”. It is categorically impossible for the ExA to “**be satisfied**” on this requirement unless the safety appraisal by the COMAH CA is received at the consenting stage. It is virtually certain that BESS on the scale proposed will require COMAH notification, for reasons set out above.

65. It is impossible for the SoS to discharge his duties under R.24(1)(a) P(HS)Regs 2015 unless the Policy in Sect. 4.11.4 NPS EN-1 is observed.

66. As observed by ECDC Para. 26 above, the only recourse for the Applicant would be to extend the Application to seek “deemed” HSC by a S.12(2)(2B) Direction within this Examination. However they have declined to do this, and have moreover declined to finalise a design enabling the report from the HSE which would also be required by S.12(3) P(HS)A 1990.

67. As detailed in my REP5-093, a “full consequence model” is required to appraise the issues of siting, safety distances, and protection of areas of particular natural sensitivity or interest, as required by Article 13(2) of Seveso (remaining in force via R.24 P(HS)Regs 2015 and a duty of the SoS by R.24(1)(b)).

68. Conditions for obtaining HSC “post-consent” have not been satisfied. There is no “full consequence model” to appraise the siting matters in Article 13(2) of Seveso. There are no provisions anywhere in Policy or law for the safety appraisal from the COMAH CA to be obtained “post-consent”. Policy is clear that the ExA must receive the safety appraisal from the COMAH CA as part of the consenting process. Absent such safety appraisal, the Application must be rejected.

(5,268 words)

EJF 30/01/23

List of Annexes referred to follows; Annexes uploaded separately

**List of Annexes referred to: –**

Post-Hearing submission: OFH2  
Dr Edmund Fordham  
( dated 16<sup>th</sup> December 2022 )

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

**New Annex added this submission (30 January 2023)**

EF46 – United Nations Manual of Tests and Criteria, 7<sup>th</sup> edition.