REPRESENTATION BY CREICH COMMUNITY COUNCIL

ON S36 APPLICATION FOR

ALLT AN TUIR RENEWABLE ENERGY PARK

ECU Reference ECU00005008

27/03/2025

Contacts:

CREICH COMMUNITY COUNCIL SECRETARY

secretary@creichcommunitycouncil.org.uk

PROFESSOR COLIN MACFARLANE

c.j.macfarlane@strath.ac.uk

Contents

Introduction

1) These comments are submitted by Creich Community Council in **opposition** to the proposal for Allt an Tuir Renewable Energy Park. The proposal is referenced as ECU00005008 and has been submitted by RSK Environment Limited.

2) The application is in 14 volumes plus the main report of the Environmental Impact Assessment[1]. When we reference the main submission, it is by volume number and chapter number – for example Vol1 Chpt5 – with more detailed reference as required.

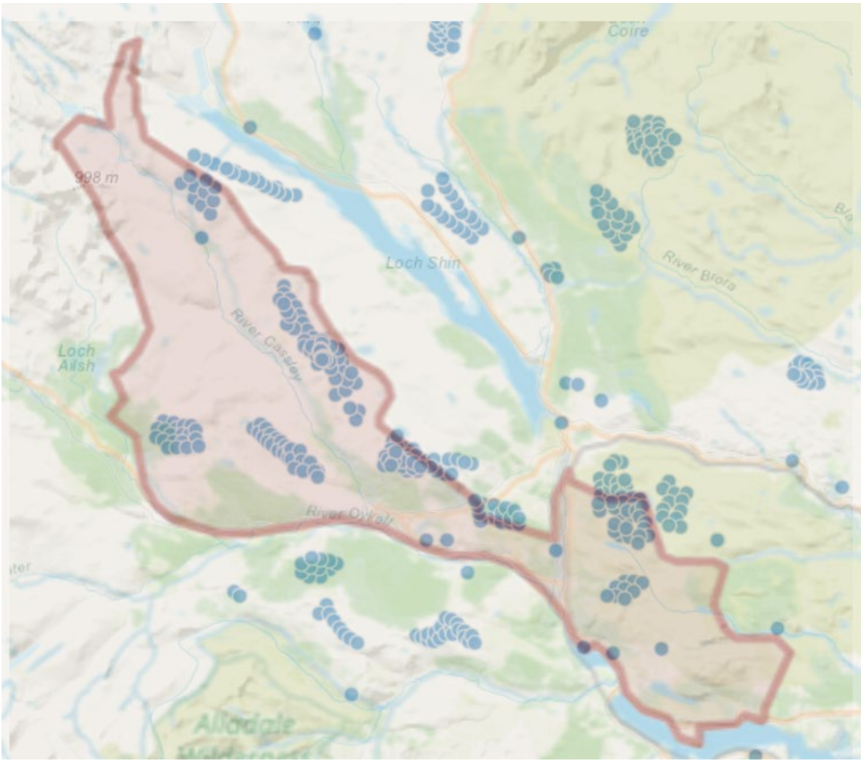
3) The proposed development is located a short distance northwest of Rosehall in the Kyle of Sutherland (KoS) and is centred on National Grid Reference NC 44631 04485.

4) It is to consist of 9 wind turbines of approximately 6.6 MW each and with tip heights up to 200m, a solar panel array between 15 to 18 Hectares at 18 Megawatts MW power capacity and a Battery Energy Storage System (BESS) of 12 MW power capacity.

Creich and Creich Community Council

5) Creich Community Council represent the people in arguably one of the most scenic and scenically diverse areas of the highlands, encompassing the north shore of the inner Dornoch Firth, the Kyle of Sutherland and the north bank of the Oykel to the watershed at Assynt in the West. There are straths, rivers, mountains, and the tidal waters of the Kyle. Views can be intimate or panoramic with wide skies and colours and textures that change with the seasons.

6) Views are, however, already blighted by multiple wind turbine installations as shown here with Creich boundaries outlined in red. Turbines installed or planned in 2024 are shown in blue. More are now planned. We have many wind farms in our area – but we are also ringed in the hills by turbines. This is a critical aspect of our objection.



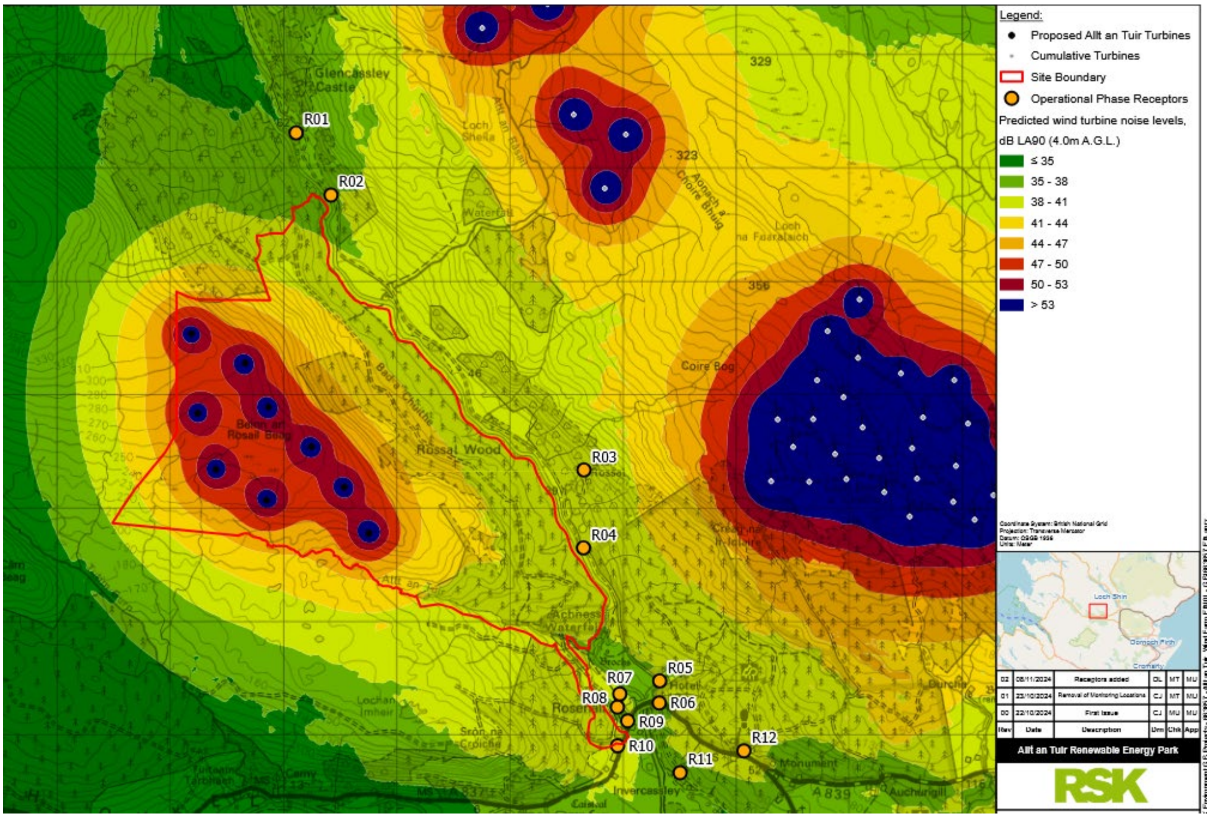
[1] Allt an Tuir Renewable Energy Park Environmental Impact Assessment Report – Volume 1

Basis of Objection

7) These comments have been reviewed and agreed by the Community Council as representing the views of the overwhelming majority of the Creich residents.

8) Throughout our comments we want to make clear that every aspect of objection is amplified by the cumulative impact we already endure.

9) Vol1-Chpt 11 and Technical Appendix 11.3 discuss turbines in the immediate vicinity of Rosehall. The purpose of this document is to consider cumulative impact on *noise*, but the number of sites and turbines listed shows how crowded the local area is. Vol 1-Chpt 11 Fig 11.6 shows this:



10) The constant addition of more and more developments and more and more turbines means there is a visual impact in every direction and few settlements and houses are not in proximity to or cannot see turbines or planned turbines,

11) Creich has some 6000 residents and about 200 wind turbines. Taken on a per capita basis, Edinburgh would have 16,300 turbines of which about 160 would be on Salisbury Crags and Arthur's seat on an equal area distribution. Of course, Edinburgh's wind turbines would be concentrated more than this – on the Braid Hills, Corstorphine Hill and, the heights of Holyrood Park. Wherever you looked in Edinburgh, wind turbines would intrude on the view.

12) We suspect this would be unacceptable to the douce citizens of the Capital. It is also unacceptable to the people we represent who are, almost without exception, opposed to the intrusion of the multiple wind farms, pylon lines and battery storage systems that litter and will further litter our parish.

13) An overarching basis of our objection is that this and other proposals are inequitable. We suffer continual and continuing loss, intrusion, social, commercial and cultural damage, but with no benefit.

In the main, however, we base our objections to this planning application on:

- the hazards and risks associated with the equipment and, in particular, the potential for failures of battery storage units, inverters and transformers to cause immediate and irretrievable long term harm to people, wildlife and the land.
- the cumulative visual and social effects of this proposal when taken with other existing and approved schemes
- The damage caused to our roads and lifestyle by the heavy goods traffic associated with construction.

Hazards and Risks

14) Every new proposal intrudes on another view or affects more residents or, and very importantly, adds risk of substantial damage to land and environment from installation and commissioning failures, failures in equipment, failure to design correctly, failure to maintain and failure in operation.

BESS Background

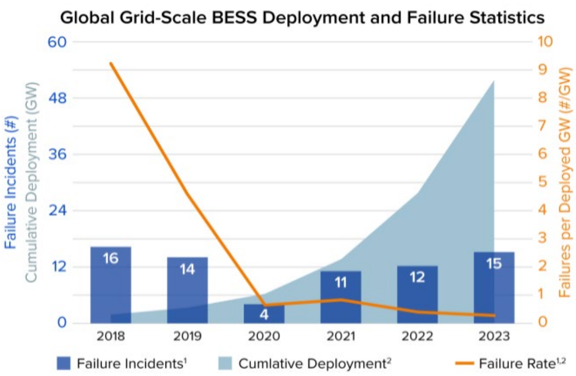
15) In a more general sense, there have been over 30 recorded serious thermal runaways in Battery Energy Storage Systems (BESS) worldwide. In 2020 a 20 MWh BESS in Liverpool took over 11 hours to contain and resulted in an explosion and release of toxic gasses.[1]

16) Incidents are gathered by the Electric Power Research Institute (EPRI)[2]. The collation of information was initiated in 2021 as part of a wider suite of BESS safety research after the concentration of lithium-ion BESS fires in South Korea and the Surprise, Arizona, incident in the US.

17) The database was created to inform energy storage industry stakeholders and the public on BESS failures and includes discussion of root causes (which are immediate) and underlying influencing factors.

18) The figure to the right (from EPRI) shows that, although the installed capacity of BESS has grown, the rate of incidents per GW installed remains relatively steady.

19) Thus, the industry may or may not have an ‘improving’ safety record, but the number of incidents in time is steady and the technology has very substantial potential for large scale catastrophic incidents and a steady rate of possible initiators.



Sources: (1) EPRI Failure Incident Database, (2) Wood Mackenzie. Data as of 12/31/23.

[1] Lithium-ion energy storage battery explosion incidents, Zalosh, Gandhi, Barowy Accessed 30/02/205 https://doi.org/10.1016/j.jlp.2021.104560
[2] EPRI BESS Failure Incident Database. Accessed 30/01/2025. https://storagewiki.epri.com/index.php/BESS_Failure_Incident_Database

Hazards of Batteries

20) No competent engineer would suggest that a large-scale BESS does not present complex potential initiators of major hazards that may have low probability but have large consequences to life, the environment and to population health. The only engineering argument, we suggest, would be about whether the hazards are adequately controlled and whether thresholds of acceptable risk are exceeded.

21) An argument on the planning side would be whether the applicants have displayed in their application sufficient understanding of the risks involved in their project and shown the engineering competence to deal with them.

22) Hazards for Li-ion batteries are not the same for one cell as they are for thousands of cells. There are reviews of the range of hazards in papers by Vazzana et al and Jevarajan et al[1]. This and other publications should be referred to for detail and we only offer a summary here.

23) The impacts of failure vary with the size and volume of the battery, since the tolerance of a single cell to a set of off nominal conditions does not translate to a tolerance of the larger battery system to the same conditions.

24) Li-ion batteries are prone to overheating, swelling, electrolyte leakage, venting, fires, toxic and flammable smoke, and explosions. There is a summary of the process in Chen at al.[2]

25) The cells, if Li-ion, will degrade over time and repeated charge/discharge cycles.

26) In the worst case there would be a deflagration, a consequent explosion and an out-of-control thermal runaway.

27) The primary failures are likely to lead to a fast fire with associated pressure in the flame front – a deflagration.

28) However, the gases produced as a result of a fire, smoke, and/or thermal runaway can accumulate to a combustible level in the installation location and cause an explosion (detonation). They are also toxic. Chen et all [11] discuss their composition.

29) In general, the off-nominal conditions that can cause the occurrence of catastrophic events with Li-ion batteries can be categorized into electrical, mechanical, and environmental types.

30) The most common electrical hazards are over-charge/discharge, and external or internal short circuits.

31) Less common, although very relevant here, are the effects of sustained low temperature. If cells operate at low temperature their performance drops and while this may be commercially undesirable it is not all that happens.

32) As a cell is operated at low temperatures unobservable changes take place within the cell materials. These are not reversed when temperature rises again, and they are now defects in the cell and make the cell more likely to fail – usually with an internal short circuit

33) The performance of all Li-ion components at low temperatures is interdependent and interconnected resulting in a significant decrease of the capacity and faster degradation upon continuous cycling. Thus, operation at low temperature increases the inherent hazards of battery cells.

---

[1] Risk Management in Energy Storage using Lithium-Ion Batteries: Emerging Risks Associated with Bess Systems Vazzanaa et al. Chemical Engineering Transactions vol. 111, 2024
Battery Hazards for Large Energy Storage Systems. Jevarajan et al, ACS Energy Letters, 7, 2022

[2] Lower explosion limit of the vented gases from Li-ion batteries thermal runaway in high temperature condition. Chen e al., accessed 30/1/2025; Journal of Loss Prevention in the Process Industries https://doi.org/10.1016/j.jlp.2019.103992

34) Further, however, there is evidence that at very low temperatures (as experienced in central Sutherland) lithium cells experience counter-intuitive behaviour. The table below (from [1]) shows that cycling of cells at minus 10 Celsius produces faster times to thermal runaway (TR). This should be understood by those putting forward battery systems in northern Scotland.

Table 2
The summary of key results for cells at different cycling conditions.

Case	Fresh cell	25 °C/0.5 C	25 °C/1 C	0 °C/0.5 C	0 °C/1 C	-10 °C/0.5 C	-10 °C/1 C
Time to crack of pressure valve (s)	286	274	246	226	206	189	161
Time to TR(s)	474	441	337	264	224	191	162
Surface T just before the cracking of pressure valve (°C)	131.35	125.96	128.57	122.43	131.67	123.36	117.58
Surface T just before TR (°C)	204.15	187.37	176.08	163.76	162.35	125.27	118.48
Mass loss (g)	38.75	36.15	28.90	26.99	21.37	20.89	19.70
Maximum flame T (°C)	803.64	738.35	662.12	638.09	582.00	434.26	570.66
Maximum surface T (°C)	738.39	734.79	732.68	696.72	631.89	729.10	708.61
Maximum T-rate (°C/s)	143.39	115.07	94.25	67.28	48.73	123.48	112.59

Transformers as Initiators

35) It is a fact that transformers explode and cause fire despite their protective systems.

36) The processes involved happen in around 200 to 400 milliseconds, for which standard protections are not designed to react.

37) Typically, for some reason there will be an internal short-circuit in the transformer. The short-circuit reaches 1,200 degrees Celsius and the oil, in contact with this temperature, vaporizes and creates explosive gases. Within milliseconds, a pressure wave is traveling at the speeds above 1,000 m/sec. The pressure wave propagates internally, and pressure may build inside the casing to greater than 10 atmospheres and the transformer ruptures.

38) The explosive gases generated during the short-circuit will be in contact with oxygen and the oil contained in the transformer, which leads to an explosion and associated fire. This is, in essence a Boiling Liquid Expanding Vapour explosion or BLEVE with greater energy flux than a jet or pool fire. A typical 25 MVA transformer may hold 8 tonnes of mineral oil with a flash point around 160 degrees Celsius.

39) In one study[2,] peak overpressure caused severe damage within 20 m of the explosion centre with a 100% probability of the thermal radiation from a BLEVE causing fatalities to a distance of 140 m. A majority of the fragments would land within a range of ~100 metres.

40) Even a 'simple' fire will generate temperatures capable of 'flashing off' other oils at distances of 10/15 metres depending on wind speed.

41) Clearly leaked burning oil extends the influence of a transformer oil fire.

42) At Allt an Tuir we do not know the number, size and rating of the transformer units and, no doubt, claims will be made about the safety of the selected units.

43) What we do know, however, is what the costs of incidents in transformers rated 25 kVA and above has been in an interval from 1997 to 2001[3]. The tables show the results:

[1] Kong D et al; Effect of low temperature on thermal runaway and fire behaviours of 18650 lithium-ion battery: A comprehensive experimental study. Process Safety and Environmental Protection 174 (2023) 448–459
[2] Fire and Explosion Risks and Consequences in Electrical Substations - A Transformer Case Study
Mohanad El-Harbawi ASME Open Journal of Engineering 2022, Vol. 1 / 014501-1
[3] Analysis of Transformer Failures. William H. Bartley P.E. ; The Hartford Steam Boiler Inspection & Insurance Co. 2003

Table 1 – Number and Amounts of Losses by Year

Table 1	Total # of Losses	Total Loss	Total Property Damage	Total Business Interruption
1997	19	$ 40,779,507	$ 25,036,673	$ 15,742,834
1998	25	$ 24,932,235	$ 24,897,114	$ 35,121
1999	15	$ 37,391,591	$ 36,994,202	$ 397,389
2000	20	$ 150,181,779	$ 56,858,084	$ 93,323,695
2001	15	$ 33,343,700	$ 19,453,016	$ 13,890,684
Grand Total	94	$ 286,628,811	$ 163,239,089	$ 123,389,722

** Total losses in 2000 includes one claim with a business interruption portion of over $86 million US*

Table 1A – Number and Amounts of Losses by MVA and Year

Table 1 A	Total # of Losses	Losses w/data	Total MVA reported	Total PD (with size data)	Cost /MVA
1997	19	9	2567	$20,456,741	$7969
1998	25	25	5685	$24,897,114	$4379
1999	15	13	2433	$36,415,806	$14967
2000	20	19	4386	$56,354,689	$12849
2001	15	12	2128	$16,487,058	$7748
Total	94	78	17,199	$15,4611,408	

44) In another study, causes were split into internal (water content in the oil, insulation failure, short circuits between windings, short circuits between windings and their tanks, and failures of bushing connections)[1]. External causes were lightning strikes, switching errors and short circuits on transmission lines. Internal to external causes were 40/10.

45) The rate of transformer explosion as initiator rate for BESS incidents is not trivial. On average it is 3/1000 per year per unit. This does not account for common mode failure in linked groups of transformers.

46) The point here is that BESS and associated power conversion/transmission systems could be treated as major hazard sites on the basis of transformers alone.

Thermal Incidents in Battery Storage

47) Thermal runaway (TR) is a release of the electrochemical energy in a Li-ion battery cell as heat.

48) There are two sources of heat during a TR - the electrochemical energy in a battery cell being released and the combustion of the off-gases, vapours and fumes etc. from the decomposition of the contents of the battery cell. The energy released as heat will typically be a factor of 20 on the rated electrical energy storage capacity of the BESS.

49) TR will continue in a Li-ion battery cell until the mass or reactive materials is depleted. Heat propagating from cell to cell explains the name as it is self fuelled. Once started, a TR can only be contained, not extinguished or put out, until the energy in the cells is used.

50) There are differences between this energy release and a conventional fire such that conventional fire suppression systems will work. Conventional systems operate by cooling and removing oxygen. TR does not require oxygen and can only be cooled using very large and continuous drenching with water.

51) Provision of suitable amounts of water within a short reaction window is an issue and, given the toxic nature of some fire products from a Li-ion fire, the fire water then becomes a problem in itself.

[1] Analysis of Major Failures of Power Transformers. Tenbohlen, Hanif, Martin; on behalf of Cigre

52) Venting of flammable release products may lead to flash vapour fires when safety valves open. Failure to vent, however, in a process to starve a fire of oxygen will build up pressure and temperature inside the container and lead to high energy explosive ignition of flammable gases which may be considerably more damaging in terms of propagation that a vented fire.

53) Fire fighting for a battery fire comes down to the liberal use of water. If, at the same time however, there is a burning oil 'pool' fire which should be smothered and not drenched with water, the situation becomes more complex. Again, separation of hazard sources is important.

54) The only way to contain a TR once started, is to cool the surrounding battery cells to prevent propagation and let the cells in TR burn out. The best medium for this, according to National Fire Chiefs Council (NFCC) guidance is water – hundreds of tonnes of water.

55) We reference the three BESS TRs that have happened worldwide in 2025. Moss Landing in California was 'extinguished in 2 days but re-ignited 2 days later and battery delinking or isolation was only completed more than 3 weeks after first ignition. At the time of this submission, the site is still not free from any risk of re-ignition.

56) There were two in the UK, one at Thurrock in Essex on 19th and 20th February 2025 and one at Rothienorman in Aberdeenshire on 21st February 2025.

57) The Essex County Fire and Rescue Service (ECFRS) took ten minutes to respond to the fire and took 48 hours to contain and control the site.

58) The Fire Commander on the ground at Thurrock stated, "The response was supported by the site's safety measures, including a reliable local fire water supply and appropriate spacing between battery units, which helped limit the spread of the fire."

Gases and Vapours From Battery Fires

59) At a minimum, the following can be released by a Li-ion battery fire:

Hydrogen (H_2)	Gas, flammable
Oxygen (O_2)	Gas, that promotes and intensifies combustion
Carbon Monoxide (CO)	Gas, chemical asphyxiant and flammable
Carbon Dioxide (CO_2)	Gas, simple asphyxiant
Methane (CH_4)	Gas, simple asphyxiant, flammable
Ethylene(C_2H_4)	Gas, flammable
Hydrogen Fluoride(HF)	Acutely toxic vapour - fatal if swallowed, in contact with skin or if inhaled. Causes severe skin burns and eye damage
Hydrofluoric Acid(HF)	Acutely toxic liquid and fumes
Hydrogen Cyanide(HCN)	Gas, chemical asphyxiant, flammable
Phosphorus Pentafluoride(PF_5)	Toxic and corrosive vapour
Phosphoryl Fluoride(POF_3)	Vapour that causes severe skin burns and eye damage - Fatal if inhaled
Nitrogen Oxide(NO)	Intensifies fire; oxidizer. Toxic, corrosive fatal if inhaled
Hydrogen Chloride(HCl)	Vapour that causes severe skin burns and eye damage - Fatal if inhaled

60) Hydrofluoric Acid (HF) is considered in both anhydrous and Hydrofluoric Acid form as the major contaminants from a TR. HF exposure poses a risk to health and life at 30ppm, and exposure for 30 minutes will result in death.

61) HF has been measured in smoke from TRs at up to 600ppm. HF is very reactive in the environment and quickly forms salts. When HF is released into the atmosphere, it will react and dissociate on contact with soils, water, structures and all living matter. Plants and some

wildlife are susceptible to HF exposure. Very low HF vapour concentrations 0.1 to 0.5ppm can injure or kill vegetation. Birds are very susceptible due to their high respiratory rates. Fish and other aquatic life can be affected with very low Fluoride concentrations in water.

62) There is no mention in the application of gas release which, given the failure to mention battery fires except in passing, is probably not surprising.

Objections Based on Design- Transformers, Control Spaces and Battery Storage

63) An arrangement of the sub-station is set out in Vol 2a-Chpt 2 and Figures 2.10, 2.11, 2.12. This includes the layout for a 12 MW/95.4MWhr Battery Storage System.

Spacing

64) The 'Good Practice Guidance for Applications under sections 36 and 37 of The Electricity Act 1989 (July 2022 edition)' states in paragraph 5.2.3: "A S36 application should also clearly set out the detail of the generation station(s) that consent is being sought for. For each generating component, details of the proposal should include:

"The scale of the development (for example dimensions of the wind turbines, solar panels, battery storage); components required for each generating station; and for battery storage, the approximate export capacity in megawatts (MW) and megawatt hours (MWh)."

65) No details are given in this application for the battery type although this is loosely covered by the term 'Lithium-ion battery technology solution'. Some detail is given of the power conversion units and there is a proposed layout of battery modules and inverter/transformers

66) A fire in a transformer or in a battery storage unit is a reasonably predictable event. Both transformer fires and battery fires are associated with explosions, deflagrations and continuing fires.

67) A primary safety variable in battery storage and electricity sub-station design is space.

68) A good safety design uses space as an effective fire control measure. Space allows energy dissipation so that projectile damage is somewhat mitigated. Space mitigates thermal effects, and space also allows access for firefighting to isolate dangerous units.

69) The design layout shown in Vol 2a-Chpt 2 Figure 2.10 shows ***no space used in design for safety reasons***. Power conversion units are placed metres away from battery units and battery units themselves are separated by 2.5 metre.

70) The National Fire Chiefs Council (NFCC) recommends a *minimum* separation distance of **6m** (National Fire Chiefs Council, 2022) between battery enclosures.

71) Transformer incidents will throw debris with high energy to at least 20 metres and possibly to 100 metres so that Tx separation from battery units is also critical

72) The applicants have not shown any basis for their separation choices. They should show by calculation with their information sources how they calculate the spacing.

73) Space may not come free, but it is very cheap to incorporate into a design at the earliest (planning) stages and the running costs are minimal.

[The applicants <u>must</u> show by calculation (with sources) and using probabilities of individual unit failure, multiple unit failure and consequential unit failure, the separation required to mitigate fires, deflagration pressures and explosions]

Emergency Access and Firefighting

74) Linked to the risk of battery and transformer incidents is the need to control the fires that follow.

75) One single access track is shown approaching the substation compound from SE quadrant. This is shown as a single-track road with passing places. A wind from the north round to the West could easily interdict access along this track and it does not seem designed to handle large number of fire-fighting vehicles.

76) There is no water supply at the Allt An Tuir site, let alone a "reliable local fire water supply" and there is only sparse mention of fire systems – at Vol 1: 2.8.47 "*The batteries would meet recognised fire safety standards and be fitted with automatic fire suppression technolog*y."

77) If water is used to contain a TR it will be contaminated with toxic chemicals. No detail on how that contaminated water will be contained or how it will be removed from the site is mentioned in any of the documentation. There is mention of bunding at the BESS substation compound but no detail on what any bund will be built from or how it will function – especially when 100's of tonnes of water are being played on the battery units.

Objections Based on Safety

78) Reasonably foreseeable incidents will produce emergency situations with very high potential for damage to requiring emergency response. The application does not mention these.

79) The Scottish Fire and Rescue Service (SFRS) will not reach the Allt an Tuir site within the 10 minutes that Essex Fire and Rescue Services achieved – the response time will probably be more than an hour. A battery fire and possible thermal runaway will be well established before there is any intervention. Access to the site if there are thermal releases and toxic smoke releases may not be possible along the single access road. There is no mention of liaison with emergency services, times to react and numbers and types of appliances.

80) Conventional fire suppression systems have a low probability of containing the situation – and even then, only for a short time. Only one sentence mentions fire suppressant systems without describing them.

81) There will be production of toxic and combustible gases, vapour and fumes and hence large amounts of contaminants reaching the environment. Released materials are extremely harmful to humans, wildlife in all forma and to the land. There is no recognition of this in the impact assessment.

82) Any response to a fire incident will require large volumes of water that can be applied for long periods of time. There is no discussion of water sourcing, storage or quantities. And yet, this is the only way to deal with a runaway battery fire.

83) Emergency evacuation of residents may be required. No emergency plan is discussed.

Traffic Construction and Access

84) There are associated hazards and costs from construction traffic on our small roads. Not only risks to people but also costs that will fall on the community from damage to the roads which will accumulate and often become evident after the wind farm traffic has gone. This is another aspect of cumulative effects that is often ignored.

85) Damage to roads is roughly proportional to the axle weight raised to the fourth power. Thus an 8.5 tonne axle load from an HGV will cause ~190 times more damage than the 2.3 tonne axle of alight van.

86) Damage caused can be rutting, cracking or initiation of local weakness that will develop into potholes. As is well known freeze/thaw in winter rapidly attacks these weaknesses.

87) It is noted in Vol1-Chpt 10 that the Applicant would enter into a Section 96 (wear and tear) Agreement or a suitable alternative for the local adopted roads / routes to be used by construction vehicles. This purports to inspect before and after use and to restore the roads to the condition at first inspection.

88) Our objection here is that experience shows that issues of damage after heavy loads traverse highland roads may not show up immediately after use. Like fatigue in steel, failure is accelerated but may not show immediately.

89) Local people will bear the burden of this damage through their council rates for many years to come.

Impact on Wildlife and People

Freshwater mussels

90) Critically endangered freshwater pearl mussels inhabit the Oykel and Cassley rivers, which are designated as Special Areas of Conservation (SAC) due to their populations of mussels and salmon. These mussels, facing global extinction, are highly vulnerable to silt, sediment, pollution, and minerals. The proposed development will take place near known mineral deposits, causing harmful leaching into the watercourses.

91) Probably the most alarming cause of damage would be run-off from the site after any fire and yet no details are given of any mitigation.

92) The potential impact of works on these freshwater mussels was in the scope of the EIA – but only for the construction phase. The potential impacts and their likelihood of occurrence should be assessed and quantified in a full probabilistic risk analysis for the installation, commissioning and operational phases. It may well be that the risk to this critically endangered species will be such as to cause rejection of the application (and similar applications).

Social and Commercial Damage

93) The area is heavily focussed on tourism with the landscape a primary reason for visiting. The steady accumulation of wind farms is already causing loss as the reputation for beauty and peace is taken away with every new development.

94) Some areas – almost always the very rural places - suffer most from the intrusion into their lives of construction noise and traffic. Considerable stress is being caused as is evidenced by the opposition to these schemes and the stress caused by feeling of helplessness in the face of government and industrial pressure is severe.

Conclusion

95) On behalf of the people of Creich in the Kyle of Sutherland we oppose the granting of planning permission for the Allt an Tuir Renewable Energy Park. Enough is enough.