Written Representation on: Decommissioning the Cottam Solar Park.

Introduction

It is easy to see how developers of solar farms, and especially large-scale solar farms, are seen as lucrative businesses for investors with deep pockets of funds. The global market for a few decades has been awash with opportunities, with Governments attempts in meeting net zero emissions by 2050.

Investors of large-scale solar projects have quickly learned to use the system of finding agreeable landowners, community engagement, local planning authority involvement and specialist consultants to overcome regulation and obligation routes to gain approvals to projects.

However, there appears to be an aspect that is not given a great deal of publicity or consideration and that is the financial risk and financial liability, in decommissioning a solar scheme.

The capital cost and risk of developing and implementing a solar project is largely in the hands of the project owner/investors in the expectation of resulting profits. The landowner is unlikely to be financially involved in the early stages prior to approval of the solar project and with little risk.

However, the capital cost of decommissioning has little to no return on investment, so project efficiency, regulatory compliance and achieving cost certainty, in decommissioning, is fundamental.

Regulations /Precedents/Conditions

Precedent Reference 1:

Town and Country Planning Act 1990 (Section 62A Applications) Development of a ground mounted solar farm with a generation capacity of up to 49.99MW, together with associated infrastructure and landscaping At Berden Hall Farm, Ginns Road, Berden.

The securing of decommissioning of the site **is capable of being (and is routinely) dealt with via planning conditions rather than planning obligations.**
Paragraph 27 of the UK Government's planning practice guidance for renewable and low carbon energy states that "**solar farms are normally temporary structures and planning conditions can be used to ensure that installations are removed when no longer in use and the land is restored to its previous use".**

It is, therefore, accepted practice to secure the **decommissioning of solar panels via condition.** There is no policy basis to require an applicant to enter planning obligation and/or decommissioning bonds with a local planning authority.

This has been acknowledged in the Planning Inspectorate's recent S62A decision to grant consent for another solar scheme in Uttlesford's administrative area1.

Further, **such arrangements are not required for either of the much larger nationally significant solar schemes consented via the development consent order regime (Little Crow, 150MW; or Cleve Hill, 350MW).**
Such an S106 for this development would not meet the statutory test of CIL regulation.

Decommissioning of these sites is secured via requirements (the DCO equivalent of conditions) and there is no obligation within the DCOs to secure a decommissioning bond. **It therefore cannot be said that requiring a decommissioning S106/bond for a solar site of fewer than 50MW is necessary or fairly and reasonably related in scale and kind to the development regulation 122 and would, therefore, be unlawful.**

The precedent clearly identifies there is no policy basis to require an applicant to enter planning obligation and/or decommissioning bonds with a local planning authority and decommissioning is secured via requirement, the DCO equivalent of condition.

Precedent Reference 2:
Planning Application No. 18/0945, Variation of condition 2 (operational length) and condition 3 (solar farm decommissioning) to extend from 30 to 40 years attached to appeal approval APP/H0928/W/16/3147861, Land south of Dallan Bank Wood, Newby
Meeting of Planning Committee, Thursday, 14th February 2019 9.30 am (Item Pla/156/02/19)
RESOLVED that be GRANTED subject to the following conditions.

1. The development hereby permitted shall be implemented by 25 January 2020.**Reason:** To comply with the provisions of the Town and Country Planning Act 1990 as amended by Section 51 of the Planning and Compulsory Purchase Act 2004

2. The permission hereby granted shall expire after 40 years following the date when electrical power is first exported ('first export date') from the development to the electricity grid network, excluding electricity exported during initial testing and commissioning. Written confirmation of the first export date shall be provided to the local planning authority no later than one calendar month after the event.
Reason: To avoid any ambiguity as to the duration of the approved development.

3. Within 6 months of the cessation of the export of electrical power from the site, or within a period of 40 years and 6 months following the first export date, whichever is the sooner, all infrastructure associated with the development shall be removed from the site and the site restored to its original condition in accordance with the submitted Construction, Decommissioning and Traffic Management Method Statement dated July 2015.
Reason: To ensure the site is restored once the development is complete and in the interests of the amenity of the area.

These precedents clearly identify there is no policy basis to require a solar farm owner to enter planning obligation and/or decommissioning bonds with a local planning authority and decommissioning is secured via requirement, the DCO equivalent of condition.

The solar farm owner is liable for decommissioning and may enter into an agreement with an investor/bank or insurance company or the incumbent landowner/s of the site through a bond.

However, should the solar farm fail, for any reason, resulting in liquidation of the solar farm owner, who then becomes financially liable for the decommissioning of the solar farm?

Financial Considerations

Two main elements of a project contribute to emissions: the manufacturing and the decommissioning, and if you are not looking at both, you are not looking at the whole impact of the project on the environment."

Decommissioning in the renewable energy sector will be a challenge. It is currently the tip of the iceberg compared to the more urgent problem the industry faces in the future as assets become stranded or obsolete.

There is a risk that some solar farm owner may not be able to fully fund the decommissioning programs for which they are responsible and may ask for the setting aside of decommissioning funds.

The decommissioning element may sit outside any 1st or 3rd party financing arrangement with decommissioning not seen as a major risk. It may be an increasing focus for all parties, and something not easily ignored in the future.

Sustainability/Environment

Ultimately, however, increasing disclosure and accountability amounts to nothing if it does not solve the problem in hand: the mountains of fibreglass, composite materials, solar panels, and batteries heading for landfill.

Much renewable energy infrastructure is resource-rich and includes rare earth elements and other valuable materials, such as steel, copper and glass. Recovering these and reintroducing them into the production cycle can present a commercial opportunity and reduce the reliance on raw minerals.

The EU predicted that, by 2030, the following would be recycled annually: 95% of 1.5 million tonnes of photovoltaics, up from just 5,000 tonnes in 2020; and 100% of 240,000 tonnes of lithium-ion batteries (40,000 tonnes last year).

Billions of pounds are pouring into the clean energy that is seen as crucial for the transition to net-zero emissions. But the financial sector is not taking sufficient account of what happens to such assets when they reach the end of their life. It may soon have to.

Renewable energy investment is growing fast, but the similarly rapid build-up of non-recyclable waste is an environmentally and **financially costly risk that cannot be ignored.**

Regulations will put more onus on banks and investors to consider waste management and decommissioning in renewables financing plans.

A small percentage of solar panels and batteries are now recycled but that figure is forecast to shoot up in the coming decades. Globally, 60 to 78 million tonnes of photovoltaic solar panels must be decommissioned by 2050, according to respective studies by Cambridge University and the International Renewable Energy Agency. Meanwhile, the boom in electric vehicles is raising concerns about what will be done with the thousands of tonnes of spent batteries.

Summary

The capital cost of decommissioning has little to no return on investment, so project efficiency, regulatory compliance and achieving cost certainty, decommissioning, is fundamental.

A significant effort across the UK in both Central and Local Governments, as well as industry is needed to ensure that processes are put in place to cover any long-term potential risk to the environment, public health and including financial risk.

Billions of pounds are pouring into the clean energy that is seen as crucial for the transition to net-zero emissions. But the financial sector is not taking sufficient account of what happens to such assets when they reach the end of their life. It may soon have to.

Renewable energy investment is growing fast, but the similarly rapid build-up of non-recyclable waste is an environmentally and financially costly risk that cannot be ignored.

With up to 78 million tonnes of panels forecast to be decommissioned by 2050, more sustainable solutions other than landfill will need to be developed.

Decommissioning of renewable energy assets has not been a focus of financing arrangements or corporate relationships, with the issue typically seen as someone else's problem.

For any significant renewable energy development linked to green bonds, it would be expected to have to be qualitative disclosures on how the end of life is managed.

The EU predicted that, by 2030, the following would be recycled annually: 95% of 1.5 million tonnes of photovoltaics, up from just 5,000 tonnes in 2020; and 100% of 240,000 tonnes of lithium-ion batteries (40,000 tonnes last year).

The precedents clearly identify there is no policy basis to require a solar farm owner to enter planning obligation and/or decommissioning bonds with a local planning authority and decommissioning is secured via requirement, the DCO equivalent of condition.

Will the ExA Confirm that if the Cottam Solar Project is approved it will be conditioned by the provision of an Agreement between the Landowner and the Applicant in respect of their joint legal responsibility to the approved decommissioning plans of the Scheme?

It is highly likely that the incumbent solar farm operator or incumbent landowner will dispose of its asset at some time or cease to exist.

This raises some complex and interesting questions. What happens if the operator ceases to exist by the time an environmental or safety issue occurs? Just how recoverable these costs will be, is a relative unknown.

Will the ExA ensure that the incumbent solar farm operator and/or incumbent landowner absolve any commitment they have in decommissioning through contract exchange, or for whatever reason, be unable to continue and enter liquidation? An up-to-date Agreement between all the parties involved in decommissioning should be maintained by the ExA.

Will the ExA ensure that financial due diligence is undertaken to ensure that there will be no financial burden, because of decommissioning the Scheme, on the public and **especially the local community. The financial risk must be dealt with by the incumbent landowner and the asset owner.**
Will the ExA also agree to identify the specific start date, and completion date of decommissioning the Scheme?

Will the ExA also identify the period in the Scheme from cessation of exporting of electrical power from the site to the start date of decommissioning?

Roy Clegg

<u>Written Representation on the Cumulative and Overlapping Impact on The Cottam Solar Project</u>

There have been numerous Representations regarding Cumulative and Overlapping impact on the NSIP's in Lincolnshire.

The response from the Planning Inspectorate has continuously responded by stating that the ExA's for these NSIP Schemes will be conducted separately, and consequently each Examining Authority will only have responsibility for examining their own individual case.

Additionally, they will need to remain separate and impartial from each other in interrogating the different issues between these individual Schemes and the particulars and merits of each case.

The passage of time in the planning procedure set down in timetables for the Schemes is now moving at a fast pace.

Will the Planning Inspectorate now establish an ExA to deal with the Cumulative and Overlapping impact on those Schemes in the Planning process, <u>OR</u> withdraw from dealing with Schemes individually?

The Planning Inspectorate has also stated that individual Examining Authorities will seek reports and evidence on the interrelationship with other NSIPs during the respective examinations as well as Statements of Common Ground between the applicant for the scheme, statutory consultees, and applicants for other nearby NSIP applications, in relation to overlapping issues that are relevant to the proposed Development Consent Order. Thus, the examinations will provide an opportunity for parties to submit views on any cumulative effects.

This does not rest easily when considering the Planning Inspectorates decision that Schemes will be conducted individually and separately. Will the Planning Inspectorate **reconfirm** That the ExA for each of the NSIP's Schemes within Lincolnshire and the existing planning process **will <u>only</u> have responsibility for examining their own case and will remain <u>separate and impartial from each other NSIP?</u>**

It is also noted that the applicant for Cottam has submitted a Cumulative Assessment Site Plan with its application, which is likely to form part of the Examining Authority's Initial Assessment of Principal Issues. **Will the ExA for the Cottam Scheme ensure that Applicants submission on Cumulative Assessment Site Plan is inadmissible in the assessment of the Scheme?**

Roy Clegg

The Impact of EMF on Marine Life, Flora and Fauna, Human Life and Biodiversity in the Cottam Solar Project.

1. Written Representation (WR) on Electromagnetic Fields (EMF)

The developer, Cottam Solar Project, has not made any consideration of the impact of Electro Magnetic Fields (EMF) on:

- Marine Life.
- Flora and Fauna.
- Human Life.
- Biodiversity Net Gain

Introduction

The Project will cover an area of 3,000 acres and comprise Works No.1A, 1B, 1C and 1D— a ground mounted solar photovoltaic generating station with a gross electrical output capacity of over 50 megawatts and 20Km of electrical cabling.
Cabling between transformers and the switchgear and from switchgear to the onsite substation will be a minimum of 0.4m deep and 0.4m wide or a trenchless technique will be used. Suspended cables will be suspended between 0.4m to 2.4m above ground level.

Watercourse Cable Crossing Locations, in which there will be 31 watercourse crossings, including the Rivers Trent and Till and their tributaries. The river crossings will be subject to temporary horizontal directional drilling pits.

These crossing will make provision for additional and possible future cabling from Gate Burton, West Burton, and Tillbridge and Solar Farm projects. Where set in horizontal directional drilling sections, the maximum bore of a single drilled cable tunnel is 1.0m

The mighty River Trent, whose 271km long journey begins near Stoke-on-Trent and ends in the sea at the Humber Estuary is special and is one of the UKs most important rivers.

Its catchment helps feed the nation, nourishes the communities that live on its banks and supports a huge diversity of natural habitats that need both our protection and help with recovery and reconnection.

Our rivers and freshwater habitats are polluted because of human activities including how we treat water and the ways in which we manage land. We are facing an ecological emergency with 15% of all UK wildlife under threat from extinction and our rivers are a critical factor in this.

Ambient levels of nonionizing electromagnetic fields (EMF) have risen sharply in the last five decades to become a ubiquitous, continuous, biologically active environmental pollutant, even in rural and remote areas.
Many species of flora and fauna, because of unique physiologies and habitats, are sensitive to exogenous EMF in ways that surpass human reactivity. This can lead to complex endogenous reactions that are highly variable, largely unseen, and a possible contributing factor in species extinctions, sometimes localized.

Numerous studies across all frequencies and taxa indicate that current low-level anthropogenic EMF can have myriad adverse and synergistic effects, including on orientation and migration, food finding, reproduction, mating, nest and den building, territorial maintenance and defence, and on vitality, longevity and survivorship itself.

Since the 1960s, scientists have discovered that variations in the resonances correspond to seasonal changes in solar activity, the Earth's magnetic environment, in atmospheric water aerosols and various other earth-bound phenomena, including increased weather activity due to climate change.

Many species rely on the Earth's natural fields for daily movement, seasonal migration, reproduction, food-finding, and territorial location, as well as diurnal and nocturnal activities. Most harmful radiation coming from outer space is blocked by the Earth's magnetosphere.

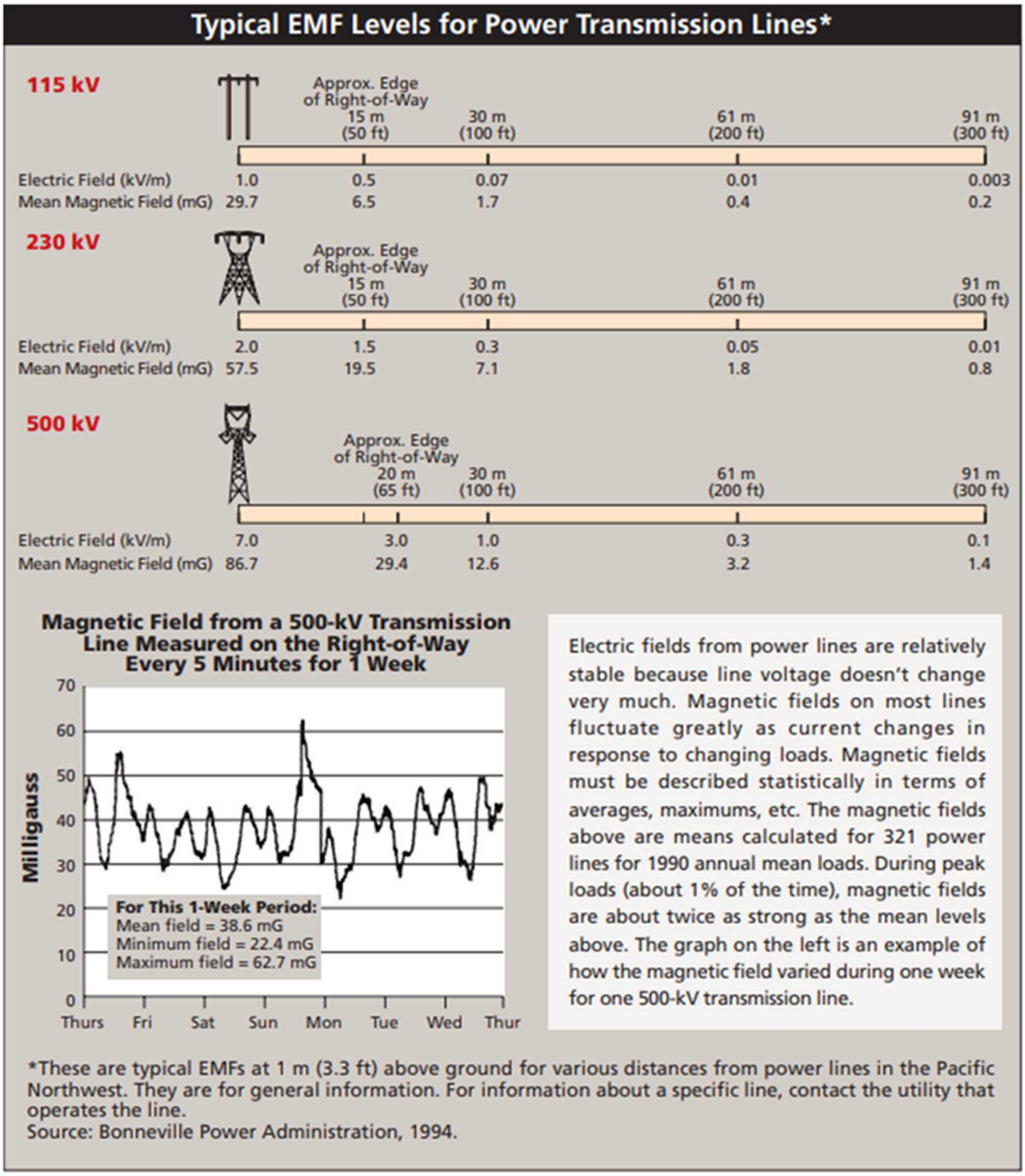
And although "natural," not all energy is alike. Man-made exposures contain propagation characteristics — such as alternating current, modulation, complex signalling characteristics (e.g., pulsed, digital, and phased array), unusual wave forms (e.g., square and sawtooth shapes), and at heightened power intensities at the Earth's surface that simply do not exist in nature.

These are all man-made artifacts.

Almost 4,971 mi (8,000 km) of high voltage direct current (HVDC) cables were present on the seabed worldwide, 70% of which were in European waters, and this is only expected to grow dramatically as new sources of renewable energy are built to replace fossil fuels globally.

The developer has identified a myriad of cable runs in the project resulting in connections carrying up to 400Kv to transport electricity from the solar panels to the National Grid at Cottam Power Station using transformers, inverters etc.

Conventional overhead power lines of this size, linked to the National Grid must have a clearance height of at least 7 metres.



The cable carrying power lines at ground level in the project of 400Kv will have a greater effect on Electromagnetic Fields than if they were 7 metres above ground level.

On this basis the magnetic fields will be significantly stronger, and the effect of EMF will be distanced further away by at least 7 metres.

For example, a magnetic field measuring 57.5 milligauss immediately beside a 230 kilovolt transmission line measures just 7.1 milligauss at 100 feet, and 1.8 milligauss at a distance of 200 feet, according to the World Health Organization in 2010.

The possible cumulative effect from future cabling of the Gate Burton, West Burton, and Tillbridge and Solar Farm projects will impact the consideration of EMF.

2. Written Representation (WR) on Marine Life.

The oceans, seas and rivers with their inhabitants are extremely important for the survival of us humans. The oceans regulate the climate of the planet and produce most of the oxygen. Millions of people depend on a healthy marine ecosystem for their livelihoods. What happens when, through our ill-considered and selfish intervention, the oceans can no longer maintain their vital functions for the entire planet?

There have been extensive EMF wildlife reviews published between 2003 and 2021 (10–22). Recently, Levitt et al. (23–25) extrapolated to broad ecosystem level effects for the first time, including extensive tables that match rising ambient levels to effects seen at vanishingly low intensities now common in the environment as chronic exposures.

The impact of EMF on Marine Life, especially when the power lines cross watercourses will be considered below:
Static- and ELF-EMF probably play important roles in the evolution of living organisms. They are clues used in many critical survival functions, such as foraging, migration, and reproduction. Living organisms can detect and respond immediately to low environmental levels of these fields.

There are two types of anthropogenic exposures created by cables: high voltage direct current (HVDC) that emits static magnetic fields, and three-phase alternating current (AC power transmission) that emit time-varying electromagnetic fields.

There is enough evidence to indicate we may be damaging non-human species at ecosystem and biosphere levels across all taxa from rising background levels of anthropogenic non-ionizing electromagnetic fields (EMF) from 0 Hz to 300 GHz.

Contrary to popular opinion, we know a great deal about how non-ionizing electromagnetic fields (EMF) affect non-human species because we have been using animal and plant models in research going back at least to the 1930's (1).

Effects have been seen in all taxa, in various frequencies, intensities, and exposure parameters. To non-human species, these are highly biologically active exposures, often functioning as stressors. This includes non-ionizing EMF in the static, extremely low frequency (ELF; 0–300 Hz) through the radiofrequency (RF) ranges used in all modern technology between 3 kHz and 300 GHz.

In addition, there have been extensive EMF wildlife reviews published between 2003 and 2021 (10–22). Recently, Levitt et al. (23–25) extrapolated to broad ecosystem level effects for the first time, including extensive tables that match rising ambient levels to effects seen at vanishingly low intensities now common in the environment as chronic exposures.

There are two prevalent misconceptions today about how low-level non-ionizing EMF couples with and affects non-human species:
(1) There is no need for environmental concern since exposures as currently regulated are too low to cause effects; and
(2) Existing exposure standards for humans are sufficient to cover non-human species too.
Neither supposition is accurate.

ICNIRP/IEEE/FCC have guideline components for both emissions (expressed as a value of radiant energy in space for far-field encounters at some distance from the generating source) and exposures [expressed as a specific absorption rate (SAR).

There are many things in the environment that can affect how non-ionizing electromagnetic energy is absorbed, including atmospheric moisture and/or particulate content, soil composition, natural and/or artificial obstacles (trees/buildings), and the presence of other waveforms which can augment and/or diminish exposures, among others.

For instance, many species can sense natural DC magnetic fields in diverse ways including migratory bird species (38, 39); numerous insect species including honey bees (40, 41); fish (42–47); mammals (48); bats (49); molluscs (50), and bacteria (51, 52). Some bird species may actually ‘see' the Earth's magnetic fields via complex magnetoception capabilities (53) located in their eye and beak areas

Many animals have evolved other special receptor organs. This unique ability allows electric fish to distinguish subtle differences in electrical properties within its immediate vicinity, including the electric fields of other fish, via electroreceptors capable of detecting a field of 5 nV/cm. While such evolutionary perceptual adaptations are extremely efficient and sensitive, they also render such species exceptionally vulnerable to unnatural anthropogenic fields.

The primary concern for aquatic species is from AC-ELF exposures from underwater cabling and other technologies, not RF which is of more concern for ground-based and aerial species (24).

The magneto mechanical model involves the naturally occurring iron-based crystal called magnetite (78–80) that has been found in most species studied, often in very different physiological areas.

Magnetite is highly reactive to external electromagnetic fields—a million times more strongly than any other known magnetic material. The abdominal areas of honey bees, for instance, contain magnetite with complex nerve endings feeding into it and can detect static magnetic field fluctuations as weak as 26 nT against background earth-strength magnetic fields that are much higher (79). They can also sense weak alternating fields at frequencies of 10 and 60 Hz (79). Bees are also affected by RFR.

Radiofrequency radiation may also affect natural “natal homing behaviour”—the astounding ability of some species like sea turtles (90); eels (91); and salmon (42–44), among others—to return to their original birth location to reproduce. The underlying mechanism, though imperfectly understood, involves such species being “imprinted” with the exact location of their birth, likely through geomagnetic configurations, then “remembering” it at reproduction time even when thousands of kilometres away.

There are at least 48 papers showing DNA damage after exposure to RFR at < 0.4 W/kg [see Supplement 1 in reference (24)]. Genotoxic effects are also seen in animal and plant species that are found exceptionally sensitive to both natural and man-made EMF [also see Supplement 2 in reference (24)]. Insects are of special concern as populations are being decimated globally (24).

Salmon had completely disappeared from the Trent River system by about the mid-1930s. where previously the River Trent and its tributaries historically sustained a native population of many thousands of salmon, with net fisheries reporting catches from the River Trent of around 3000 fish.

This has been achieved by the introduction of about 150,000 young salmon to the River Dove each year since 1998. This program has resulted in the first observation for 70 years of returning breeding adult fish in the River Trent.

The Trent Rivers Trust (TRT) is the lead organization for salmon in Nottinghamshire. Current Legislation affecting salmon includes the following: Atlantic Salmon are protected under the Salmon and Freshwater Fisheries Act 1975, supplemented by the Salmon Act 1986, and the species is listed under the EC Habitats Directive Annex 11a.

The Water Framework Directive and its work identifies amongst other species the European eel/elvers that is on the IUCN Red List, and on the OSPAR list of threatened and/or declining species and habitats and protected under the European Eel Regulation (European Commission) No 1100/2007 and the Eels (England and Wales) Regulations 2009.

3. Written Representation (WR) on Flora and Fauna.

There is enough evidence to indicate we may be damaging species at ecosystem and biosphere levels across all taxa from rising background levels of anthropogenic non-ionizing electromagnetic fields (EMF) from 0 Hz to 300 GHz leaving wildlife unprotected.

The literature is voluminous on EMF effects to nonhuman species, going back at least to the 1930s using modern methods of inquiry. We have, after all, been using animal, plant, and microbial models in experiments for decades.

There is no question that the huge diversity of pollinator species across the planet is suffering and that losses could be catastrophic with an estimated 90% of wild plants and 30% of world crops in jeopardy. There is a likelihood that rising EMF background levels play a role. Bees have been known for decades to have an astute sense of the Earth's DC magnetic fields, and rely on that perception for survival. For centuries beekeepers had noticed curious movements in beehives but Austrian ethologist Karl von Frisch finally interpreted that activity in the 1940s, winning the Nobel Prize in 1973 for what came to be known as the honey bee "waggle dance." Through complex circles and waggle patterns, bees communicate the location of food sources to other members of the hive, using the orientation of the sun and the Earth's magnetic fields as a gravity vector, "dancing" out a map for hive members to follow like nature's own imbedded GPS. Bees also detect the sun's direction through polarized light and on overcast days use the Earth's magnetic fields, likely through the presence of magnetite in their abdominal area, and employ complex associative learning and memory.

Flowers, on the other hand, which are electrically grounded through their root systems, tend to have a negative charge in their petals created by surrounding air that carries around 100 V for every meter above ground. The accumulating positive charge around the flower induces a negative charge in its petals which then interacts with the positive charge in bees.

Trees also give us an answer. As a good electrical conductor (iv), a tree reacts sensitively to electromagnetic interference fields. Trees under radiation stress lose their leaves, starting with the brown colouration at the leaf ends (v). On the one hand, this could be due to a disturbed metabolism in or on the cell (vi), as has already been shown in animal cells under exposure to microwave radiation (vii). On the other hand, the brown colouration and withering of the leaves could also indicate a disturbed water balance. Water is very sensitive to electromagnetic radiation because it itself has an electromagnetic momentum.

Many species of flora and fauna, because of unique physiologies and habitats, are sensitive to exogenous EMF in ways that surpass human reactivity. This can lead to complex endogenous reactions that are highly variable, largely unseen, and a possible contributing factor in species extinctions.

Taken as a whole, this indicates enough information to raise concerns about ambient exposures to nonionizing radiation at ecosystem levels.

Wildlife loss is often unseen and undocumented until tipping points are reached. It is time to recognize ambient EMF as a novel form of pollution and develop rules at regulatory agencies that designate air as 'habitat' so EMF can be regulated like other pollutants.

Many species rely on the Earth's natural fields for daily movement, seasonal migration, reproduction, food-finding, and territorial location, as well as diurnal and nocturnal activities. Most harmful radiation coming from outer space is blocked by the Earth's magnetosphere.

4. Written Representation (WR) on Human Life.

Section 17 of the EIA Scoping Report Document (page 186) only considers the effect of Human Life as follows:
17 Electromagnetic Fields
17.1 Introduction
17.1.1 This scoping report chapter considers the likelihood of significant electromagnetic field (EMF) effects created by the Scheme during its construction, operation and decommissioning phases, with particular focus on risk to human health.
17.1.2 EMFs arise from the generation, transmission, distribution, and use of electricity. EMFs occur around all electronic infrastructure. In this instance, the most significant EMF sources are the cable routes and associated infrastructure which connect the Scheme to the grid.
17.1.3 The chapter will describe and identify the potential level of effects arising because of the Scheme and covers:
• Underground cable routes:
• Substations including inverters, transformers, and switch gear; and
• Energy storage.
17.1.4 This chapter is supported by the following appendices:
• Appendix 17.1: High-Level Electro Magnetic Field Assessment
Appendix 17.1: deals with: Qualitative Dust Assessment and Construction Dust Management Plan Cottam 1 and not High-Level Electro Magnetic Field Assessment, as specified.

Appendix 17.1: High-Level Electro Magnetic Field Assessment does not exist in the developers' documents submitted. The effect of EMF on Human Life is therefore not supported by the developer in the project.

What does need to be recognised is that:
The cable carrying power lines at ground level in the project of 400Kv will have a greater effect on Electromagnetic Fields than if they were 7 metres above ground level.

The magnetic fields created on the development site will be significantly stronger, and the effect of EMF will be distanced further away by at least 7 metres.

For example, a magnetic field measuring 57.5 milligauss immediately beside a 230 kilovolt transmission line measures just 7.1 milligauss at 100 feet, and 1.8 milligauss at a distance of 200 feet, according to the World Health Organization in 2010.

5. Written Representation (WR) on BioDiversity.

Mice and rats have been the primary animal species used in research, but also rabbits, dogs, cats, chickens, pigs, non-human primates, amphibians, insects, nematodes, various microbes, yeast cells, plants, and others. Effects have been seen in all taxa, in various frequencies, intensities, and exposure parameters. To non-human species, these are highly biologically active exposures, often functioning as stressors. This includes non-ionizing EMF in the static, extremely low frequency (ELF; 0–300 Hz) through the radiofrequency (RF) ranges used in all modern technology between 3 kHz and 300 GHz.

There has been an unprecedented rate of biodiversity decline in recent decades according to the International Union for Conservation of Nature which maintains a "Red List of Threatened Species" that is considered the world's most comprehensive source on the global conservation status of animal, fungi and plant species — all critical indicators of planetary health.
IUCN's 2018 list showed that 26,000 species are threatened with extinction, which reflected more than 27% of all species assessed. This was greatly increased from their 2004report that found at least 15 species had already gone extinct between 1984 and 2004, and another 12 survived only in captivity.

Genetic effects and EMF effects on insects.

Despite classic assumptions that non-ionizing radiation cannot directly damage DNA, genotoxic effects have been seen in land-based, aerial, aquatic, and plant species at very low intensity RFR exposures far below ICNIRP/IEEE/FCC guidelines. There are at least 48 papers showing DNA damage after exposure to RFR at < 0.4 W/kg [see Supplement 1 in reference (24)].
Insects are of special concern as populations are being decimated globally (24).

Depending on insect type and exposure duration, Michaelson and Lin (1) back in 1987 noted sequential insect reactions to RFR (at high intensities): insects first tried to escape, followed by motor disturbance and coordination problems, including stiffening, immobility, rigidity, and eventually death.

Ants also react adversely to RFR (109–111). Cammaerts et al. (111) found that memory and association between food sites and visual/olfactory cues in ants (Myrmica sabuleti) was significantly inhibited, with memory eventually wiped out altogether, from exposures to GSM-900 MHz signal at 0.0795 μW/cm2.
Affected insect groups included niche specialist species, as well as common and generalist species, many of which are critically important for pollination, as well as seed, fruit, nut and honey production, and natural pest control, among others of immeasurable economic and ecological value.

Environmental EMF should be added to this list since many insects and other living species have sensitive receptors for EMF.
Since all food webs are uniquely tied together, there are negative cascading effects across all ecosystems.

Species sensitivity to EMFs.

Other species have vastly more complex electromagnetic sensing tools than humans, as well as unique physiologies that evolved to sense weak fields. Many species are highly sensitive to the

Earth's natural electromagnetic fields, as well as geographic and seasonal variations. In fact, it appears that most living things — including many species of mammals, birds, fish, and bacteria — are tuned to the Earth's electromagnetic background in ways once considered as "superpowers" but are now known to be physiological, even as mechanisms are still imperfectly understood.

For example, many animals have been observed sensing earthquakes long before human instruments detect them, including snakes and scorpions that seek shelter; cattle that stampede; birds that sing at the wrong times of day; and female cats that frantically move kittens.

This ability is likely due, in part, to numerous species reacting to changes in the Earth's magnetic field and electrostatic charges in the air detected through a naturally occurring mineral called magnetite found in many species.

Cattle exposed to various magnetic field patterns directly beneath or near power lines exhibit distinct patterns of alignment showing evidence for magnetic sensation in large mammals, as well as overt behavioural reactions to weak ELF-MF in vertebrates. implying cellular and molecular effects. Roe deer also consistently align their body axis in a general north–south direction and orient their heads northward when grazing or resting.

Also, bodies that are predominately parallel to the ground, which includes most four-legged mammals, rather than a perpendicular upright gait, conduct EMF in different ways than vertical species like humans, apes, and other primates. Species that hug the ground, like snakes, salamanders, and frogs, have unique exposures to ground currents, especially on rainy nights when water, as a conductive medium, can increase exposures. This may make some species more sensitive to artificial ground current caused by electric utility companies using the Earth as their neutral return to the substation.

Conclusions.

Effects from both natural and man-made EMF over a wide range of frequencies, intensities, wave forms, and signalling characteristics have been observed in all species of animals and plants investigated. The database is now voluminous with in vitro, in vivo, and field studies from which to extrapolate.

The majority of studies have found biological effects at both high and low-intensity man-made exposures, many with implications for wildlife health and viability. Ambient environmental levels are biologically active in all non-human species which can have unique physiological mechanisms that require natural geomagnetic information for their life's most important activities.

The EMFs from power lines and electrical devices have a much lower frequency than other types of EMR, such as microwaves, radio waves or gamma rays. However, a low frequency wave does not necessarily mean that it is low energy; a charging cable for a phone produces a low frequency, low energy electromagnetic field, while a high-tension power line can create a much higher energy electromagnetic field that is still low in frequency.

EMR associated with power lines is a type of low frequency non-ionizing radiation. Electric fields are produced by electric charges, and magnetic fields are produced by the flow of electrical current through wires or electrical devices. Because of this, low frequency EMR is found in close proximity to electrical sources such as power lines. As current moves through a power line, it creates a magnetic field called an electromagnetic field. The strength of the EMF is proportional to the amount of electrical current passing through the power line and decreases as you move farther away.

For instance, many species can sense natural DC magnetic fields in diverse ways including migratory bird species (38, 39); numerous insect species including honeybees (40, 41); fish (42–47); mammals (48); bats (49); molluscs (50), and bacteria (51, 52). Some bird species may actually ‘see' the Earth's magnetic fields via complex magnetoception capabilities (53) located in their eye and beak areas.

We have a long over-due obligation to consider potential consequences to other species – an obligation we have thus far not considered before species go extinct.

References

1. Michaelson SM, Lin JC. Biological Effects and Health Implications of Radiofrequency Radiation. New York and London: Plenum Press (1987). doi: 10.1007/978-1-4757-4614-3
4. Wiltschko R, Thalau P, Gehring D, Nießner C, Ritz T, Wiltschko W. Magnetoreception in birds: the effect of radio-frequency fields. J Royal Soc Interface. (2015) 12:20141103. doi: 10.1098/rsif.2014.1103
16. Balmori A. Electromagnetic radiation as an emerging driver factor for the decline of insects. Sci Total Environ. (2021) 767:144913. doi: 10.1016/j.scitotenv.2020.144913
23. Levitt BB, Lai HC, Manville AM II. Effects of non-ionizing electromagnetic fields on flora and fauna, part 1. Rising ambient EMF levels in the environment. Rev Environ Health. (2021) 37:81–122. doi: 10.1515/reveh-2021-0026
24. Levitt BB, Lai HC, Manville AM II. Effects of non-ionizing electromagnetic fields on flora and fauna, Part 2 impacts: how species interact with natural and man-made EMF. Rev Environ Health. (2021) 37:327–406. doi: 10.1515/reveh-2021-0050
25. Levitt BB, Lai HC, Manville AM II. Effects of non-ionizing electromagnetic fields on flora and fauna, Part 3. Exposure standards, public policy, laws, and future directions. Rev Environ Health. (2021). doi: 10.1515/reveh-2021-0083 [Epub ahead of print].
30. Barnes F, Freeman ER Jr. Some thoughts on the possible health effects of electric and magnetic fields and exposure guidelines. Front Public Health. (2022) 10:994758. doi: 10.3389/fpubh.2022.994758
31. Karipidis K, Brzozek C, Bhatt CR, Loughran SP, Wood A. What evidence exists on the impact of anthropogenic radiofrequency electromagnetic fields on animals and plants in the environment? A systematic map protocol. Environ Evid. (2021) 10:39. doi: 10.1186/s13750-021-00252-w
32. Thielens A, Bell D, Mortimore DB, Greco MK, Martens L, Joseph W. Exposure of insects to radio-frequency electromagnetic fields from 2 to 120s A, BSci Rep. (2018) 8:3924. doi: 10.1038/s41598-018-22271-3
33. Thielens A, Greco MK, Verloock L, Martens L, Joseph W. Radio-frequency electromagnetic field exposure of western honey bees. Sci Rep. (2020) 10:461. doi: 10.1038/s41598-019-56948-0
38. Moller A, Sagasser S, Wiltschko W, Schierwater B. Retinal cryptochrome in a migratory passerine bird: a possible transducer for the avian magnetic compass. Naturwissenschaften. (2004) 91:585–8. doi: 10.1007/s00114-004-0578-9
39. Heyers D, Manns M, Luksch H, Güntürkün O, Mouritsen H. A visual pathway links brain structures active during magnetic compass orientation in migratory birds. PLoS ONE. (2007) 2:9. doi: 10.1371/journal.pone.0000937
40. Fleischmann PN, Grob R Rn structures active during magnetic compass orientation in migratory b Anim Cogn. (2020) 23:1051–051 doi: 10.1007/s10071-020-01431-x
41. Collett TS, Barron J. Biological compasses and the coordinate frame of landmark memories in honeybees. Nature. (1994) 386:137–40. doi: 10.1038/368137a0
42. Putman NF, Lohmann KJ, Putman EM. QuinnTP, Klimley AP, Noakes DLG. Evidence for geomagnetic imprinting as a homing mechanism for Pacific salmon. Curr Biol. (2013) 23:312–6. doi: 10.1016/j.cub.2012.12.041
43. Putman NF, Scanlan MM, Billman EJ, Oas a homing mechanism for Paci, et al. An inherited magnetic map guides ocean navigation in juvenile Pacific salmon. Curr Biol. (2014) 24:446lrit doi: 10.1016/j.cub.2014.01.017
44. Putman NF, Jenkins ES, Michielsens CG, Noakes DL. Geomagnetic imprinting predicts spatio-temporal variation in homing migration of pink and sockeye salmon. J Royal Soc Interface. (2014) 11:20140542. doi: 10.1098/rsif.2014.0542
45. Putman NF, Meinke AM, Noakes DL. Rearing in a distorted magnetic field disrupts the 'map sense' of juvenile steelhead trout. Biol Lett. (2014) 10:20140169. doi: 10.1098/rsbl.2014.0169

46. Putman NF, Williams CR, Gallagher EP, Dittman AH. A sense of place: pink salmon use a magnetic map for orientation. J Exp Biol. (2020) 223:218735. doi: 10.1242/jeb.218735
47. Quinn TP, Merrill RT, Brannon EL. Magnetic field detection in Sockeye salmon. J Exper Zool. (2005) 217:137–42. doi: 10.1002/jez.1402170114
48. Malewski S, Begall S, Schleich CE, Antenucci CD, Burda H. Do subterranean mammals use the Earth's magnetic field as a heading indicator to dig straight tunnels? PeerJ. (2018) 6:e5819. doi: 10.7717/peerj.5819
49. Holland RA, Kirschvink JL, Doak TG, Wikelski M. Bats use magnetoreception to detect the earth's magnetic field. PLoS ONE. (2008) 3:e1676. doi: 10.1371/journal.pone.0001676
50. Ratner SC. Kinetic movements in magnetic fields of chitons with ferromagnetic structures. Behav Biol. (1976) 17:573. doi: 10.1016/S0091-6773(76)91045-2
51. Blakemore R. Magnetotactic bacteria. Science. (1975) 190:377. doi: 10.1126/science.170679
52. Blakemore RP, Frankel RB, Kalmijn A. South-seeking magnetotactic bacteria in the southern hemisphere. Science. (1980) 212:1269. doi: 10.1126/science.212.4500.1269
53. Yong E. Robins can literally see magnetic fields, but only if their visions is sharp. DiscoverMagazine.com, July 8 (2010). Available online at: https://www.discovermagazine.com/planet-earth/robins-can-literally-see-magnetic-fields-but-only-if-their-vision-is-sharp (accessed November 17, 2022).
54. Panagopoulos DJ, Johansson O, Carlo GL. Polarization: a key difference between man-made and natural electromagnetic fields, in regard to biological activity. Sci Rep. (2015) 5:14914. doi: 10.1038/srep14914
55. Kalmijn AJ. Electric and magnetic field detection in elasmobranch fishes. Science. (1982) 218:916. doi: 10.1126/science.7134985
56. Tenforde TS. Electroreception and magnetoreception in simple and complex organisms. Bioelectromagnetics. (1989) 10:215–21. doi: 10.1002/bem.2250100302
57. Tenforde TS Biological responses to static and time-varying magnetic fields. In: Lin JC, editor. Electromagnetic Interaction with Biological Systems. New York, NY: Plenum Press (1989). doi: 10.1007/978-1-4684-8059-7_5
66. Ahmad M, Galland P, Ritz T, Wiltschko R, Wiltschko W. Magnetic intensity affects cryptochrome-dependent responses in Arabidopsis thaliana. Planta. (2007) 225:615–24. doi: 10.1007/s00425-006-0383-0
74. Manger PR, Pettigrew JD. Ultrastructure, number, distribution and innervation of electroreceptors and mechanoreceptors in the bill skin of the platypus, Ornithorhynchus anatinus. Brain Behav Evol. (1996) 48:27ehav doi: 10.1159/000113185
75. von der Emde G. Active electrolocation of objects in weakly electric fish. J Exp Biol. (1999) 202:1205–15. doi: 10.1242/jeb.202.10.1205
76. Montgomery JC, Bodznick D. Signals and noise in the elasmobranch electrosensory system. J Exp Biol. (1999) 202:1349–349 doi: 10.1242/jeb.202.10.1349
77. Yong E. An Immense World, How Animal Senses Reveal the Hidden Realms Around Us. New York, NY: Random House (2022), p. 276–99.
78. Eder SHK, Cadiou H, Muhamad A, McNaughton PA, Kirschvink JL, Winklhofer M. Magnetic characterization of isolated candidate vertebrate magnetoreceptor cells. Proc Natl Acad Sci USA. (2012) 109:12022–7. doi: 10.1073/pnas.120565310
79. Kirschvink JL, Kuwajima T, Ueno S, Kirschvink SJ, Diaz-Ricci JC, Morales A, et al. Discrimination of low-frequency magnetic fields by honeybees: biophysics and experimental tests. In: Sensory Transduction, edited by DP Corey and S D Roper Society of General Physiologists, 45th Annual Symposium. New York, NY: Rockefeller University Press (1992), p. 225–40.
81. Gegear RJ, Casselman A, Waddell S, Reppert SM. Cryptochrome mediates light-dependent magnetosensitivity to Drosophila. Nature. (2008) 454:1014–8. doi: 10.1038/nature07183

82. Hiscock H, Mouritsen H, Manolopoulos DE, Hore PJ. Disruption of magnetic compass orientation in migratory birds by radiofrequency electromagnetic fields. Biophy J. (2017) 113:1475–84. doi: 10.1016/j.bpj.2017.07.031
83. Pakhomov A, Bojarinova J, Cherbunin R, Chetverikova R, Grigoryev PS, Kavokin K, et al. Very weak oscillating magnetic field disrupts the magnetic compass of songbird migrants. J Royal Soc Interface. (2017) 14:20170364. doi: 10.1098/rsif.2017.0364
84. Wiltschko W, Munro U, Beason RC, Ford H, Wiltschko R. A magnetic pulse leads to a temporary deflection in the orientation of migratory birds. Experientia. (1994) 50:697–700. doi: 10.1007/BF01952877
85. Wiltschko W, Wiltschko R. Magnetoreception in birds: two receptors for two different tasks. J Ornithol. (2007) 148:S61–76. doi: 10.1007/s10336-007-0233-2
86. Wiltschko R, Wiltschko W. Sensing magnetic directions in birds: radical pair processes involving cryptochrome. Biosensors. (2014) 4:221–43. doi: 10.3390/bios4030221
87. Wiltschko W, Freire R, Munro U, Ritz T., Rogers L, Thalau P, et al. The magnetic compass of domestic chickens, Gallus gallus. J Exp Biol. (2007) 210:2300–10. doi: 10.1242/jeb.004853
88. Wiltschko R, Wiltschko W. Magnetoreception in birds. J Royal Soc Interface. (2019) 16:20190295. doi: 10.1098/rsif.2019.0295
89. Wiltschko R, Stapput K, Thalau P, Wiltschko W. Directional orientation of birds by the magnetic field under different light conditions. J Royal Soc Interface. (2010) 7:S163–77. doi: 10.1098/rsif.2009.0367.focus
90. Brothers JR, Lohmann KJ. Evidence for geomagnetic imprinting and magnetic navigation in the natal homing of sea turtles. Curr Biol. (2015) 25:392lJR doi: 10.1016/j.cub.2014.12.035
91. Naisbett-Jones LC, Putman NF, Stephenson JF, Ladak S, Young KA. A magnetic map leads juvenile European eels to the gulf stream. Curr Biol. (2017) 27:1236–236 doi: 10.1016/j.cub.2017.03.015
94. Kirschvink JL, Gould JL. Biogenic magnetite as a basis for magnetic field sensitivity in animals. Biosystems. (1981) 13:181–201. doi: 10.1016/0303-2647(81)90060-5
95. Kirschvink JL. Birds, bees and magnetism: a new look at the old problem of magnetoreception. Trends Neurosc. (1982) 5:160–7. doi: 10.1016/0166-2236(82)90090-X
96. Yuan Q, Metterville D, Briscoe AD, Reppert SM. Insect cryptochromes: gene duplication and loss define diverse ways to construct insect circadian clocks. Mol Biol Evol. (2007) 24:948–55. doi: 10.1093/molbev/msm011
97. Kyriacou CP. Clocks, cryptochromes and Monarch migrations. J Biol. (2009) 8:55. doi: 10.1186/jbiol153
98. Jones DS, MacFadden BJ. Induced magnetization in the Monarch butterfly, Danaus Plexippus (Insecta, Lepidoptera). J Exp Biol. (1982) 96:1–9. doi: 10.1242/jeb.96.1.1
99. Guerra P, Gegear RJ, Reppert SM. A magnetic compass aids monarch butterfly migration. Nature Comm. (2014) 5:4164. doi: 10.1038/ncomms5164
109. Cammaerts MC, Rachidi Z, Bellens F, De Doncker P. Food collection and response to pheromones in an ant species exposed to electromagnetic radiation. Electromagn Biol Med. (2013) 32:315agn doi: 10.3109/15368378.2012.712877
110. Cammaerts MC, Vandenbosch GAE, Volski V. Effect of short-term GSM radiation at representative levels in society on a biological model: the ant Myrmica sabuleti. J Insect Behav. (2014) 27:514–26. doi: 10.1007/s10905-014-9446-4
111. Cammaerts MC, De Doncker P, Patris X, Bellens F, Rachidi Z, Cammaerts D. GSM-900 MHz radiation inhibits ants' association between food sites and encountered cues. Electromagn Biol Med. (2012) 31:151–65. doi: 10.3109/15368378.2011.624661
112. von Frisch K. The Dancing Bees, an Account of the Life and Senses of the Honey Bee. Wien, Vienna: Springer-Verlag (1954). doi: 10.1007/978-3-7091-4697-2
113. von Frisch K. The Dance Language and Orientation of Bees. Boston, MA: Belknap Press of Harvard University Press (1967)

114. Li Y, Sun C, Zhou H, Huang H, Chen Y, Duan X, et al. Extremely low-frequency electromagnetic field impairs the development of honeybee (Apis cerana). Animals. (2022) 12:2420. doi: 10.3390/ani12182420
115. Valkova T, Vacha M. How do honeybees use their magnetic compass? Can they see the north?
128. Gandhi OP. Polarization and frequency effects on whole animal absorption of RF energy. Proc IEEE. (1974) 62:1171–5. doi: 10.1109/PROC.1974.9581
129. Gandhi OP. Conditions of strongest electromagnetic power deposition in man and animals. In: IEEE Transaction on Microwave Theory and Techniques. (1975) 23:1021–29. doi: 10.1109/TMTT.1975.1128736

Further References

(i) Pall, Martin L (2018): 5G: Great risk for EU, U. and International Health! Compelling Evidence for Eight Distinct Types of Great Harm Caused by Electromagnetic Field (EMF) Exposures and the Mechanism that Causes Them, May 17, 2018
(ii) Becker, R.O. & Selden, G. (1985): The Body electric. New York, Morrow, 1985, Reprint 1987
(iii) König, H. L. (2012): Unsichtbare Umwelt, Der Mensch im Spielfeld elektromagnetischer Feldkräfte, 6. Auflage, 2012
(iv) Johnson, B. (2013): The Ascent of Sap in Tall Trees: a Possible Role for Electrical Forces. Water Research Journal, WATER 5, 86-104, Nov 3 2013
(v) Schorpp, V. (2011): Tree Damage from Chronic High Frequency Exposure. First Symposium, The effect of electromagnetic radiation on trees, The Groene Paviljoen, Baarn, 18.02.2011
(vi) Pall, M. L. (2016): Electromagnetic Fields Act Similarly in Plants as in Animals: Probable Activation of Calcium Channels via Their Voltage Sensor, Current Chemical Biology, 2016, Vol. 10, No. 1, Bentham Science Publishers
(vii) Disruption of the voltage-dependent calcium ion channels at the cell membrane: An explanation in film and text under https://www.naturalscience.org/news/2021/09/water-the-elixir-of-life-threatened-by-radiation/
(viii) Slocum, J. (2009): Does Military Sonar Kill Marine Wildlife? Scientific American, 10.6.2009
(ix) Wissenschaft.de (1998): Tod im Lärm. https://www.wissenschaft.de/allgemein/tod-im-laerm/

Written Representations - Cottam Solar Project.

Written Representation WR1 - Regulations and Guidelines when using Lithium-Ion Batteries

Batteries can be said to be the beating heart of all large-scale solar farms and like all hearts require continuous monitoring and maintenance to ensure to functionality and reliability. At the very centre of this, is accountability, traceability, and transparency throughout a battery's life.

The high profile of the developer does not rest easily when looking at the submission of the project which is littered with missing and essential and vital information on which to make a comment or judgement.

The detailed Specification, Testing and Certification of batteries and approval by an independent body reveals so much knowledge and confirmation about a product or service, none of which have been submitted by the developer.

There is no information about the metal content in the batteries, type of wafer insulation and testing conditions, Manufacturers Warranties, specific failure rates or life expectancy of batteries.

From the manufacturer to the dealer to the consumer, back to the manufacturer, or to the remanufacturer / recycler, Lithium-ion batteries have a long journey to make in their lifetime.

Yet, with many people's safety at stake, on every move and stop, they need to be handled with the utmost care.

Even though their battery chemistry is considered one of the safest, lithium-ion batteries still pose significant risks when not handled carefully.

The high-voltage nature of a lithium-ion battery comes with electrical hazards, such as short circuit, electrocution, electric shock or burning, whereas the chemical component inside the battery (the electrolyte) could leak out and cause intoxication or corrosion.

Lithium-ion batteries are prone to thermal runaway.
If the temperature exceeds a certain threshold, the cells begin to vent hot gasses, which increases the temperature even further, and ultimately leads to ignition, explosion, and significantly dangerous fires.

The larger the battery storage, the greater the risk of a runaway fire.

There appears to be no updated safety regulations in respect of lithium-ion batteries, but the following three documents appear to be those in use awaiting updates:

- Batteries Directive 2006/66/EC: This is an EU-Directive that provides guidelines to the member states concerning the manufacture and disposal of batteries in the EU. Its aim is to improve the environmental performance of batteries and accumulators.

- General Product Safety Directive (GPSD): The GPSD provides standards for product safety to protect consumers from potential hazards, by means of EN standards. The relevant EN standard for lithium-ion batteries is EN 60086-4. It serves as a reference point for specifications and technical solutions at the product design stage.

- ADR (International Carriage of Dangerous Goods by Road) The ADR is a UN-document, adopted by the European Union, which regulates the transport of hazardous goods over land. Following ADR rules is mandatory for transportation of lithium-ion batteries. The specific requirements for this type of battery can be found under article 2.2.9.1.7. All lithium-ion batteries are Class 9 and get the UN number 3480 and thus the safety rules vary.

What type of battery are you transporting?
Let's look at the different options and their ADR requirements.

New lithium-ion batteries
New batteries at the beginning of their journey are in their most stable state (except for manufacturing defects), as they are charged up to 60 to 70% to ensure stability.

Used lithium-ion batteries for reuse.
Battery Directive 2006/66/EC states that every battery producer has a take-back obligation.

Undamaged waste lithium-ion batteries
When a used battery can't be remanufactured or reused for a different purpose, it gets the 'waste' status and its ADR specifications change.

Damaged and defective lithium-ion batteries
Damaged lithium-ion batteries pose the biggest risk, as they are transported in a potentially highly unstable state.

Given this situation it would seem reasonable to expect the proposed solar farm developers to have included Risk Assessments and Method Statements for dealing with every phase of a battery's life.
How long will a battery last? 3 years, 10 years or 15 years?

What will the effect be on supply to the grid, how long will it take to replace the batteries and what will happen to the spent batteries?

Items such as the temperature under which they are used, whether they have been stored, how quickly they have been charged and discharged, whether they have been left discharged for any period, and a whole number of other factors.

Another big variable is the question of what counts as a charge / discharge cycle. Sometimes the battery will have undergone a deeper charge cycle than others, sometimes it may be a 20% to 80%, other times it may only be a top up, say 30% to 60% and whether this counts as a cycle.

The Environmental Statement, Volume 3, Appendix 2-A Bess and Substation states at 1.2.5. Batteries and inverters would be replaced approximately every 15 years suggesting that the batteries will last much longer.

The proposed specification for a LFP 280Ah cell type battery, taken from many sources on the internet suggest a Cycle life of 2,000 which at best would be 1000 charges and discharges per day, or just under 3 years. (CADEX Battery University)

Written Representation WR2 - Fire Risks in Large Scale BESS

Fire risks in large scale BESS I am sure will be dealt with by others but it will be useful to note that in the Liverpool BESS, fire was theoretically protected by a suppression system that failed to activate and would not have had any effect anyway, as the investigator states: Although there was a fire suppression system in the container, the speed of propagation indicated that this hadn't activated.

The McMicken explosion was an object lesson in this. The installed "clean agent" system operated correctly, as designed, on detection of a hot fault in the cabin. There was no malfunction in the fire suppression system, but it was completely useless because the fire was not a conventional fuel-air fire, it was a thermal runaway event. Only water will serve in thermal runaway.

Indeed, in the McMicken explosion the "Novec 1230" clean agent arguably contributed to the explosion by creating a stratified atmosphere with an air/Novec 1230 mixture at the bottom and inflammable gases accumulating at the cabin top.

Written Representation WR3 – Environmental Risks from Water Contamination

The rivers Trent and Till run through the proposed site raising significant questions about the amount of water required and contamination control that a critical event of a fire would result in environmental damage from toxic run-off.

In addition, the field adjacent to the site is an area of flooding which will potentially further increases toxic run-off risk and critical event control.

If a fire occurs in a battery, it is likely that there will be a closure of the solar farm and will remain closed until such time as the contaminated water has been filtered and disposed of to ensure that a further fire can be satisfactorily and safely dealt with?

On the issue of Water Supplies the guidance is substantially inadequate. The suggestion of a water-cooling system capable of delivering 'no less than 1,900 litres per minute for at least two hours' would deliver a total of only 228,000 litres. There is limited data on the measurement of water volumes deployed in previous BESS fires; the best comparison being the report quoted on the July 2021 Victoria Big Battery (VBB) fire where 900,000 litres were required over six hours to extinguish it. The fire was in two units, spreading from the first to the second after 2 hours and involved an estimated BESS size of 4.25 MWh.

Moreover, the volume of water required will be proportional to the size of the BESS on fire, so it is not possible or helpful to suggest a single figure for total water requirement as stated in the NFCC Guidance.

It is suggested that the total water requirement should be expressed as X litres per MWh of energy storage. From the VBB experience, X= 900,000/4.25 = 211,765 litres per MWh.

It is more difficult to specify the rate of delivery required since larger fires will certainly take much longer to extinguish.

It is suggested that a rounded figure for guidance might be:

'at least 200,000 litres per MWh of storage delivered over up to 12 hours. Very large BESS fires will require longer to extinguish and will need longer-term surveillance to monitor any signs of re-ignition'.

Using the recommended figure above, a 20 MWh BESS fire such as that at Basing Fen would require the delivery and storage of 4 million litres of water whilst a complete fire at the proposed 700MWh BESS at Cleve Hill, Kent would involve 140 million litres of cooling water.

Summary

The high profile of the developer does not rest easily when looking at the submission of the project which is littered with missing and essential and vital information on which to make a comment or judgement.

Lithium-ion batteries have a long journey to make in their lifetime from the manufacturer to the dealer to the consumer, back to the manufacturer, or to the remanufacturer / recycler,

Yet, with many people's safety at stake, on every move and stop they need to be handled with the utmost care.

A thermal runaway fire cannot be controlled like a regular (air-fuel) fire. A significant volume of water will be required to cool a BESS fire. It will be contaminated with highly corrosive hydrofluoric acid and other hazardous chemicals.

The activation of a suppression system would have had little or no effect on the resultant fire/explosion in a BESS fire.

We respectively ask that the risks associated with the deployment of large-scale BESS, must be addressed in order to avoid the issues clearly highlighted by the Deputy Fire Safety Commissioner of the London Fire Brigade when he said:

"If we know some things could fail catastrophically or it could have those effects," he said, "it's going to be a difficult day if one of us is standing there in court saying we knew about it but we didn't do anything."

It is important to recognise that the rivers Trent and Till run through the proposed site raising significant questions about the amount of water required and contamination control that a critical event of a fire would result in environmental damage from toxic run-off.

In addition, the field adjacent to the site is an area of flooding which will potentially further increases toxic run-off risk and critical event control.

Final Comment: The fundamental failure mode of Li-ion batteries presenting major hazard is thermal runaway. This paper is far from the first to identify the risk which is now well-known.

However, the BESS industry has still not agreed or implemented adequate engineering standards to address basic Prevention measures to pre-empt thermal runaway accidents.

The developer has not proved their submission to be sound, and contains significant weakness and a lack of depth in their submission should not be approved.