Prees Parish Council

Response to Resident regarding Electromagnetic Radiation

Introduction

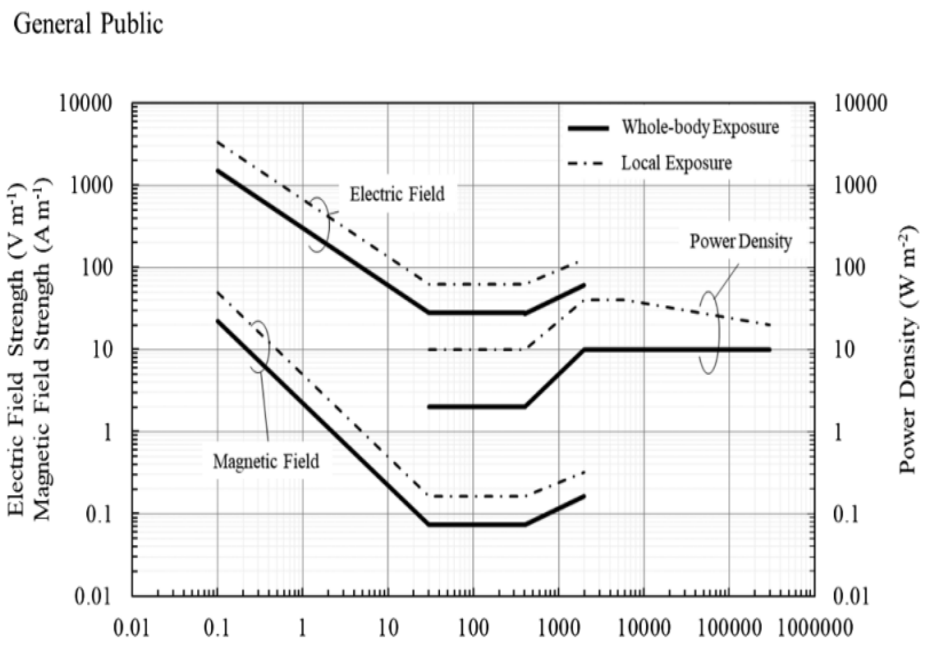
A resident contacted Prees Parish Council concerned about the level of electromagnetic radiation in the vicinity of their property, with particular concerns about 5G mobile telephone masts, a nearby Severn Trent installation for detecting water leaks and electricity smart meters.

Almost all studies on the effects of Electromagnetic Radiation on human health deals with the heating effect, which is a well known mechanism. The resident claims extreme sensitivity to the direct effect of electromagnetic radiation. The resident is not alone in making this observation; others have made similar claims.

I have looked into this subject as best I can. A lot has been written in the past, some respectable scientific studies but many unsubstantiated or mathematically or scientifically unsupported works. This report describes the situation as I see it currently. It may contain errors and it only takes into account a very small selection of the published information on this subject.

Internationally recognised limits

The International Commission on Non-Ionizing Radiation Protection (ICNIRP) guidelines provide recommendations for limiting human exposure to electromagnetic fields, including radiofrequency (RF) and low-frequency (LF) fields. These guidelines aim to protect individuals from potentially adverse health effects related to exposure to these fields [1].



Reference RF exposure levels for exposure to the general public

The above diagram shows that a safe rf power is considered to be less than 2 $W.m^{-2}$ for radio frequencies in the range 40 MHz – 400 MHz and 10 $W.m^{-2}$ whole body exposure and around 30 $W.m^{-2}$ for localised exposure for radio frequencies in the range 400 MHz to 300 GHz, which covers all mobile telephone transmission frequencies including 5G.

In animal studies, substantiated changes have only been reported from acute exposures with whole-body Specific Absorption Rate (SAR) in the order of 4 $W.kg^{-1}$ of body mass, which result in core temperature rises of 1°C or more, or localised exposure of around 3 $W.m^{-2}$. However, there is no evidence that this corresponds to an impact on health. [2]

Numerous human studies have investigated indices of cardiovascular, autonomic nervous system, and thermoregulatory function, including measures of heart rate and heart rate variability, blood pressure, body, skin and finger temperatures, and skin conductance due to low intensity RF radiation. Most studies indicate that there are no effects on endpoints regulated by the autonomic nervous system. The relatively few reported effects of exposure were small and would not have an impact on health, were inconsistent and may be due to methodological limitations or chance. With exposures at higher intensities, up to a whole-body SAR of about 1 $W.kg^{-1}$ [6], sweating and cardiovascular responses have been reported that are similar to that observed under increased heat load from other sources. The body core temperature increase was generally less than 0.2°C.

Electromagnetic hypersensitivity

It is difficult to evaluate the incidence of electromagnetic hypersensitivity (EHS), defined as a condition where individuals report experiencing a range of adverse symptoms attributed to electromagnetic fields (EMF). These symptoms are not consistently linked to any specific biological or chemical mechanism, and there's no scientific evidence to support a direct causal link between EMF exposure and the reported symptoms. While EHS is not a recognized medical diagnosis, the experience of symptoms is generally accepted as being of psychosomatic in origin.

Stein and Udasin (2020) [5] state that “EMF can induce changes in calcium signaling cascades, significant activation of free radical processes and overproduction of reactive oxygen species in living cells as well as altered neurological and cognitive functions and disruption of the blood-brain barrier”, although the RF power levels required to cause noticeable effects are not explicitly stated. They conclude that “the mechanisms underlying the symptoms of EHS are biologically plausible and that many organic physiologic responses occur following EMF exposure”.

Adair at el 2005 [6] published a study of the effects of exposing volunteers to low power electromagnetic fields. No mechanism is put forward regarding the reasons for symptoms reported and the results as published are based upon subjective data.

A conference on Electromagnetic Hypersensitivity [4] was held in Prague in 2004, In summary, the report did not find any consistent scientific evidence of sensitive or specific pathophysiological markers for EHS. They noted geographical variation in terms of symptomatology, the attributed source of exposure and the estimated prevalence of EHS. They note that there is only limited evidence to guide the management of affected individuals, the majority of conventional medical effort to date (2004) being directed at psychological therapy such as cognitive behavioural therapy. Evaluation of this approach has been limited but shows some potential for success, they report. Their recommendations include research to understand EHS and estimate its prevalence within the UK and conducting robust trials of cognitive behavioural therapy.

5G

5G operates in the frequency band 3410-3680 MHz. 4G operates within a variety of defined frequency bands in the range 791-3680 MHz.

I have done some calculations based upon what I perceive to be a typical 5G mobile telephone installation to give a ball park figure of radio frequency (RF) power densities close to a mast. I have used the following specifications, derived from technical data of various sources. See Appendix 1.

Mean height of antenna: 25m
Transmitter power: 20W
Antenna: omnidirectional in the horizontal plane with a main lobe in the vertical plane of half power beamwidth of 18° centred on the horizontal. This calculates to a gain of 10dBi. The gain of the principal side lobe in relation to the main lobe is -20dB.
Ground: horizontal.
Nearby resident: 2 storey housing with resident 5m above ground level.

The calculated rf power densities are as follows:

For a resident located a horizontal distance of 20m from the mast, a typical RF power density of 0.0002 $W.m^{-2}$ can be expected.

The maximum power density of 0.001 $W.m^{-2}$ would occur at a horizontal distance of around 130m from the mast.

Whilst these figures are the result of "back of an envelope" calculations (available on request), they concur with measurements made by Ofcom [3]. Having taken measurements of 5G RF power densities at many locations accessible to the public, this table shows the highest 22 readings. The highest of these is a reading of 0.00239 $W.m^{-2}$ at Harker Street, Liverpool. Whilst the figures are of a similar order to my calculations, in general they seem to indicate that my numbers are an overestimate, most likely due to antenna and antenna mounting, particularly the tilting upwards of antenna arrays.

Whilst reliable measurements on the direct effect of electromagnetic radiation on the human body at the low levels of radiation the public are exposed to are impossible to make, the widespread use by the public of mobile telephones is a useful source of data. The levels of radiation due to a mobile telephone held close to the body, measured by numerous studies at around 0.1-2 $W.m^{-2}$, is considerably higher than any other source the public is likely to be exposed to such that any noticeable health problems due to ambient levels will easily show up in data of mobile telephone users within the wider population.

This study suggests that the maximum power density the public are likely to be exposed to from a 5G transmitter, approximately 0.001 $W.m^{-2}$, is some 10000 times less than the reference safe limit of 10 $W.m^{-2}$ and 1000 times less than the 1 $W.m^{-2}$ intensity that a high proportion of mobile telephone users will experience. Thus the cumulative maximum exposure to the continuous radiation of a typical 5G mast is equivalent to the use of a mobile telephone near the head for less than 2 minutes per day. It is difficult to see how 5G could cause a health problem that has not been apparent amongst heavy mobile telephone users.

Table 4.1: Highest average exposure levels at all locations visited[13]

City	Measurement location	Highest All Band value (% of ICNIRP level)	Highest 5G Band value (% of ICNIRP level)
Belfast	Lanyon Place	0.0807	0.0006
Birmingham	Mailbox Birmingham	0.4688	0.0386
Bristol	Aztec West Business Park	0.1431	0.0010
	St Augustine's Parade	0.0460	0.0068
Cardiff	Newport Road	0.0978	0.0016
	The Senedd	0.1195	0.0060
	St David's Centre	0.0823	0.0041
Edinburgh	Gorgie Road	0.1419	0.0004
Glasgow	Renfrew Street	0.1399	0.0044
Liverpool	Harker Street	0.4608	0.0239
	Lawrence Road	0.1371	0.0069
	Hatton Garden	0.0894	0.0011
London	Canary Wharf	1.4960	0.0000
	Charing Cross	0.5970	0.0014
	Grays Inn Road	0.0420	0.0013
	Pentonville Road	0.0711	0.0117
	Victoria Station	0.2483	0.0042
	Waterloo Station	0.3828	0.0065
Manchester	Chester Road	0.3017	0.0053
	Crumpsall Vale	0.0736	0.0016
	Great Bridgewater Street	0.2460	0.0019
Stevenage	Wedgwood Gate	0.0654	0.0008

Highest measured exposure levels measured by OFCOM. The measurements are based on an ICNIRP value of 10 Wm^{-2} [3].

5G verses 4G

5G operates at frequencies above 3410 MHz whereas most 4G systems operate in the lower frequency bands. It is the higher frequencies that 5G operates that is often stated as a cause for concern. However the higher frequencies of 5G offer advantages in that antennas can be designed to be more directional, allowing signal power to be directed into the distance and well above the heads of local residents, and the higher frequencies are known to be less penetrative to the human body.

Smart electricity meters and remote condition monitoring

Both these systems deal with small packets of data transmitted as a short burst of radio signal separated by long periods of radio silence. There is no point in committing the system to more radio transmissions than the minimum required.

In the case of smart meters, continuous transmission would block the network. There are many different systems in use, but typically they use the mobile telephone network or other low power radio networks. The data transmitted will include identification of the meter and data associated with its operation. It may conceivably retransmit data from other nearby smart meters.

An example is the Itron ERT compatible smart meter operating in the American market using low power radio transmission in the American 900 MHz band. Typical data transmitted is:

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15:19:47.035141 decode.go:45: CenterFreq: 912600155
15:19:47.040839 decode.go:46: SampleRate: 2359296
15:19:47.042413 decode.go:47: DataRate: 32768
15:19:47.043984 decode.go:48: ChipLength: 72
15:19:47.046395 decode.go:49: PreambleSymbols: 21
15:19:47.047490 decode.go:50: PreambleLength: 3024
15:19:47.048779 decode.go:51: PacketSymbols: 96
15:19:47.049751 decode.go:52: PacketLength: 13824
15:19:47.053034 decode.go:59: Protocols: scm
15:19:47.053892 decode.go:60: Preambles: 111110010101001100000
15:19:47.054497 main.go:111: GainCount: 5
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The left hand column is time, indicating a data transfer period of around 0.025 seconds. Even if the rf carrier is held open for 10 times that period, a transmission burst of only 0.25 seconds is indicated. This is typically repeated every 30 minutes.

As the long term cumulative power associated with this system is extremely small, it is difficult to see any noticeable health effects resulting from its operation.

In the case of the Severn Trent water leakage detection system, it is understood that it employs the low power, battery powered LoRaWAN 868 MHz technology. This would normally transmit a very limited set of data as a short burst of radio signal separated by long periods of, perhaps, a day, typically an ‘I am here’ signal, battery condition and leak detection status. A node may retransmit data from other nodes. The average radio power output would be severely limited by the battery which would prevent anything other than very low cumulative rf power over a period of time. Severn Trent will not be wanting to change these batteries more than necessary. As in the case of smart meters, it is difficult to see any noticeable health effects resulting from its operation.

Other concerns

Concern has been expressed in relation to the pulsed (digital) modulation associated with mobile telephone signals. As all radiated frequency components must be located within a specified band and within specified maximum power levels, there is no technical reason for any concern in this respect.

Concern has also been expressed with regard to the phased antenna arrays mounted on mobile telephone masts. This common technique is employed throughout the range of radio frequencies and is a means to direct RF power to where it is needed. In the case of mobile telephone aerials, this is into the distance, not directed towards the nearby ground or in the direction of local residents.

The author notes historical reports of ‘head buzzing’ and cases of demodulation within the head of signals from nearby high power public broadcast transmitters. In all known cases, this was due to the presence of metal within the body, in particular tooth fillings.

Conclusion

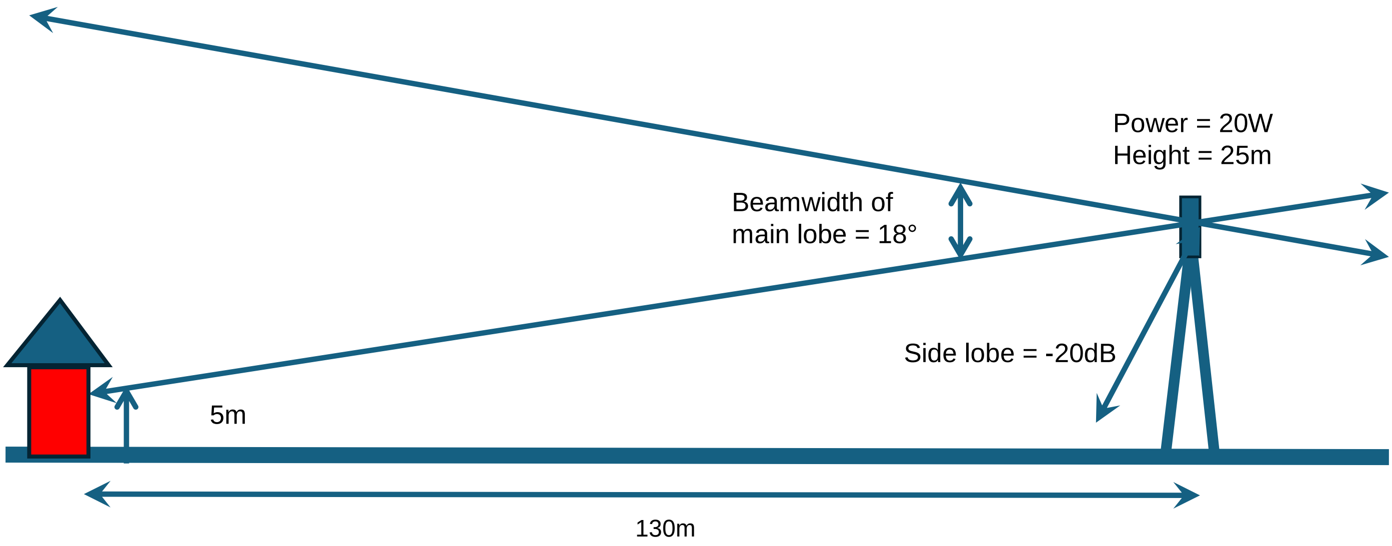
At this stage, I believe that Prees Parish Council does not have the ability to state that there is a health risk associated with ambient levels of electromagnetic radiation that Prees residents are likely to be exposed to. This represents the best advice so far with the evidence obtained within a relatively short period of time. As with all lines of research, opinion should be left open to further evidence based developments.

Appendix 1

What level of radiation can be expected from a 5G base station?

Every installation will be different and there will be a vast variation is signal densities in the vicinity of any one installation. However the calculations below will give a ball park estimate of the rf power densities in the vicinity of a 5G mast.

The following example calculations are based on what is believed to be typical figures. The methodology employed can be employed for specific 5G installations of known specification.
5G transmit power of one channel is 20W.
Antenna polar diagram in horizontal plane is omnidirectional.
Antenna polar diagram of main lobe in vertical plane has -3dB beamwidth of 18° centred on the horizontal.
Antenna gain of principal side lobe in relation to the main lobe is -20dB.
Mean height of antenna above ground level is 25m.
Ground is horizontal.
2 storey housing is in the locality with residents living 5m above ground level.



Maximum radiation density expected from nearby residents from the main lobe.

Gain of antenna main lobe = $10log_{10}\left(\frac{180°}{18°}\right) dBi = 10dBi$

ERP of main lobe = $20W \times 10^{\left(\frac{10dBi}{10}\right)} = 200W$

Minimum horizontal distance a resident 5m above ground level will be within the antenna main lobe = $\frac{(25m-5m)}{tan\ 9°} = 126.3m$

Distance from centre of antenna to resident = $\frac{126.3m}{\cos 9°} = 128\ m$

Power density at this distance = $\frac{200W}{4\pi(128m^2)} = 0.001\ W.m^{-2} = 0.1\ \mu W.cm^{-2}\ to\ 2sf$

Maximum radiation density expected from residents 20m from the antenna base from the principal side lobe.

Gain of antenna principal side lobe = $(10 - 20)dBi = -10\ dBi$

ERP of principal side lobe = $20W \times 10^{\left(\frac{-10dBi}{10}\right)} = 2W$

Distance from centre of antenna to resident = $\sqrt{((25-5)^2 + 20^2)}\ m = 28.3\ m$

Power density at this distance = $\frac{2W}{4\pi(28.3m^2)} = 0.0002\ W.m^{-2} = 0.02\ \mu W.cm^{-2}\ to\ 2sf$

So the maximum power density for this example will be 0.001 $W.m^{-2}$ or 0.1 $\mu W.cm^{-2}$ observed by the resident approximately 125m from the mast base.

In order for the resident 20m from the mast base to observe this power density, the gain of the principal side lobe must be approximately -13dB with respect to the gain of the main lobe.

I will consider a working figure for the maximum rf power density in the vicinity of a 5G transmitter of 0.001 $W.m^{-2}$. It is quite possible that this is a significant overestimate.

Referring to the table below, these calculations are supported to some extent by the table below, which records measurements made by Ofcom [3].

References

1. Guidelines for Limiting Exposure to Electromagnetic Fields (100 kHz to 300 GHz), International Commission on Non-ionizing Radiation Protection (ICNIRP), Health Phys 118(5): 483–524; 2020, https://www.icnirp.org/cms/upload/publications/ICNIRPrfgdl2020.pdf accessed 17 July 2025.

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Summary of results, Ofcom, 21 February 2020 (updated 17 April 2020), https://www.ofcom.org.uk/siteassets/resources/documents/consultations/category-1-10-weeks/189981-consultation-proposed-measures-to-require-compliance-with-international-guidelines-for-limiting-exposure-to-electromagnetic-fields-emf/associated-documents/secondary-documents/emf-test-summary.pdf?v=324545 accessed 17 July 2025.

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