Consultation: Proposed measures to require compliance with international guidelines for limiting exposure to electromagnetic fields (EMF)

Summary of consultation responses from the amateur radio community

Context for this summary

There are around 80,000 licensed radio amateurs in the UK. The interests of 22,000 of them are represented through their membership of the Radio Society of Great Britain (RSGB). RSGB also acts as a parent organisation to affiliated smaller groups and societies. Among its publicly stated aims is the wish to: *"increase awareness and understanding of amateur radio and to make the hobby accessible to everyone"*.

Shortly after we published our consultation document on 21 February 2020, RSGB alerted its members to our proposals and produced its own overview of the content (see annex 1 to this summary). RSGB said it would be submitting a response to the consultation and urged its members to also respond separately. On 28 May 2020 the RSGB issued guidance to radio amateurs on how they might respond to each of our consultation questions (see annex 2 to this summary).

RSGB's own full consultation response was submitted to Ofcom and published on its website on 5 June 2020. The consultation closed on 12 June 2020. RSGB's response is attached at annex 3 to this summary and is also published separately alongside responses from stakeholders not connected to the amateur community.

Radio amateur respondents

In total, we received 255 responses from radio amateurs or on behalf of radio amateur groups. Of these, 83 were submitted by respondents asking for their name and/or their whole response to remain confidential. Where it was unclear whether a respondent wished to remain confidential or not, we requested clarification. Those who did not confirm they were content for their identity to be published have been treated as confidential.

Those **organisations/groups** submitting non-confidential responses were: Furness Amateur Radio Society, Great Yarmouth Radio Club, Horsham Amateur Radio Club, Norfolk Amateur Radio Club, Shefford and District Amateur Radio Society, Swindon & District Amateur Radio Club, Telford & District Amateur Radio Society, Worksop Amateur Radio Society.

Those **individuals** submitting non-confidential responses were: A Rigby, Alan Betts, Albert Allen, Alex Browne, Alistair Cockeram, Alister Watt, Andrew Barrett, Andrew Bryce, Andrew Gilfillan, Andrew Lenton, Andrew Levy, Andrew Nehan, Andrew Palmer, Andrew Pevy, Andy Foad, Anthony Pugh, Anthony White, Barry Lewis, Bruce MaCaulay, Carl Langley, Charles Heater, Charles Jones, Charles Mitchell, Christopher Bauers, Christopher Catt, Christopher Danby, Christopher Danby, Christopher Pearson, Christopher

Shipman, Clive Reynolds, Clive Widdus, David Atkins, David Blake, David Crump, David Duff, David Ferrington, David Hobro, David Holman, David Honey, David Johnson, David Keston, David Lawley, David Lloyd, David Millard, David Perry, David Rumens, David Shaw, David Thomson, Den Forrest, Derek Bate, Derek Kozel, Donald Shaw, Dr Anthony Norden, Dr Carl Littlejohns, Dr Christopher Duckling, Dr Colin Smithers, Dr Douglas Fenna, Dr John Morgan, Dr John Rogers, Dr Stephen Baker, Dr Stewart Bryant, Duncan Fisken, Frank Wilson, Gareth Blades, Gary Myers, Geoffrey Sandford, George Richardson, Gerald Edinburgh, Gerald McGowan, Gerald McLaughlin, Graham Bedwell, Graham Smith, Harry Hogg, Iain Moffat, Ian Braithwaite, Ian Coleman, Ian Leather, Ian Parker, James Butler, James Hay, James Keddie, Jeremy Lefever, Jeremy Willis, Jim Bacon, John Bowen, John Coleman, John Fellows, John Gould, John Gumb, John Jebb, John Kirby, John Marsden, John Randall, John Rowlands, Julian Smith, Keith Bird, Keith Haywood, Ken Eastty, Kenneth Taber, M J Whatling, Mark Atfield, Mark Capstick, Mark Elliott, Mark Gahagan, Mark Godden, Mark Hill, Mark Horn, Martin Sweeting, Martyn Preston, Martyn Vincent, Michael Brown, Michael Cooke, Michael Naylor, Noel Matthews, Paul Bigwood, Paul Bradfield, Paul Marsh, Paul Randall, Paul Robinson, Paul Tomlinson, Paul Zipzer, Pete Webster, Peter Cooper, Peter Fox, Peter Hutchison, Peter Marten, Peter Torry, Phil Moreau, Philip Cadman, Philip Day, Phillip Morris, Raymond Chandler, Raymond Fothergill, Reginald Gynn, Richard Jolliffe, Richard Martin, Richard Perzyna, Richard Smith, Robert Evans, Robert Rees, Robert Scott, Robin Caine, Roger Eales, Roger Ferrand, Ron Fleming, Serge Moisseyev, Shaun O'Sullivan, Simon Watson, Sojan Mathew, Stephen Hartley, Stephen Tompsett, Stephen Turner, Steve Marsh, Steven Clarke, Terence Metcalfe, Thomas Hill, Timothy Dabbs, Tony Bettley, Trevor Clapp, Trevor Shackleton, Trevor Webb, Victor Brand, Vincent Robinson

Views of radio amateurs

Almost all amateur radio respondents drew on either RSGB guidance or on the full RSGB submission in their comments. Many reused all or part of the RSGB's wording. Others made the same points in their own words. Many attached the full RSGB document to their response, or included links directly to the response as published on RSGB's website. The key parts of RSGB's response used or adapted by most amateur radio respondents were the following passages:

> **In respect to Question 1 of the consultation:** "*RSGB fully supports the underlying principle that Radio Amateurs need to be aware of the risks relating to EMF exposure, and of the ways to mitigate those risks. Indeed, RF Safety is an integral part of the existing UK amateur radio licence and our (Ofcom-approved) exam training syllabus. However, RSGB does not agree with Ofcom's proposals to implement that principle by adding a major new enforceable condition to amateur licences. We believe this would be:*
>
> > *1. In breach of statutory general duties. The Communications Act 2003 and the Wireless Telegraphy Act 2006 together require that regulations made by Ofcom:*
> >
> > > *• Must be proportionate, objectively justifiable, and targeted only at cases in which action is needed;*
> > >
> > > *• Must not impose burdens which are unnecessary; There would also be a danger of double regulation with what is normally a HSE/PHE matter.*
> >
> > *2. Not objectively justifiable*

• The Amateur licences include a long-standing requirement that safety precautions should be taken against "radio frequency radiation" which is accepted by Public Health England (PHE), and the NRPB before it, as being proportionate to the low levels of risk arising from Amateur Radio activities.

3. Inadequate with respect to the requirement for impact assessments

• The document contains no impact assessment of any kind.

4. Disproportionate and Discriminatory We emphasise that all impacts upon Amateur Radio will be disproportionate to the related risks of harm.

• They will be extremely disruptive to the Amateur Service and Amateur Satellite Service

• They fall most heavily upon the very large numbers of non-commercial licensed spectrum users many of whom lack the resources to make the assessments demanded".

In respect to question 2 of the consultation: "*In principle, RSGB strongly supports the appropriate and technically correct application of ICNIRP 2020 Guidelines. But RSGB does not agree with the manner in which Ofcom proposes to achieve this within the Amateur licence. We also find many serious technical and drafting errors within the proposal. This part of the Ofcom proposals is undermined by serious technical and drafting errors. Regardless of any other merits, RSGB finds it impossible to support the proposal in its present form. Ofcom's entire approach to achieving EMF Safety through power regulation is undermined by a lack of clarity about the basic concepts of "power" and "EIRP" in the context of radiation protection.*

• For ICNIRP compliance purposes, "power" must be clearly defined as Average Power during the appropriately defined period of several minutes. This is nowhere made clear.

• Indiscriminate use of the "EIRP" (a far field concept) to calculate EMF exposures at very short distances from an antenna will frequently lead to either overestimates or underestimates of field strengths. To mandate this methodology creates a severe risk of unsafe advice and actions.

• Mobile and other forms of temporary operation (other than mobile phone handsets) are not addressed at all by the proposed regulations".

In respect to question 3 of the consultation: "*Again, RSGB finds this impossible to agree. The potentially helpful advice about achieving compliance is overbalanced by a heavy emphasis on enforcement and penalties.*

• "Guidance", by its very nature, cannot include further elements of regulation. The enforcement provisions of the Wireless Telegraphy Act 2006 and their applicability under criminal law apply equally to all parts of the licence

• *RSGB has good reason to be sceptical of Ofcom's capability to enforce any such licence conditions. The expertise required to inspect an Amateur station with regard to EMF compliance goes far beyond that needed to survey a mobile phone base station".*

The dominant theme of responses from radio amateurs was that the proposed licence condition should not be applied to amateur licences. Many respondents went on to endorse RSGB's "constructive alternative" whereby the society would enhance its own training and guidance material. They pointed out that RSGB already has radio frequency safety (including an awareness of the ICNIRP guidelines) in its exam syllabus.

Additional points

In addition to points made in line with RSGB's prepared guidance and response, some of the radio amateurs made additional points or further elaborated on points made elsewhere. In making their points, many pointed to their own long experiences of working with amateur radio and described the particular characteristics of their own radio equipment. We have set out below what we consider to be the main themes arising from responses.

<u>EMF concerns do not apply to radio amateurs</u>

Many of the radio amateurs who submitted responses that went further than RSGB's submissions expressed views about Ofcom's motivation for its proposals. The common thread was that Ofcom appeared to be reacting to concerns – whether founded or unfounded – about perceived health risks associated with 5G mobile. The radio amateurs felt this had nothing to do with them or their hobby and there was no justification for "lumping" the two cases together.

They explained that commercial and amateur use of spectrum is fundamentally different (e.g. in terms of frequencies used, power and duty cycles, available guidance and training) to use of frequencies by mobile operators.

For example, one respondent said: *"There is already enough irrational paranoia among the general public on the whole topic of RF transmissions (generally associated with cell phone masts) without adding radio amateurs to that same category"*. Another said our proposals *"appear to be an excessively heavy hammer to crack a trivial almost non-existent nut".*

Others noted that ICNIRP was established to cover personal safety in the presence of continuous RF transmissions, such as broadcasting, radar and similar situations. They said amateur radio transmissions were anything but continuous.

<u>Absence of risk to the general public</u>

Many radio amateurs said they were already required to operate without causing undue interference and there was no evidence to suggest there was any issue with amateurs not abiding by this principle. They said there was no risk to the general public because of the intermittent nature of transmissions and the general use of only modest power levels.

Some challenged Ofcom to point to any instances of harm from amateur radio transmission worldwide and said the absence of any such evidence showed that further measures to test or monitor were unwarranted and simply penalised hobbyists. One said: *"Given that many thousands of electromagnetic waves pass*

through my study and home at all times day and night from a barrage of radio, TV, internet, satellite, mobile telephone, fire, police and ambulance frequencies etc. etc. I do not believe the frequencies used by amateur radio operators…. would add a single EMF difficulty for anyone, anywhere at any time".

One respondent said a lone operator should not be liable for exceeding the limit because that is their prerogative in their own space. It would only be an issue if third parties are put at risk. Amateurs have used 400W output (plus antenna gain) without problems and should be allowed to continue.

Threat to the existence of the amateur radio community

Some radio amateurs said the Ofcom proposals presented a risk to the very existence of their hobby. They cited two reasons: 1) the unfair association of amateur radio with high power mobile transmission presented a negative image to the wider population; and 2) the burden of compliance with new rules will drive people away from the hobby and discourage new enthusiasts from taking it up.

For example, one respondent said it would encourage people to make "*spurious complaints against our activities"* and warned of a risk of abuse, physical violence and potential criminal damage to equipment. Others said onerous limits on field exposure could also prejudice planning applications against the installation of amateur radio aerial equipment, particularly in urban environments.

Others said the requirement for complicated record keeping would seriously detract from the enjoyment of the hobby, and that this would undoubtedly impact the amateur sector, seriously reducing its accessibility to new entrants. One respondent said: *"You appear to want to rid yourselves of a troublesome administrative burden and to rid the airwaves of Amateur Radio activity in this country, clearing our frequency allocations for commercial use".*

A number of respondents pointed to the value of amateur radio in developing expertise and in helping emergency services in times of emergency, such as floods and other major incidents (some cited the Lockerbie air disaster). This resource could be lost if radio amateurs are driven away.

Unreasonable burden of compliance

The burden of compliance with the proposed new licence condition was addressed more directly in further responses. One respondent summed up a general concern, saying*: "99% of radio amateurs will NOT have the resources or technical expertise to perform the tests, particularly at high frequencies"*, and suggested that even Ofcom engineers would find the calculations challenging. Other respondents said the proposals were not consistent with our objectives for 'light-touch' regulation.

Others described the proposals as *"heavy handed over regulation"* that would involve very significant training, record keeping, equipment expense and time for no real benefit. Many said compliance was beyond the reasonable technical capability of the amateur operator and that properly calibrated equipment was unaffordable or unavailable.

Many others expressed scepticism that Ofcom could enforce compliance on the tens of thousands of licensed radio amateurs in the country. Others pointed to practical difficulties in making reasonable assessments. For example, one respondent said many radio amateurs experiment with antennas and aerials that do not have an easily calculable radiation pattern. Although a simple dipole resonant at the frequency of operation can have its field strength relatively easily calculated, the same dipole used away from its resonant frequency will have differing radiation patterns.

One respondent said: *"I am qualified to post grad level with an MA and cannot make out any relevant or understandable measures that I can take from this document."* The respondent went on to say that radio amateurs enter the hobby for fun and because they are interested in the scientific exploration afforded by the hobby. They are not businesses, and should not be treated as though they are.

Equality considerations

Some respondents said Ofcom needed to conduct an equality impact assessment because of the disproportionate impact our proposals would have on disadvantaged people. They said a significant proportion of amateurs are elderly and rely on their radio transmitters for meaningful occupation. Others were blind or disabled in other ways. Amateur radio provided a valuable mental stimulus for these groups unable to pursue other hobbies.

Annex 1

Radio Society of Great Britain

Advancing amateur radio since 1913

Proposed measures to require compliance with international guidelines for limiting exposure to electromagnetic fields (EMF)

Brief by the Radio Society of Great Britain

28 February 2020

On 21 February Ofcom launched a consultation [1] proposing that all radio equipment (not just amateur radio) that can transmit at more than 10W (EIRP) be subject to a new licence condition for compliance with the International Commission for Non-Ionising Radiation Protection (ICNIRP) Guidelines for public exposure to electromagnetic fields. The proposals include a requirement to carry out and record assessments to show compliance using one or more of the following:

- Physical measurements
- Tests
- Calculations
- Following manufacturers' guidance/instructions

It is expected that most stations will be able to show compliance without having to make measurements. The RSGB is preparing a response to Ofcom and will be asking for members' comments on the details and regulations proposed. This briefing note explains what it means for amateurs.

Background: EMF exposure and amateur radio

The underlying requirement is to protect the public from exposure to EMF, which could damage health. Ofcom proposes that all Wireless Telegraphy Act (WTA) licences will contain a new and more rigorous clause (and associated guidance) to ensure radio equipment complies with EMF exposure guidelines.

This is not entirely new, as the current amateur licence conditions already require that we take safety precautions against RF radiation in line with Public Health England recommendations. As a responsible organisation we also have RF safety (including an awareness of ICNIRP) in our Exam Syllabus and may consider expanding this aspect further in due course.

The reference levels are given in the ICNIRP guidelines. Licensees will be required to keep records that demonstrate how they have complied with the ICNIRP guidelines. Ofcom refers to Table-7 of the current 1998 guidelines [2] which we note is different to the draft 2018 guidelines [3] that are about to be finalised.

If you comply with 1998 guidelines, you will also comply with the 2018 guidelines. Similar requirements exist in the USA (since 1999) and Germany (since 2008).

The requirement is that power absorbed over time (30 minutes) is at a safe level. This means the simultaneous EMF for each of your radios (if more than one can be used at the same time) must be added together to show that the total EMF from the station is compliant. The ICNIRP Reference Levels are given as Electric Field (V/m), Magnetic Field (A/m) or Power Density (W/m^2).

Compliance with one of these limits is sufficient – you do not have to prove all three. Calculations account for the average duty cycle of a given transmission mode, which means different calculations are needed for SSB and digital transmissions.

The IARU has published a PC application, ICNIRPcalc, which calculates safe distances. This allows you to input maximum power, antenna type, feeder type / length and transmission mode. From that it calculates and gives you a safe distance according to the ICNIRP 1998 guidelines. If this distance is less than your nearest property boundary then you have shown compliance for the general public requirement. The IARU application can be downloaded from [4].

Will the RSGB assist in future with such a requirement?

Yes. The RSGB EMC Committee (EMCC) will be preparing a spreadsheet in which you can fill in the relevant parameters for each band you use. That would then give you individual safe distances and combined field strength at your closest boundary. This spreadsheet can be kept as a record that you have assessed your station. An online webpage version of this tool is also envisaged.

The EMCC will also be preparing and publishing a guidance note for those who might want to measure the levels. We recognise that difficulties can arise with direct measurements in the near field that can lead to widely varying results, and thus there is a need for a reliable means to derive field strengths.

What happens next?

The proposed changes will not be introduced until the end of 2020 at the earliest. The Ofcom consultation ends on 15 May 2020, after which Ofcom will release a policy statement and indicative timeline.

With respect to the consultation, we will prepare further guidance as well as our own response. We also encourage you to make a considered response to Ofcom to show your concerns.

Please contact John Rogers, M0JAV emc.chairman@rsgb.org.uk if you can help us prepare our own response, or if you need further advice.

References

[1] Ofcom EMF Consultation: https://www.ofcom.org.uk/consultations-and-statements/category-1/limiting-exposure-to-emf

[2] ICNIRP Guidelines 1998: https://www.icnirp.org/cms/upload/publications/ICNIRPemfgdl.pdf

[3] ICNIRP Guidelines 2018 (Draft): https://www.icnirp.org/en/activities/public-consultation/consultation-1.html

[4] IARU ICNIRPcalc tool: https://www.iaru-r1.org/about-us/committees-and-working-groups/emc-committee-c7/links-to-emc-resources/

Annex 2

Ofcom Consultation:

Proposed measures to require compliance with international guidelines for limiting exposure to electromagnetic fields (EMF)

Guide by the Radio Society of Great Britain

28 May 2020

On 21 February Ofcom launched a consultation proposing that all radio equipment (not just amateur radio) that can transmit at more than 10W (EIRP) be subject to a new licence condition for compliance with the International Commission for Non-Ionising Radiation Protection (ICNIRP) Guidelines for public exposure to electromagnetic fields. The proposals include new licence conditions and mandatory guidance to carry out and record assessments to show compliance using one or more of the following:

- Physical measurements
- Tests
- Calculations
- Following manufacturers' guidance/instructions

It is expected that most stations will be able to show compliance without having to make measurements. However, the nature of Ofcom's approach, prompted by 5G concerns, is in our view onerous and disproportionate.

The RSGB is preparing a detailed response to Ofcom. This guidance paper is to assist individual radio amateurs that may wish to make their own considered responses to the consultation before the 12 June deadline (extended from 15 May 2020).

Background

Following the release of the Ofcom consultation, the RSGB released an initial Briefing Paper on 28th February. Subsequently there has also been a release of Ofcom FAQs in April and a confirmation that the ICNIRP guidelines are now formally updated to their new 2020 edition, from their previous 1998 issue.

The consultation, briefing paper etc, are all collated and linked from our EMF page at:

https://rsgb.org/main/technical/emc/emf-exposure/

Note: Replies to Ofcom should be in your own words and not be a copy of this!

Question 1: Do you agree with our proposal to take steps to mitigate risks related to EMF and be in a position to hold licensees, installers and users to account if issues are identified? Please explain the reasons for your response.

RSGB fully supports the underlying principle that Radio Amateurs need to be aware of the risks relating to EMF exposure, and of the ways to mitigate those risks. Indeed, RF Safety is an integral part of the existing UK amateur radio licence and our (Ofcom-approved) exam training syllabus.

However RSGB does not agree with Ofcom's proposals to implement that principle by adding a major new enforceable condition to Amateur licences. We believe this would be:

1. In breach of statutory general duties

The Communications Act 2003 and the Wireless Telegraphy Act 2006 together require that regulations made by Ofcom:

- Must be proportionate, objectively justifiable, and targeted only at cases in which action is needed;
- Must not impose burdens which are unnecessary;

There would also be a danger of double regulation with what is normally a HSE/PHE matter.

2. Not objectively justifiable

- The Amateur licences include a long-standing requirement that safety precautions should be taken against "radio frequency radiation" which is accepted by Public Health England (PHE), and the NRPB before it, as being proportionate to the low levels of risk arising from Amateur Radio activities.

3. Inadequate with respect to the requirement for impact assessments

- The document contains no impact assessment of any kind.

4. Disproportionate and Discriminatory

We emphasise that all impacts upon Amateur Radio will be disproportionate to the related risks of harm.

- They will be extremely disruptive to the Amateur Service and Amateur Satellite Service
- They fall most heavily upon the very large numbers of non-commercial licensed spectrum users many of whom lack the resources to make the assessments demanded.

Question 2: Do you agree with our proposal

a) to include a condition in spectrum authorisations requiring compliance with the basic restrictions for general public exposure identified in the ICNIRP Guidelines

b) that this condition should apply to equipment operating at powers greater than 10 Watts EIRP?

Regarding 2a)

In principle, RSGB strongly supports the appropriate and technically correct application of ICNIRP 2020 Guidelines. But RSGB does not agree with the manner in which Ofcom proposes to achieve this within the Amateur licence. We also find many serious technical and drafting errors within the proposal.

Regarding 2b)

This part of the Ofcom proposals is undermined by serious technical and drafting errors. Regardless of any other merits, RSGB finds it impossible to support the proposal in its present form.

Ofcom's entire approach to achieving EMF Safety through power regulation is undermined by a lack of clarity about the basic concepts of "power" and "EIRP" in the context of radiation protection.

- For ICNIRP compliance purposes, "power" must be clearly defined as Average Power during the appropriately defined period of several minutes. This is nowhere made clear.
- Indiscriminate use of the "EIRP" (a far field concept) to calculate EMF exposures at very short distances from an antenna will frequently lead to either overestimates or underestimates of field strengths. To mandate this methodology creates a severe risk of unsafe advice and actions.
- Mobile and other forms of temporary operation (other than mobile phone handsets) are not addressed at all by the proposed regulations.

Question 3: Do you agree with our proposed guidance on EMF compliance and enforcement? Please explain the reasons for your response.

Again, RSGB finds this impossible to agree. The potentially helpful advice about achieving compliance is overbalanced by a heavy emphasis on enforcement and penalties.

- "Guidance", by its very nature, cannot include further elements of regulation. The enforcement provisions of the Wireless Telegraphy Act 2006 and their applicability under criminal law apply equally to all parts of the licence
- RSGB has good reason to be sceptical of Ofcom's capability to enforce any such licence conditions. The expertise required to inspect an Amateur station with regard to EMF compliance goes far beyond that needed to survey a mobile phone base station.

A Constructive Alternative

Instead of Ofcom's proposed mandatory form of "guidance", RSGB is enhancing its own training and guidance material. This is intended to complement an extension of the existing 'light' touch regulatory approach within the Amateur licence itself.

We also note that Ofcom's own (non-mandatory) Amateur Licence Guidance is currently silent on the entire topic of EM Field exposure, but we are prepared to discuss reasonable enhancements to that more appropriate document.

While taking account of the general guidance that Ofcom can provide, the RSGB guidance will be much more specific – and much more valuable – to Amateur Radio installations.

Please contact John Rogers, M0JAV emc.chairman@rsgb.org.uk if you need further advice.

Annex 3

Ofcom Consultation:

Proposed measures to require compliance with international guidelines for limiting exposure to electromagnetic fields (EMF)

Response by the Radio Society of Great Britain

June 5, 2020

The Radio Society of Great Britain (RSGB, www.rsgb.org) writes on behalf of its members and the wider Amateur Radio community in the UK.

Amateur Radio is a science-based technical hobby enjoyed by over three million people worldwide. It is fully recognised by the International Telecommunication Union (ITU) and is listed in the ITU Radio Regulations as the 'Amateur Service' and the 'Amateur Satellite Service'. RSGB participates in ITU conferences and is recognised as one of the leading national Amateur Radio organisations.

The Amateur Radio community in the UK already has a strong awareness of electromagnetic fields (EMF) in relation to antennas, propagation, licensing and safety. The current Amateur Licence already includes a schedule Note about EMF exposures [1].

We note that the present consultation has been largely prompted by public concerns about 5G, most of which are known to be unfounded. Nonetheless, RSGB takes EMF Safety very responsibly. We support the ICNIRP 2020 Guidelines [2] and welcome the opportunity to enhance our own guidance to Radio Amateurs.

However, RSGB is deeply concerned on both regulatory and technical grounds with the burdensome and disproportionate approach taken by the Ofcom proposals [3]. Specific areas of concern are highlighted in our answers to the consultation questions. Our response is supported by detailed factual evidence in the Annexes.

In their impact upon Amateur Radio, the current Ofcom proposals do not meet the statutory criteria for objective justification. Ofcom admits that it is not aware of any cases where the ICNIRP Guidelines have

been breached [3, para 4.11]; RSGB is likewise not aware of any such cases involving Amateur Radio. Those same observations were made 30 years ago, and formed the justification for the 'light touch' approach of the licence Note which remains equally valid today.

The proposed changes would have a damaging effect upon Amateur Radio in the UK while delivering little or no improvement in terms of EMF Safety.

Instead, RSGB offers a straightforward and constructive alternative (Annex 1): to continue the proven 'light touch' approach of the Amateur Radio Licence with only appropriate minor updates. To complement this, RSGB will develop further training and guidance materials (Annex 5) for EMF Safety, and invites Ofcom to do the same in its Guidance for Amateur Licensees [4].

Consultation Questions & Answers

Question 1: Do you agree with our proposal to take steps to mitigate risks related to EMF and be in a position to hold licensees, installers and users to account if issues are identified? Please explain the reasons for your response.

RSGB fully supports the ICNIRP Guidelines [2] and the principle that Radio Amateurs need to be aware of the risks relating to EMF exposure, and of the ways to mitigate those risks.

But RSGB does not agree with Ofcom's proposals to implement that principle by adding a major enforceable condition to Amateur licences. The main points are set out below; each one is supported by detailed evidence in the respective Annexes. Point 6 below offers a constructive alternative to handle this matter.

1. Statutory Requirements

The Communications Act 2003 [5] and the Wireless Telegraphy Act 2006 [6] together require that regulatory interventions by Ofcom:

- Must be proportionate, objectively justifiable, and targeted only at cases in which action is needed; and
- Must not impose burdens which are unnecessary.

For the Amateur Services, RSGB believes that the proposed enforcement regime will fail to meet any of those statutory requirements (Annex 2.1).

2. Lack of Objective Justification

The Amateur Licence includes a long-standing requirement that safety precautions should be taken against "radio frequency radiation". When this 'light touch' approach was originally introduced in 1992 [7] it was accepted by the National Radiological Protection Board (the predecessor of Public Health England) as being proportionate to the low levels of risk arising from Amateur Radio activities (Annex 2.3).

Nothing has changed to affect that judgement. Ofcom admits [3, para 4.11] that "we are not aware of any cases where the ICNIRP Guidelines have been breached." RSGB is likewise not aware of any such cases involving Amateur Radio. Therefore, as far as the Amateur Services are concerned, the current proposals do not meet the statutory test for objective justification.

3. Lack of Impact Assessment

RSGB strongly disputes the claim [3, paras 6.22-27] that the consultation document comprises its own impact assessment. Those six paragraphs are purely descriptive, not addressing any of the specific proposals; and elsewhere in the document the word "impact" is scarcely to be found. In fact, the document contains no impact assessment at all.

RSGB requests publication of the Equality Impact Assessment cited in paras 6.25-6.27, and of all other Ofcom documents related to the impact of the current proposals upon different identifiable groups of licensees.

4. Disproportionate

We emphasise that the impact of these proposed changes upon the Amateur Radio Services will be disproportionate to the related risks of harm. Ofcom already acknowledges this risk to be small (see point 2 above). In our view, therefore (Annex 3):

- The administrative impact of the proposed regulations upon the Amateur Radio Services would be considerable, the more so because individual Amateurs typically have several different use-cases (frequency bands, power, antennas, modes; at home or away), each of which would require detailed documentation;

  Because Amateur Radio is by definition an experimental pursuit, the administrative impact would also be continual and open-ended;

- The operational impact would be highly disruptive until all necessary EMF assessments had been completed – and almost all would merely confirm that no operational changes are required.

5. Discriminatory

Those onerous and disproportionate regulatory demands would fall most heavily upon the sector of spectrum users who are least equipped to meet them: the non-commercial sector, which includes some 60,000 individual Radio Amateurs. This raises strong questions about discrimination.

We note in Annex 2.2 that the Ofcom proposals appear to be double regulation for commercial spectrum users. The Health and Safety at Work Etc Act already includes a general duty for protection of the public as well [8]. The ICNIRP Guidelines are already implemented by specific regulations under that Act [9, 10] and by compliance with Planning regulations [11] (see Annex 2.2 for details). Commercial licensees will thus have procedures for assessments and filing already in hand.

But non-commercial licensees will not. The new and burdensome regulatory impact would thus fall most heavily upon those who have the fewest resources to meet those demands. In our view that would constitute discrimination – all the more so because Ofcom admits there is no objective evidence that the Amateur Services require such regulations (see point 2 above).

6. A Constructive and Proven Alternative

RSGB strongly recommends a continuation of the 'light touch' regulation of EMF Safety within the Amateur Licence, which has been proven over the past 30 years (details in Annex 2.3).

In line with that evidence and the need for a more proportionate approach, in Annex 1 we propose a more appropriate amendment of the existing Note to Schedule A of the Amateur Licence concerning EMF Safety, updating the terminology to directly reference the latest ICNIRP Guidelines [2].

To complement this, RSGB intends to update and enhance its own guidance on EMF Safety (Annex 5) and is also ready to discuss a future revision of Ofcom's Amateur Licence Guidance [4] which currently does not address the topic.

Question 2: Do you agree with our proposal

a) to include a condition in spectrum authorisations requiring compliance with the basic restrictions for general public exposure identified in the ICNIRP Guidelines

In principle, RSGB strongly supports the appropriate and technically correct application of ICNIRP 2020 Guidelines.

But RSGB finds it impossible to agree with the manner in which Ofcom proposes to achieve this within the Amateur Licence. We also find many serious technical and drafting errors within the proposal (see below and Annex 4 for details).

Question 2: Do you agree with our proposal

b) that this condition should apply to equipment operating at powers greater than 10 Watts?

This part of the Ofcom proposals contains many serious technical and drafting errors.
Regardless of any other merits, RSGB finds it impossible to support the proposal in its present form.

Ofcom's approach to achieving EMF Safety through power regulation is undermined by a lack of clarity about basic concepts summarised below.

- Serious technical errors in making reference to the ICNIRP Guidelines [2];
- Definition of "power": for ICNIRP compliance purposes, "power" must be clearly defined as Average Power during the appropriately defined period of several minutes [2]. This is not made clear;
- Indiscriminate use of the "EIRP" concept to regulate EMF exposures. At very short distances from an antenna, this method of calculating field strengths will frequently produce inaccurate results that could be either overestimates or underestimates. To make this methodology mandatory creates a severe risk of unsafe advice and actions – none of which must ever be allowed;
- Definition of a "site", and resulting lack of consideration about Mobile and Temporary operation which will affect numerous users, not least the Emergency Services – and of course Radio Amateurs;
- Differences between supervised and unsupervised operation.

Further details of each of these points are given in Annex 4.

Question 3: Do you agree with our proposed guidance on EMF compliance and enforcement? Please explain the reasons for your response.

Again, RSGB regrets that it is impossible to agree with the proposed "guidance" which is seen to contain further elements of regulation. The potentially helpful advice about achieving compliance is overbalanced by a heavy emphasis on enforcement and penalties.

1. Overall Approach

"Guidance", by its very nature, cannot include further elements of regulation. The enforcement provisions of the Wireless Telegraphy Act 2006 [6] and their applicability under criminal law already apply equally to all parts of the licence; they are set out already on Ofcom's website as applying generally to all users. It is incorrect to include them again within one part of the licence.

It also implies that enforcement may be particularly applied in this specific area. That appears threatening, and might also encourage unfounded accusations against individual Amateur licensees (of the type that have already been made about 5G).

2. Enforcement

RSGB already has reason to be sceptical of Ofcom's capability to enforce any such licence conditions. The expertise required to inspect an Amateur station with regard to EMF compliance goes far beyond that needed to survey a mobile phone base station.

3. A Constructive and Proven Alternative

Instead of Ofcom's minatory form of "guidance", RSGB is enhancing its own training and guidance material (Annex 5). This is intended to complement a continuation of the existing 'light touch' regulatory approach within the Amateur Licence itself.

While taking account of any general guidance that Ofcom can provide, RSGB guidance will be more specific – and thus much more valuable – to Amateur Radio installations. Annex 5 outlines the types of guidance that will be developed.

Annexes and References

Additional material forming part of the RSGB response can be found on the following pages.

Annexes

Annex 1: Alternative Amendment to the Existing Amateur Licence

Ofcom licenses amateur radio in the UK using a number of key elements:

- UK Amateur Licence conditions (for Foundation, Intermediate, Full and foreign visitors) [1];
- Ofcom Guidance for the UK Amateur Licence [4];
- Variations of the licence to facilitate repeaters, gateways, beacons and a small number of 'special research permits'.

The present consultation directly concerns only the core Amateur Licence [1]. With respect to EMF Safety, the licence currently includes the following Note, applicable to all holders and power levels:

> "In all frequency bands, high intensities of radio frequency radiation may be harmful and safety precautions should be taken. Advice concerning safe levels of exposure to radio frequency radiation is provided by Public Health England."

This condition reflects the 'light touch' approach to regulation of EMF Safety within the Amateur licence that has proven successful for 30 years, needing only the most minor of amendments and updates. This has been supported by RSGB in terms of information and training (Annex 5).

We remind Ofcom that this approach, along with the original text of the licence Note [7], was agreed by the National Radiological Protection Board (the predecessor of Public Health England) as being proportionate to the objective level of risk. As established in response to Question 1, nothing has changed to affect that view.

In line with that evidence, and in line with the need for a proportionate approach, RSGB recommends the following strategy:

- A modest update to the existing Note to Schedule A of the Amateur Licence concerning EMF Safety (proposed new wording in red):

  > In all frequency bands, high intensities of radio frequency radiation may be harmful and safety precautions should be taken. Guidelines for limiting exposure to radio frequency radiation are provided by the International Commission on Non Ionizing Radiation Protection (ICNIRP).

To be complemented by:

- New, non-mandatory guidance from Ofcom about EMF Safety in Amateur Radio (noting that the current Ofcom Guidance for the UK Amateur Licence [4] is silent on this topic).
- New and enhanced training materials from RSGB to raise awareness of EMF Safety among Radio Amateurs, and to help with EMF assessment (Annex 5).

Taken together, these measures will meet all rational requirements for EMF Safety in the Amateur Radio Services.

Annex 2: Statutory Issues and Proven Precedent

This Annex identifies the statutory requirements for new regulatory interventions by Ofcom. It also relates the history of the current 'light touch' approach to EMF Safety in the current Amateur Licence.

1. Statutory Requirements

The Communications Act 2003 [5] requires that regulatory interventions by Ofcom must be:

- "proportionate"; and
- "targeted only at cases in which action is needed"; and that Ofcom has a duty to ensure its regulatory work:
- "does not involve the imposition of burdens which are unnecessary".

Furthermore, the Wireless Telegraphy Act 2006 [6] establishes that licence terms, provisions and limitations must be:

- "objectively justifiable", "proportionate" and "non-discriminatory".

RSGB does not consider that the proposed enforcement regime will meet those legal requirements regarding their specific effects upon Amateur Radio.

2. Multiple Regulation

For commercial spectrum users, the Ofcom proposals appear to constitute multiple regulation. Although this is not directly the business of RSGB, we make this point to emphasise that the impact of any new regulations would fall most heavily upon non-commercial spectrum users, including Radio Amateurs.

The Health and Safety at Work Etc Act regulates the workplace activities of all commercial spectrum users. But Section 3 of that Act also establishes a general duty for protection of the public in general [8]:

> *General duties of employers and self-employed to persons other than their employees.*
> *(1) It shall be the duty of every employer to conduct his undertaking in such a way as to ensure, so far as is reasonably practicable, that* ***persons not in his employment*** *who may be affected thereby are not thereby exposed to risks to their health or safety.*

For commercial spectrum users, compliance with the ICNIRP Guidelines is already implemented by the related Control of Electro-magnetic Fields at Work Regulations 2016 (CEMFAW) [9]. In HSE terminology, 'Exposure Limit Values' are legal limitations that are directly based on the ICNIRP Basic Restrictions. 'Action Levels', relating to quantities that can be measured more easily, are directly based on ICNIRP Reference Levels and have the same purpose. For further explanation, see the HSE Guide to the CEMFAW Regulations [10].

ICNIRP Guidelines are also implemented by the mobile network operators, by a voluntary agreement under the Code of Best Practice on Mobile Network Development [11]. Under this code, the EMF Safety section of which was developed together with Public Health England,

‘ICNIRP compliance certificates’ are routinely submitted in Planning applications, and are required by local authorities under their own codes.

Therefore commercial spectrum users are already well equipped to make the EMF Safety assessments required by the CEMFAW Regulations and by Planning Control regulations where applicable.

But non-commercial spectrum users – including Radio Amateurs – are not. The full implications of this point are examined in Annex 3.

3. Proven Precedent for Amateur Radio

There is a long-standing requirement in the Amateur Licences that safety precautions should be taken against “radio frequency radiation” in line with Public Health England (PHE) recommendations [1]. This is also noted in the Ofcom FAQs [12, page 3]. The syllabus for the Amateur licence examinations also covers this topic.

This ‘light touch’ approach was originally introduced in the early 1990s [7] following consultations between the Radiocommunications Agency (predecessor of Ofcom), the National Radiological Protection Board (NRPB, predecessor of Public Health England) and RSGB. It was agreed by all three bodies as being proportionate to the low levels of risk arising from Amateur Radio activities.

In the following 30 years, nothing has objectively changed to affect that judgement.

We note that Ofcom’s proposal has arisen because of current health concerns relating to 5G; but in the consultation document [3, para 4.11] Ofcom explicitly admits that it is not aware of any cases (including 5G) where the ICNIRP Guidelines have been breached. RSGB is likewise not aware of any such cases involving Amateur Radio.

In short, the proposal does not meet Ofcom’s own criteria for evidence-based regulation. On the contrary, RSGB concludes that the existing ‘light touch’ regulation has proved successful and remains fit for purpose.

However, RSGB does welcome this opportunity to review and enhance its existing information and training materials about EMF Safety. Work has already started on this and we will be pleased to co-operate further with Ofcom in updating its Guidance for Amateur Licensees about this topic [4].

Annex 3: Impact and Discrimination

The consultation document [3] overlooks the significant and selective impact upon those members of the public who are Radio Amateurs. This also raises serious questions of discrimination.

RSGB and Ofcom have worked hard together to make Amateur Radio available and accessible to all sectors of the public. The tone and the content of the proposed regulations place that good work under threat.

1. Impact Vastly Outweighs Benefit

It is claimed [3, para 6.22] that the consultation document comprises its own impact assessment. If so, that assessment is seriously deficient in ignoring the impact upon Amateur Radio.

There are some 60,000 Amateur Radio licensees in the UK, with perhaps 30,000 individuals currently 'active' in some sense. The proposed regulations would require each of those individuals to spend a considerable amount of time and effort in preparing paperwork and assessments. Unlike many commercial spectrum users, individual Amateurs typically have several different use-cases (frequency bands, power, antennas, modes; at home or away), each one of which would require detailed documentation. Essentially, such a demand would be continual and open-ended.

In addition, we are deeply concerned that the regulations would deter the welcome influx of newcomers to Amateur Radio via the Foundation licence, thus undermining the future of muchneeded RF-related skills and understanding in the UK.

The proposed regulations would interrupt the activities of every active (and prospective) Radio Amateur until those assessments had been completed, because it would be a criminal offence to go on the air without having done so. Yet almost none of those assessments would ever be examined by Ofcom (who do not even have resources to investigate existing levels of EMC complaints that Radio Amateurs have raised).

It has also been established in response to Question 1 that, for Amateur Radio, there will be little or no actual benefit in terms of EMF Safety because the risks are already low. Therefore there is no case for demanding that ICNIRP compliance assessments must be made in advance of any question arising.

RSGB training materials will help Amateurs to understand when an informal assessment might be required, and will help to show them how to do that – but a formal, mandatory assessment should only be triggered in the same way as an EMC investigation, when an actual question has arisen.

2. Discrimination

In all other respects, Radio Amateurs are ordinary members of the public. They have no access to any professional resources. The unreasonable demands being placed upon each of those 60,000 individuals – under threat of criminal sanctions – along with the lack of either an objective or an administrative need, in our opinion constitute a strong case for discrimination.

The proposed regulations would place even more discriminatory demands upon those members of the Amateur Radio population who would have particular difficulty in fulfilling the complicated requirements. These groups would include (in no particular order) the partially sighted, the disabled, the

young, the vulnerable and the elderly.We note with particular interest that the professed purpose of Ofcom's Equality Impact

Assessments is "making sure that we are meeting our principal duty of furthering the interests of citizens and consumers, regardless of their background and identity." [3, para 6.26]. Therefore...

RSGB requests immediate disclosure of Ofcom's Equality Impact Assessment for the proposed regulations, along with all other assessments that have been carried out pertaining to these proposals.

Annex 4: ICNIRP and other EMF Safety Topics

This Annex draws attention to several drafting errors, conceptual errors and/or omissions, potentially leading to serious unintended consequences for EMF Safety.

Many of these issues arise from Ofcom's current preoccupation with 5G base stations, overlooking many other types of licensed spectrum users – including Radio Amateurs.

1. Power and EIRP

Concepts used in the regulation of "emissions" for radio communication purposes are not automatically transferable into regulations for EMF Safety.

- **Unclear use of "power"** For radio communication, "power" is normally assumed to mean Peak Envelope Power. However, for ICNIRP compliance purposes "power" must be defined as Average Power during the appropriately defined period of several minutes [3]. This is nowhere made clear.

- **Misunderstanding of "EIRP"**

  EIRP is defined only for purposes of communication over long distances, where antenna gain in a given direction is correctly assumed to be constant in value [13 a-c]. But EMF Safety is mostly concerned with the near-field region close to the antenna, where field strengths are usually highest but antenna gain is no longer constant. Depending on the type of antenna, local field strengths in the near field may vary either upward or downward from values calculated using the far-field EIRP formula.

  To make this methodology mandatory thus creates a severe risk of unsafe advice and actions – none of which must ever be allowed.

2. ICNIRP Guidelines

The key licence condition in the current proposals is paragraph 4.30 [3]. This contains errors in citing the ICNIRP Guidelines [2].

- It is categorically incorrect to require that "...the total emissions from all radio equipment on the site is *[sic]* below the basic restrictions..." ICNIRP Basic Restrictions do not apply to emissions; they apply to any EMF exposures that might result.
- There is insufficient recognition that EMF exposures can only occur where people are actually present. That condition is implicit in all of the ICNIRP Guidelines, but when defining the scope of regulations it needs to be recognised explicitly. The control measures necessary to achieve this are a different issue (see 4 below).
- In the same sentence of para 4.30, only Table 4 contains Basic Restrictions. Table 5 contains Reference Levels ("5" may be a typing error).
- For assessment of a multi-transmitter site, the licence condition must specifically require the ICNIRP methodology for the 'Simultaneous Exposure to Multiple Frequency Fields' [2].

We also note that no operator at or near a multi-transmitter site can make a valid assessment unless the proposed regulation includes a duty upon every operator at that site to disclose the necessary information to others.

3. Mobile and Temporary Operation

Mobile and other forms of temporary operation are not addressed at all by the proposed regulations (except for mobile phone handsets). This is part of the wider lack of clarity identified above, about the meaning and implications of the term “site”.

For mobile transmissions when in motion, there is no “site” in any meaningful sense. It is legally unclear what mobile operators – any mobile operators, Radio Amateurs included – are expected to do to achieve ICNIRP compliance.

It should also be noted that operators of mobile and portable equipment routinely take advantage of “good radio locations” that are already shared by a fixed site nearby. Under the proposed regulations, the operator(s) of the fixed site would have made an EMF assessment, but other nearby users could have no idea how close the predicted exposures come to the ICNIRP Reference Levels.

It is not suggested that any of those scenarios constitutes a danger; but as written, the proposed licence condition creates uncertainty for all the users affected. They cannot know what the law expects of them, and have no practical means of finding out.

Those affected by the uncertainty in the present proposals include the Emergency Services; the Media, the Banks and others with their vehicle mounted satellite dishes; and mobile and temporary operations in general – including Amateur Radio operators.

4. Supervised and Unsupervised Operation

In terms of EMF Safety, the proposed regulations fail to recognise any difference between supervised and unsupervised operation. On-site supervision can be of great value in the protection of individuals and the public against excessive EMF exposures. A trained supervising operator is uniquely placed to take all necessary actions:

- Confirm, before transmitting, that no persons are present at a location where an ICNIRP Basic Restriction or Reference Level could be exceeded; and then
- Exercise appropriate control over transmissions taking place.

Usefully, supervised operation is already defined in the Amateur Licence: “[where] operation of the Radio Equipment is carried out in the presence of and under the direct supervision of the Licensee”. In practical terms, the vast majority of Amateur Radio activities would thus be able to use the advantages of supervised operation to help ensure EMF Safety.

The same concept of supervised operation would also clarify what can be realistically expected of mobile operators (see point 3 above).

RSGB intends to pursue this concept in its own training and guidance material for Radio Amateurs (Annex 5).

Annex 5: RSGB Training Proposals

RSGB already includes RF Safety, including EMF exposure, within its formal training syllabus and is already taking this opportunity to develop additional guidance and training materials to enhance awareness of EMF Safety issues.

These proposals complement our recommendation that Ofcom should retain its proven 'light touch' regulatory approach to this topic.

The intention is to support individual Radio Amateurs in taking personal responsibility for the protection of themselves, their family, friends and neighbours, and any other members of the public who might be affected by their Amateur Radio activities.

1. Radio Amateur Examination Syllabus

The contribution of the existing Radio Amateur Examinations towards promoting EMF Safety should not be overlooked. The Syllabus [14], which was last updated in September 2019, directly addresses the safety issues related to EMF exposure. Our Foundation entry-level (which is limited to 10W PEP) includes the following syllabus items:

- *8D1: Recall that the main health effect of exposure to electromagnetic radiation is heating of body tissue and that the eyes are particularly susceptible to damage.*
- *8D2: Recall that guidance on safe levels of RF radiation is available from government and international bodies, Public Health England and the International Commission on NonIonizing Radiation Protection (ICNIRP).*
- *8D3: Recall what a waveguide is and why it is unwise to look down a microwave frequency waveguide or to stand close to or in front of high-gain antennas as they may be in use.*

These "Recall" items and the related examination questions require the candidate to demonstrate that they know a fact.

Moving up through Intermediate and finally to Full level, the syllabus reiterates the need to be aware of the guidance issued by ICNIRP, and to have a deeper understanding of the issues of RF exposure including to members of the public:

- *8D1: Recall that the International Commission for Non-Ionizing Radiation Protection (ICNIRP) produces guidance for exposure to Radio Frequency fields.*
- *8D1: Understand it is not advisable to exceed the recommended safe exposure levels and that this is particularly applicable at locations open to the public.*

In the syllabus, the term "Understand" calls for a more detailed knowledge of the subject, fully appreciating why the point is correct and the range of circumstances in which it is relevant and applicable. Typically, candidates will need to make judgements or apply good practice to a wider range of circumstances.

2. Beyond Exams – Tailored Assistance and Guidance

This section outlines some possible topics to be covered in RSGB's package of enhanced guidance and learning materials. This caters for existing longer-established amateurs who may not be currently in the formal exam and training course system.

Audiences and Delivery

Material would be made available for all three levels of the UK Amateur licence.
Media for delivery will include leaflets, talks, videos, software tools, and articles in RSGB's *Radcom* magazine, which is delivered to 20,000 RSGB members. In some respects, this would emulate the assistance we already provide for EMC matters.
Materials will also be tailored to specific interest groups within the Amateur Radio community (bearing in mind that practical EMF Safety is very frequency-specific). For example, RSGB plans to update and re-publish the comprehensive information about microwave EMF Safety that first appeared in the *RSGB Microwave Handbook* [15].

Concepts

Each of the following points would be delivered at an appropriate technical level for the three classes of Amateur licence.

- ICNIRP Guidelines, Basic Restrictions and Reference Levels; basic reasons why Reference Levels in particular vary with frequency ○ Understanding responsibilities

and that EMF Safety is targeted at people (not locations or equipment)

- Good practice in EMF Safety (making links to good practice in RF engineering and in EMC 'housekeeping')

Practical Topics

Each topic area would be developed with the aid of practical examples and materials to support Amateurs in making their own EMF Safety assessments.

- Indoor EMF Safety
- Outdoor Antennas and EMF Safety
- Special features of portable and mobile operation ○ Special features of HF operation ○ Special features of VHF/UHF operation ○ Special features of microwave operation.

References

[1] UK Amateur Radio Licence: https://www.ofcom.org.uk/__data/assets/pdf_file/0027/62991/amateur-terms.pdf

[2] International Commission on Non-Ionizing Radiation Protection (ICNIRP), Guidelines for Limiting Exposure to Electromagnetic Fields (100 kHz to 300 GHz), 2020. https://www.icnirp.org/cms/upload/publications/ICNIRPrfgdl2020.pdf

[3] Ofcom, Proposed Measures to Require Compliance with International Guidelines for Limiting Exposure to Electromagnetic fields (EMF), 2020. https://www.ofcom.org.uk/consultations-and-statements/category-1/limiting-exposure-to-emf

[4] Ofcom, Amateur Radio Licence, Guidance for Licensees: https://www.ofcom.org.uk/__data/assets/pdf_file/0026/82637/amateur_radio_licence_guidance_for_licensees.pdf [5] Communications Act 2003.

[6] Wireless Telegraphy Act 2006.

[7] Amateur Radio Licence (A) or (B) Terms, Provisions and Limitations Booklet BR68, 1992 (as revised).

[8] Health and Safety at Work Etc. Act 1974, section 3: http://www.legislation.gov.uk/ukpga/1974/37/section/3

[9] Control of Electromagnetic Fields at Work Regulations 2016: http://www.legislation.gov.uk/uksi/2016/588/pdfs/uksi_20160588_en.pdf

[10] Guide to the Control of Electromagnetic Fields at Work Regulations: https://www.hse.gov.uk/pubns/priced/hsg281.pdf

[11] Mobile UK, Code of Best Practice on Mobile Network Development in England, 2016: https://uploads-ssl.webflow.com/5b7ab54b285dec5c113ee24d/5d5d4cd69a3f3827f30d06e9_Codes%20of%20Practice.pdf (similar codes apply in Scotland and Northern Ireland)

[12] Ofcom, Consultation on New EMF Licence Condition - FAQs (revised 7 April 2020): https://www.ofcom.org.uk/__data/assets/pdf_file/0026/193625/emf-faqs.pdf

[13] (a) Harald Friis, “A Note on a Simple Transmission Formula,” Proc. IRE, 34, 1946, pp. 254256. This is the fundamental paper upon which the entire E(I)RP concept is based. It is only applicable for plane waves in free space; which only applies in the far field of any antenna and categorically excludes the near field.
(b) https://en.wikipedia.org/wiki/Effective_radiated_power Unlike many other sources, Wikipedia clearly emphasises that the “EIRP” concept only applies to the far field. (c) ITU Radio Regulations, 1.160–1.162.

[14] RSGB Exam Syllabus: https://rsgb.org/main/clubs-training/for-trainers/syllabus-2019/ [15] RSGB, *Microwave Handbook*, *volume 2*, 1991. ISBN 1 872309 01 1.