

Ofcom Consultation:

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

Response by the Radio Society of Great Britain

November 13, 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.

Following the first Ofcom EMF consultation, the RSGB is grateful for the opportunity to respond to this further consultation regarding proposed updates and implementation of the Ofcom regulations and guidance

Our response includes detailed answers to the three Ofcom questions along with additional comments and information.

The RSGB acknowledges that having a clear regulatory policy on EMF provides a sound basis for managing RF health risks.

RSGB is developing add-on sheets to the Ofcom 'EMF Calculator' that take well understood radio parameters as inputs and derive the inputs that the calculator requires. An example of this development is included in this document as part of the additional assistance we plan.

Notwithstanding this, the RSGB reiterates its original position that Ofcom retains a 'light touch' approach and only consider the simplest possible obligation within the amateur licence itself, whilst complementing that with either its proposed new EMF guidance and/or updates to more specific amateur guidance.

Consultation Questions & Answers

Question 1: Please provide feedback on the additions, amendments, and clarifications we have made to the wording of the licence condition to implement our decisions on the scope of the licence condition

Reference		Comment
1.	General	<p>The RSGB reiterates its earlier request for Ofcom to consider a simpler obligation and better guidance and training, rather than the proposed new licence condition. The RSGB acknowledges that having a clear regulatory policy on EMF provides a sound basis for managing RF health risks.</p> <p>a) The approach to managing EMF exposure from the amateur service should be proportionate to the very low level of risk and based on encouraging compliance.</p> <p>b) Guidance for the amateur service is needed on what training and assessment methods are acceptable to Ofcom, and the criteria for such acceptance. Ofcom should formally adopt the concept of “continuous improvement” so that new guidance can continue to develop. A framework should be set up for agreeing and publishing this.</p> <p>c) The current EMF exposure assessment standards used by professional radio services (e.g., IEC/CENELEC standards for broadcast and mobile communications services) have been developed over many years but do not cover the range or types of activities commonly undertaken by radio amateurs. Therefore RSGB, in collaboration with the Amateur Radio Relay League (our counterpart in the USA), is developing necessary guidance to fill this gap. Time needs to be allowed beyond the Ofcom-proposed 6-month implementation period for this process to mature.</p> <p>d) Ofcom should avoid the use of categorical words such as “safe”. This is widely recognised as bad practice in the management of controversial issues because, by over-claiming, it allows others to counterclaim that exceeding the ICNIRP reference levels is categorically “unsafe”. For this issue, the correct and neutral word would be “compliant”.</p>

Reference		Comment
2.5	<ul style="list-style-type: none"> “Accessible to the general public” 	<p>RSGB has serious concerns about the use of “<i>accessible to the general public</i>” as the criterion for identifying areas of non-compliance. It is not accessibility that is a problem, it is someone being there when transmission takes place.</p> <p>Every occurrence of “<i>...in any area that is accessible to the general public</i>” should be amended to: “<i>...in any area where a member of the general public is present when transmissions are taking place.</i>”</p> <p>This specific wording supports compliance through two different and equally justifiable means of mitigation. For EMF exposure to exceed the relevant basic restrictions, at least two conditions must apply concurrently:</p> <ul style="list-style-type: none"> The EMF levels (subject to appropriate time/spatial averaging) exceed a threshold at a location of interest One or more persons must be present at that location of interest for human exposure to take place. <p>By definition, compliance with the ICNIRP basic restrictions at a location of interest is achieved at any time when there are no people present – irrespective of the level of EMF.</p> <p>Compliance may therefore be achieved through mitigation and/or management of either of these conditions (risk management).</p>
2.5	<ul style="list-style-type: none"> Reference to ICNIRP 1998 	<p>Good change. Initially, the guidance should deem it acceptable to assess compliance based on either ICNIRP 1998, or ICNIRP 2020.</p>
2.5	<ul style="list-style-type: none"> Electromagnetic field exposure levels 	<p>This change is consistent with the aim to manage human exposure to EMF, as distinct from the fields themselves.</p>
2.5	<ul style="list-style-type: none"> Compliance with basic restriction 	<p>This change is consistent with ICNIRP guidance and a useful regulatory clarification.</p>
2.5	<ul style="list-style-type: none"> Records to be kept 	<p>This may not be proportionate for radio amateurs whose “self-training” includes experimentation and leads to frequent changes of equipment configuration. It is also counter to the 2006 removal of mandatory logbooks for amateurs</p> <p>Further, for Foundation licence holders, this is an unreasonable expectation for the extremely low risks at their 10W licensed power level.</p>
2.5	<ul style="list-style-type: none"> Limited exemptions 	<p>Good change.</p>

Question 2: Please provide feedback on the additions and clarifications to our 'Guidance on EMF Compliance and Enforcement', giving reasons for your response.

Reference	Comment
2.6	<ul style="list-style-type: none"> • EMF calculator <p>This is welcomed, but it has limitations. RSGB recommends it is used as one part of a broader compliance framework. See specific comments in response to Question 3.</p>
2.6	<ul style="list-style-type: none"> • Additional standards <p>The range of amateur and amateur satellite service activities is so wide and the type of use so different there is a requirement for new standards / guidelines endorsed by Ofcom to clarify compliance assessment. The amateur service covers a frequency range of 136 kHz to 250 GHz – a factor of two million spanning a huge range of different and changing technologies. No commercial communications licence has such range or diversity.</p>
2.6	<ul style="list-style-type: none"> • Clarify expectations on re- assessment <p>The continual experimentation inherent in the objectives of the amateur service indicates that this aspect should be considered further and guidance provided that clarifies proportionate risk management requirements.</p>
2.6	<ul style="list-style-type: none"> • Non-permanent location <p>Such guidance is useful, but needs to be reviewed in the context of the amateur service to be made practical.</p>
2.6	<ul style="list-style-type: none"> • Shared site exemptions <p>Noted – most likely to impact amateur service repeaters, beacons, or remotely-operated stations.</p>
2.6	<ul style="list-style-type: none"> • 6 months before enforcement <p>Consider:</p> <ol style="list-style-type: none"> a) The amateur service covers a frequency range far greater than any commercial communications licence. b) The absence of standards pertinent to assessing EMF exposure from the range of amateur activities. c) The time taken by commercial radio operators to respond to these types of changes was several years. <p>Therefore, requiring radio amateurs to establish analysis methods, agree them with Ofcom/PHE and then implement assessments within a 6-month period is unreasonable and disproportionate to the actual risks. The timing and practical expectations for amateur compliance assessment should be considered further.</p>

Additional comments on Ofcom Annexes A1 and A2 regarding Licence Condition and Guidance

Reference	Comment	How to fix
A1 "EIRP"	<p>The use of EIRP in this context is inappropriate</p> <p>a) EIRP is calculated using the impedance of free space which is applicable only in the far-field</p> <p>b) EIRP is not a valid concept in the near-field</p> <p>At amateur power levels and frequencies below 100 MHz compliance with ICNIRP guidelines is almost exclusively a near-field issue.</p>	<p>Need to include considerations for near-field compliance assessment which EIRP cannot address.</p>
A1 "ICNIRP guidelines" Footnote 6	<p>What is the definition of the "relevant time" and "used" in the context of a radio amateur sporadically operating his/her station?</p>	<p>A realistic time should be allowed for a reassessment after a change in an amateur's station setup.</p>
A1 "ICNIRP guidelines" Footnote 6	<p>For the amateur service, there are no adequate IEC, CENELEC or Ofcom standards that cover the scope of the amateur licence for compliance assessment based on ICNIRP guidelines.</p>	<p>Before compliance becomes enforceable, Ofcom should work with the RSGB (and others) to develop appropriate compliance assessment standards and practices.</p> <p>There should be an adequate implementation period for radio amateurs to adopt and use these.</p>
A1 "Relevant radio equipment"	<p>Use of EIRP as the only criterion for exemption is not always appropriate.</p> <p>The 10W EIRP threshold would unfairly add to the burden and deter new Foundation licensees.</p>	<p>Exemption and or pre-screening inherent compliance should consider real power available as well as or instead of the EIRP.</p> <p>Ofcom should also consider exempting Foundation licensees, who are permitted to transmit up to 10W PEP. Added guidance that any antenna, (not provided integral to the radio equipment) should be "out of reach" of anyone when transmitting, that should be sufficient for compliance.</p> <p>This might be delivered as a "screening requirement" (see flow diagram in response to question 3 below).</p>

Reference	Comment	How to fix
A1 1. A1 3.	<p>The assessment of compliance with ICNIRP should recognise that for there to be an exposure problem, at least two conditions must apply concurrently:</p> <ul style="list-style-type: none"> • The EMF levels (subject to appropriate time averaging) exceed a threshold at a location of interest • One or more persons are physically present at the location of interest. 	<p>Replace “...in any area that is accessible to the general public.” with “...in any area where a member of the general public is present when transmissions are taking place.”</p>
A2.3	<p>According to A1 footnote 6, Ofcom intends to change to the ICNIRP 2020 guidelines when work on compliance standards has progressed sufficiently.</p>	<p>RSGB is developing guidance and advice based on ICNIRP 2020 guidelines. Recommendation: Compliance with ICNIRP 1998 or ICNIRP 2020 should be “deemed satisfactory”</p>
A2.9	<p>In the event that a visitor to an amateur radio station is also a radio amateur, then it should be understood that in this case, such visitor is also exempted.</p>	<p>Clarify that any amateur licensee is considered to be covered by the “user of radio equipment” exemption from these regulations when visiting or resident at the station.</p>
A2.10, A2.11, A2.12	<p>Need to recognise the possibility either to control access and/or to control transmission as equally valid methods of limiting human exposure.</p>	<p>For clarity and emphasis, replace “...in any area that is accessible to the general public.” with “...in any area where a member of the general public is present when transmissions are taking place.”</p>
A2.13	<p>Need to reference ICNIRP 2020 for radio amateurs</p>	<p>See earlier comment A2.3</p>
A2.16	<p>Calculator is a good initiative, but it uses terms not familiar to most amateurs. RSGB is developing a front sheet to allow amateurs to input their known station parameters and uses these to calculate the inputs the Ofcom calculator requires.</p>	<p>The Ofcom calculator assesses compliance. It should NOT be interpreted to state that a given situation is non-compliant. Just that more detailed work is needed to determine compliance.</p>
A2.18, A2.19, A2.20, A2.21	<p>This is of limited value to radio amateurs since many licensed activities fall outside the scope of the listed standards.</p>	<p>Need to agree a set of activities between Ofcom, PHE, RSGB and possibly standards bodies to develop material appropriate to the amateur service.</p>

Reference	Comment	How to fix
A2.23	<p>The RSGB agrees with the principle. However, the use of the word “safe” is most inappropriate here.</p> <p>The ICNIRP occupational reference levels are way below the level that some people might possibly start to experience adverse health effects. Then ICNIRP reference levels for the general public are then set a further factor below the corresponding occupational reference levels providing a large contingency factor.</p>	<p>See comment 1. d)</p> <p>Consider alternative expression:</p> <p>Licensees, installers and users should be aware of the locations where exposure may exceed relevant ICNIRP general public exposure limits; and where necessary, undertake a risk assessment and have measures or mitigations in place to ensure that members of the public are not in fact exposed above those limits.</p>
A2.24	<p>The time averaging is amended in ICNIRP 2020 – Whole body = 30 mins, Local = 6 mins, with further complications for durations less than 6 mins.</p>	<p>This should be covered as part of the A2.23 risk assessment and consequential measures and mitigations.</p>
A2.26	<p>The purpose of the amateur service is to engage in experimentation and self-training. There are numerous amateur bands covering the spectrum between 136 kHz and 24 GHz in regular use, each different from its neighbours with higher mm bands up to 250 GHz in the licence. This means that it will be commonplace for antennas to be tried out, modified, moved, raised, lowered, rotated etc. on a continual basis.</p>	<p>Reassessing compliance with ICNIRP and recording this level of detail could be extremely onerous for amateurs. Therefore, good practice needs to be defined in practical terms before this condition comes into force.</p>
A2.27	<p>The 6-month period is unreasonable for the amateur service.</p>	<p>Regulatory practice and compliance can be improved in stages through cooperation between Ofcom, PHE and RSGB representatives and delivered for example as:</p> <ul style="list-style-type: none"> • Information and education campaign for all existing amateurs • Improved exam syllabus for new and upgrading amateurs • General good practice guidance • Simple guidelines that disallow or deprecate bad practice, and thus set reasonable boundaries for compliance assessment • Possibly the development of new IEC/IEEE standards/recommendations

Question 3: Please provide feedback on the trial version of our EMF calculator, giving reasons for your response.

A Compliance Assessment Framework is missing

A framework is required to show how compliance may be demonstrated and how the Ofcom EMF calculator is applied in that framework.

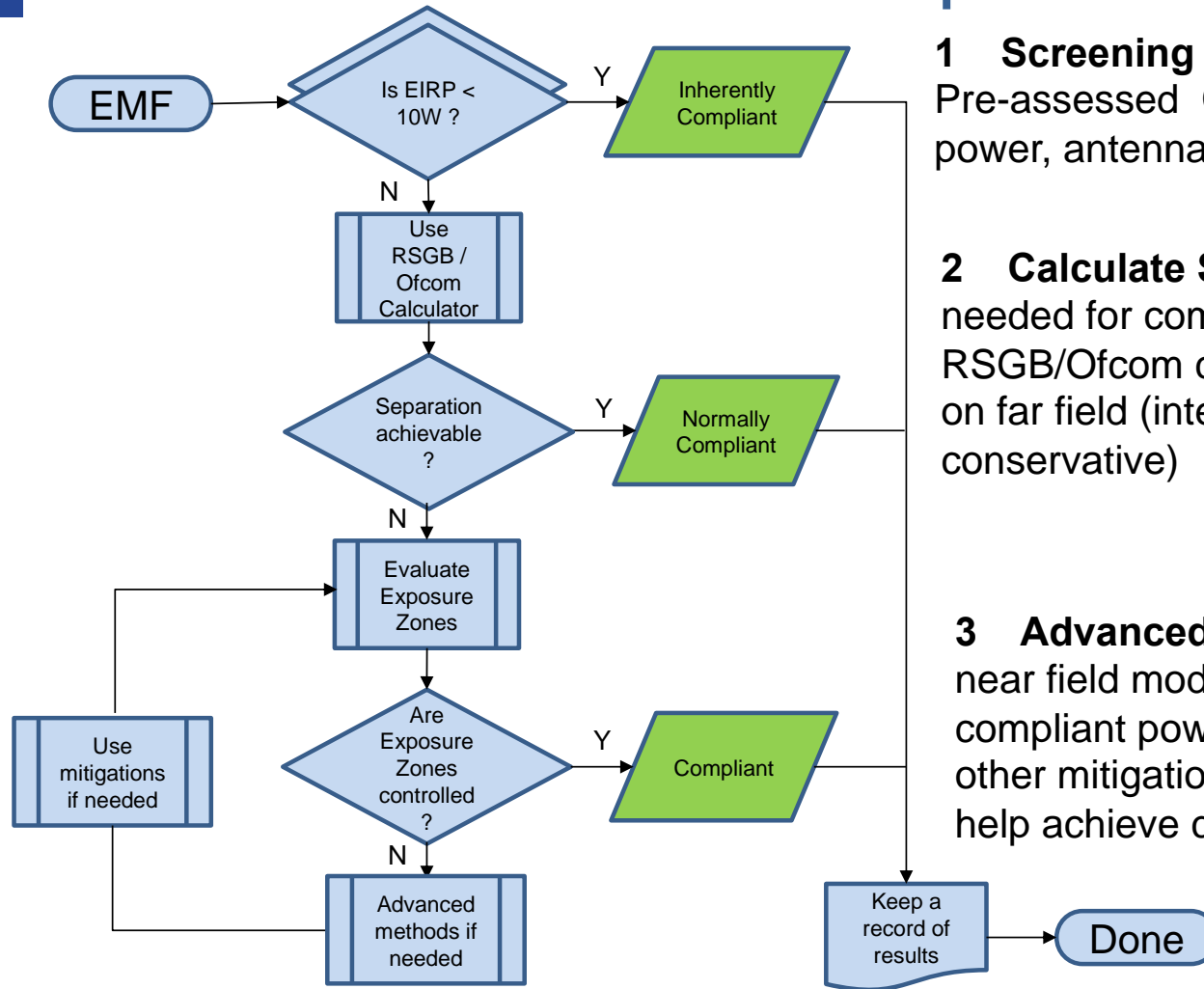
- **The EMF calculator should be presented as a screening tool, with a warning that it should NEVER be interpreted as a demonstration of non-compliance.** Any indication that the tool is related to “safety” should also be avoided in order not to raise unjustified concerns.
- The applicability of the EMF calculator to frequencies below ~100 MHz (i.e., for near-field assessments NOT based on power density) needs to be researched, validated, and qualified appropriately.
- Ofcom’s phrase, “*publicly accessible*”, fails to capture the concept of controlling access and/or transmissions as valid means of mitigation. By definition, compliance with the ICNIRP basic restrictions at a location of interest is achieved at any time when there are no people present – irrespective of the level of EMF.
- Compliance assessment guidance or standards need to be developed for the amateur service. Better to do this once for the ICNIRP 2020 guidelines, rather than have a two-step approach. Ofcom should initially accept assessments to either ICNIRP 2020 or ICNIRP 1998.

The goal is to demonstrate amateur radio equipment compliance:

- First - by using pre-assessed configurations of antenna, height and averaged transmit power, so that reference levels will not be exceeded in any practically accessible location. For some configurations (e.g., ground-based vertical radiators), compliance may require additional mitigation measures – most often, defining where people should not be present and ensuring that no-one is there while transmitting.
- Second - where no pre-assessed configuration is available, the Ofcom EMF tool can be used subject to its technical applicability and appropriate guidance.
- Finally - apply more advanced methods (such as being applied in the RSGB/ARRL research) to specific cases to establish compliance and to extend the available pre-assessed configurations.

The flow chart on the following page presents such a framework; and is an interpretation of ITU Recommendation K.52, applied to the Ofcom consultation and the amateur service:

Flowchart to Demonstrate Compliance



1 Screening Evaluation
Pre-assessed Configurations, power, antenna, height, orientation

2 Calculate Separation
needed for compliance – use RSGB/Ofcom calculator based on far field (intended to be conservative)




3 Advanced methods
near field modelling, compliant power contours, other mitigation measures to help achieve compliance....

The remaining comments on the initial implementation of the calculator anticipate Ofcom accepting, in due course, the main thrust of the flow chart.

A Front end to Ofcom EMF Calculator

The user needs to compute EIRP before submission to the Ofcom EMF calculator. Many amateurs have requested practical help in deriving the EIRP. Good practice is to support inputs that are an existing part of the station design: antenna gain in desired direction, power from transmitter, transmission mode, % time transmitted and feeder length/loss. The computation and assumptions in determining these factors for the purpose of evaluating exposure can be more complicated than the implementation of the Ofcom EMF calculator formula.

RSGB is developing add-on sheets to take well understood radio parameters as inputs and derive the inputs that the Ofcom EMF calculator requires. The following is a draft for illustration: -

Radio Setup			Feeder			Antenna		
								
Band 2m			Cable Type RG213			My Antenna		
Transmit mode SSB Processed			Feeder Linear dB			Antenna type 8 element Yagi		
Frequency MHz			Loss per 100m -7.7			Frequency MHz 144.2 MHz		
Transceiver Linear dB			Cable Length m 20.0			Antenna Linear dB		
Power in Watts 100.0 20.0			Other losses dB -0.5			Gain in dBd 12.6 11.0		
Mode factor 50.0% -3.0			Feeder loss dB -1.5			Antenna ERP 275.1 24.4		
Tx % in 6 minutes 70.0% -1.5			Average power into Antenna 21.9 13.4			Height of Antenna feed m 7.0		
Average power from Transmitter 35.0 15.4			Peak power into antenna 62.4 18.0			Sidelobe loss 0.0		
Maximum Power from Transmitter 100.0 20.0			EIRP 451.3 26.5			Peak EIRP 1289.4 31.1		

Detailed technical comments on Ofcom EMF calculator

The top-level concerns have been expressed in the previous sections. This section presents some issues with the calculator in more depth:-

Inadequate alignment with ICNIRP guidance - The Ofcom EMF calculator determines a distance based on power density and, by the absence of any further caveats or cautions, implies that is sufficient analysis. This fails to consider the definitions of the ICNIRP reference levels in the context of exposure assessment, e.g., time averaging, spatial averaging, presence or not of people, etc. Further, it neglects the application of valid risk assessment and mitigation practices. There is inadequate guidance on time averaging in the context of operating modes. Even at VHF and above, more detailed analysis is required to interpret the results to determine compliance boundaries consistent with ICNIRP exposure guidelines; e.g., the size of the human body should be considered when defining the locations to be assessed, and appropriate spatial averaging should then be applied.

Inappropriate terminology - The covering annex uses the term “safe separation distance”. Such language is inconsistent with good practice in issue management and quite foreseeably could raise unnecessary concerns, e.g., an erroneous presumption that at reduced distances, the levels would be “unsafe”. The calculator is only intended to indicate a conservative distance that is “compliant” with the general public reference levels.

Limited applicability - The formula used in the spreadsheet can offer a conservative power density estimate at frequencies at and above VHF, and in the far-field. Note that the stated scope of the referenced IEC 62232 is 110 MHz and up.

- a) **Effectiveness** - the Ofcom EMF calculator should be validated for frequencies below ~100MHz:
 - where potentially non-compliant exposures to amateur operations are typically in the near-field;
 - where the electric and magnetic field strengths close to the antenna cannot be accurately deduced from that antenna’s far-field pattern but depend upon short-range factors such as the proximity to conductors at high RF potential or carrying high RF currents;
 - where there is a complex interaction with the local ground;
 - where separate evaluation of electric and magnetic field strengths is required;
 - where constraints relate to peak, local, and whole-body average (including the interpretation of spatial averaging) and induced current; and/or
 - where induced current reference levels in the ICNIRP Guidelines are not presently considered.
- b) **Ground reflection factor** - The calculator uses the ground reflection factor. IEC 62232 Ed.1 references the value specified by the US Federal Communications Commission (FCC). The RSGB understands, from discussions with the engineer who performed the underlying research that the general application of a reflection coefficient of 1.6 goes beyond his findings and is unproven. Unfortunately, standards have yet to catch up.
- c) **Overestimation assertion inaccurate/incomplete** - The assertion that the formula overestimates in the near-field is subject to at least the following qualifications:
 - EIRP is a concept that belongs strictly in the far-field. For example, it is false to assume that a far-field pattern null of 20dB translates to (or will also exist in) the near-field. Nulls only fully form beyond the near-to-far field boundary. Near-field radiation patterns tend to broaden, and the levels at pattern minima increase. See IEC 62232 B.4.3 for range of formulas and applicability including null-filling.
 - Antenna patterns are commonly provided as 2D slices. When used to reconstruct the 3D pattern, the main beam lobe may be reasonably accurate, but secondary lobes and the gain in the rear hemisphere are subject to significant uncertainty. This may have impact on fixed-beam assessments, assessments for installations with limited range of beam rotation, or up-tilted.
 - Is not valid for the near-field of equiphase antennas (e.g., dishes), especially in the small region at the centre of the main beam.