

calculation that was ‘extremely far from correct’, but requiring measurements would impose a significant burden and cost on many licensees.

- 4.136 Some respondents also noted that their licences specified power in different terms (e.g. Watts absolute) and that calculating EIRP could be complex or impracticable. Steve Carter noted that calculating EIRP would require the licensee to take into account parameters ‘from a slew of different places’. He thought that this would be a major stumbling block in the proposed methodology, both in terms of the user complying and also in dealing with any subsequent need for enforcement. A confidential response made similar points and suggested that rules based on transmitter power output and antenna type would be much more practical to implement and enforce and would probably achieve greater compliance.

Ofcom response

- 4.137 We would first note that our EMF licence condition is designed to cover all radio licences issued by Ofcom (in licence classes which authorise powers above 10 Watts EIRP) and therefore covers a wide range of different types of radio use and frequencies. For most of these licence classes, maximum allowed transmit powers are expressed in EIRP or ERP. We recognise that amateur licences are different in that they express power in different terms (i.e. peak envelope power). However, we consider that there is a benefit in having one single threshold across all licence types and frequencies for reasons of consistency and simplicity. We have therefore decided to apply a threshold of 10 Watts EIRP (or the equivalent in ERP i.e. 6.1 Watts) across all licence classes.
- 4.138 We have also designed our simple EMF calculator so that it accepts an input power expressed in EIRP. We recognise that this will mean that amateurs will first need to calculate their EIRP in order to use the calculator. However, we note that RSGB are working to produce a ‘front-end’ to Ofcom’s calculator which will allow amateurs to enter their equipment details using parameters that are familiar to amateurs and will automatically calculate the EIRP on their behalf. We will also provide guidance on this issue in our draft Additional Guidance for Amateur Licensees which we will publish on our website shortly.
- 4.139 We agree with amateur radio stakeholders that EIRP is applicable in the far field but is not specifically applicable in the near field. We think that in most cases, entering the maximum EIRP of the equipment in the calculator should produce a conservative separation distance, even in lower frequencies where the near field is the primary issue. We recognise that there may be some scenarios where this is not the case.
- 4.140 Regarding Steve Carter’s comment that using a far-field parameter (EIRP) to assess near-field strengths could lead to misleading and even potentially dangerous results, we accept that calculations based on EIRP may not be suitable in the reactive near-field.
- 4.141 We also agree with Steve Carter’s point that the presence of external conductors, e.g. surrounding metalwork, cables, and the ground, may affect the performance of the antenna. This is particularly true in the near-field, especially in the reactive near-field (and this is more likely to affect equipment operating at relatively low frequencies). In these

- We have updated our “Guidance on EMF Compliance and Enforcement” to provide a more comprehensive list of the various ways in which licensees may demonstrate compliance. In particular, we will accept assessment methods that are consistent with recognised EMF standards from standards bodies such as IEC and ITU and we may also accept assessment methods developed by other recognised organisations such as industry associations and representative organisations like RSGB.

Further guidance for maritime use

- 4.163 The MCA suggested Ofcom provide additional guidance specific to maritime users. It said that, while it welcomed our formal “Guidance on EMF Compliance and Enforcement”, it thought it was unrealistic to expect all ship station license holders to be able to provide evidence of compliance without significant risk of error. It said that Ofcom-approved practical guidance appropriate for the widest possible range of users is essential and that failing to provide this creates the potential for large cost burdens, risks not achieving the goals of the licence variation, or risks a reduction in overall safety by encouraging licensees to migrate to exempted portable radios.

Ofcom response

- 4.164 We note these comments. As noted above, we are working to produce some Additional Guidance for Maritime Radio Users and will publish a draft version of this guidance on our website shortly. We will welcome comments on this draft version and plan to work on producing some worked examples on a range of typical maritime radio use cases for a future version.

Other comments relating to sites that are shared with another licensee

Obtaining and sharing information relating to other licensees’ equipment

- 4.165 Vodafone said it had some concerns that where site-specific considerations meant that it needed to take into account the specifics of what spectrum is deployed by sharing partner(s), there is a danger that it could transgress competition law by sharing details of network rollout. It asked Ofcom to confirm that the sharing of site-specific information when used only for the purposes of assessing EMF compliance would not be considered to be divulging competitively sensitive information.
- 4.166 Cellnex UK said it was ‘extremely disappointed’ that neither the licence condition nor the guidance suggests that licence holders should provide information to other site sharers to help them assess the cumulative EMF levels from the site. It said that an express obligation to provide information would support the employer’s obligation to co-operate and coordinate with other employers, where any workplace is shared under the Management of Health and Safety at Work Regulations 1999.

Ofcom response

- 4.167 Licensees should already have appropriate arrangements in place to take into account EMF from other radio equipment on a site in order to comply with the ICNIRP general public limits. Such arrangements should already take competition law considerations into account and we understand Cornerstone (a network infrastructure joint venture between Vodafone and Telefónica) and MBNL (a network infrastructure joint venture between EE and Three) do have arrangements in place to mitigate competition law risks including those associated with the sharing of information between competitors.
- 4.168 Licensees should continue to take competition law compliance into account as appropriate when ensuring compliance with the ICNIRP general public limits. When assessing what information may be considered necessary to obtain and share with another licensee to ensure compliance with the ICNIRP general public limits, we expect licensees to take into account the following principles:
- a) Licensees should only seek information from another licensee where they cannot rely on worst-case assumptions (for example, because those worst-case assumptions are too restrictive and further information is therefore required to make a more accurate EMF assessment).
 - b) Licensees should only share the minimum information necessary for another licensee to make an accurate EMF assessment at a particular site. Where appropriate, licensees should therefore only share limited technical information about specific radio equipment on a specific site.
 - c) Licensees should not share aggregate site information just in case it may be required in the future; licensees should only share information where it is required for a particular site.
 - d) Where considered appropriate, licensees (such as mobile network operators) should consider whether they should implement appropriate internal confidentiality safeguards to ring-fence the information that is provided by another licensee and ensure it is only provided to authorised individuals on a strictly need-to-know basis for the specific purposes of assessing EMF exposure levels at a particular site.
- 4.169 We do not consider it necessary nor appropriate to include a licence condition requiring licensees to share information with other licensees to assist in assessing compliance on a shared site. In many circumstances, licensees will not need to share information with each other and will instead be able to rely on worst-case assumptions in relation to another licensee's radio equipment. Licensees should also already have appropriate arrangements in place for shared sites in order to protect workers from EMF in accordance with the EMF Worker Regulations. For example:
- a) Licensees should already be providing site owners with relevant information about their own radio equipment on a site to enable the site owner (or another employer) to take appropriate measures to ensure compliance with the EMF Worker Regulations.

We understand both Cornerstone and MBNL already provide such information to site owners.

- b) HSE's Guidance in relation to the EMF Worker Regulations also encourages employers to share information with contractors and other employers on the work activities its own workers may encounter and the precautions to be taken.¹⁸

Last party to make a change

- 4.170 Arqiva reiterated a point made in a previous consultation response in which it requested clarification on a situation where multiple licence holders start new transmissions simultaneously; it said that this can happen, for example in the case of some shared broadcast antennas, and cellular antennas shared by two operators. It also sought clarification on whether the "last party rule" applies to existing systems, noting that the new licence condition will apply to a large number of existing sites for the first time on the date when it comes into force.
- 4.171 Another stakeholder made a similar point and suggested it is not always clear who makes the last change to a site. It explained that, at the point it is designing changes to a site, it will not necessarily know whether another licensee is also planning changes on a site. It said there is a timing and transparency issue because it may need to take that information into account to ensure its own changes to a site comply with the ICNIRP general public limits.

Ofcom response

- 4.172 Where more than one licensee starts transmissions simultaneously, we expect that all such licensees will have conducted (or will have procured a third party to conduct) an EMF assessment to ensure that their use complies with the ICNIRP general public limits. In cases where the shared site exemption does not apply (as discussed earlier in this section), this will include taking account of the total EMF exposure from other licensees' radio equipment on the shared site.
- 4.173 If a licensee requires advance notice of what changes another licensee on a shared site may be making in the near future then licensees on a shared site may want to consider putting appropriate arrangements in place to notify each other of such changes. When assessing what information may be considered necessary to share with another licensee for this purpose, we expect licensees to take into account the principles identified in paragraph 4.168 above.
- 4.174 We confirm that the last party rule will only apply from the point at which the licence condition takes effect. Where Ofcom identifies a compliance issue at a shared site where the last change occurred before the licence condition took effect, Ofcom will require all licensees at the shared site to cooperate to resolve the non-compliance. If licensees fail to

¹⁸ [HSE Guidance](#), paragraph 34.

cooperate and/or take such action, we may take enforcement action against one or more licensees at the shared site as considered appropriate on a case-by-case basis.

Sites managed by a third party

4.175 Vodafone noted that some site providers, in particular Wholesale Infrastructure Providers (WIPs), insist that ICNIRP calculations and certification is carried out by themselves, rather than the occupiers/licensees, and that this is incompatible with Ofcom's expectation that the licensee directly hold the relevant compliance records which Ofcom may request. It considered that in this situation, Ofcom should state in the compliance regime that although recording by the licensee is preferred, use of site provider-held/calculated material will be sufficient to meet Ofcom's requirements. It suggested that Ofcom would need to be patient as site agreements come up for renewal, because it cannot unilaterally dictate a retrospective term that the site provider records be made available to Ofcom.

Ofcom response

4.176 We note that in some circumstances a third party site provider or site manager (that is not a licensee) may insist on carrying out any EMF assessments on a site themselves. In such a case, we expect the site provider to play a proactive and cooperative role in ensuring the site is and remains compliant with the ICNIRP general public limits. If we find a breach of the ICNIRP general public limits in such circumstances, we may consider using soft enforcement tools (which, if considered appropriate, may include identifying the names of site providers).

4.177 We may also decide to take enforcement action against the licensee. As explained in our "Guidance on EMF Compliance and Enforcement", we will act reasonably and proportionately and take all relevant circumstances into account. One factor we would consider is whether the licensee could reasonably have been expected to have done more to ensure that the site provider complied. We expect licensees to provide site providers with all the information they need in order to fully assess the EMF exposure levels from the licensee's relevant equipment on the site. We also expect licensees to ensure site providers are kept updated when the licensee makes any change to its equipment which may increase the EMF levels in any area in which a member of the general public may be present. Licensees may decide to include contractual clauses relating to EMF compliance in any agreements they enter into with site providers.

4.178 Clause 6 of our licence condition allowed licensees to arrange for contractors to keep compliance records on their behalf. We have amended this clause to instead refer to 'third parties' to cover the situation highlighted by Vodafone. We expect that in most cases site providers will wish to cooperate in providing access to records if requested by Ofcom, and we do not expect these requests to be at a volume that would create a large administrative burden for the site provider. However, the licensee is ultimately responsible for complying with all the terms of their licence (including the EMF condition) and should therefore make suitable arrangements to ensure that records can be made available on request. We also

note that licensees have a period of time before they need to have records in place – we discuss this in paragraphs 4.198 to 4.202 below.

Actions of third parties

4.179 Vodafone noted that it had previously raised the potential issue of a third party inadvertently causing the licensee to breach the ICNIRP general public limits: for example, landlords breaching public exclusion zones, and buildings being constructed adjacent to existing masts. It said Ofcom should not take enforcement action where the licensee was unaware of the action by a third party that put the licensee into non-compliance. It also urged Ofcom to work with industry to encourage Government to introduce a planning regime whereby applicants are required to consult with spectrum licensees where the proposed build is within 50m of a site that is subject to the EMF licence condition.

Ofcom response

4.180 We explained in paragraph 5.132 of our October 2020 Statement that, in general, if changes around a site are made by third parties that the licensee is unaware of and which make the site non-compliant, Ofcom would not expect to immediately take enforcement action. However, once the licensee becomes aware of this situation, it should take appropriate action to bring the site back into compliance.

4.181 In response to Vodafone's concerns, we have raised this point with colleagues in the relevant Government department and will provide an update if there are further developments in this area.

Enforcement approach

4.182 We received a mix of comments on our proposed enforcement approach. Vodafone said that it particularly welcomed the message that Ofcom intends to take a proportionate and pragmatic approach to compliance, especially in the initial stage.

4.183 The MCA asked for clarification on how enforcement would work for vessels where the licensee may be the vessel owner but vessel command is vested elsewhere.

4.184 Stephen Hartley suggested that the enforcement statement needs to take a leaf out of the HSE (Health and Safety Executive) book and make a clear distinction between 'minor' breaches, where no significant risk has been realised and a warning or a modification of licence terms may be appropriate, and 'gross breaches' where there is a flagrant disregard for the licence condition and a criminal sanction may be more appropriate.

4.185 Julian Gannaway argued that giving the ICNIRP Guidelines the force of law would be bound to cause enforcement problems, because they were only intended as Guidelines. He said that it was good that Ofcom "encourage" compliance, but that this is meaningless if the full force of the law is still applied. He added that the EMF standards were not designed to be a hard limit or to cater for the wide variety of amateur installations and that any enforcement action should be approached with discretion.

Ofcom response

- 4.186 As explained in paragraph 14.4 of our “Guidance on EMF Compliance and Enforcement”, we intend to take a proportionate and pragmatic approach to compliance and enforcement. It is not our intention to immediately take enforcement action and impose a financial penalty or other sanctions on a licensee if a site on which they are present is found to be in breach of the ICNIRP general public limits regardless of the circumstances. Whilst we may consider such action to be appropriate in certain circumstances, our key objective is to foster and facilitate a climate of compliance across all licensees caught by an EMF condition.
- 4.187 As explained in paragraph 14.3 of our “Guidance on EMF Compliance and Enforcement”, when deciding whether to take enforcement action and what enforcement action may be the most appropriate, Ofcom will consider all relevant factors. Factors that may be relevant include whether the licensee has taken appropriate steps to ensure compliance, the risk of harm to the public and whether a breach may be particularly flagrant. Depending on the circumstances, we may decide to take informal action (such as providing information, advice and/or a warning to a licensee) or we may decide formal enforcement action may be more appropriate. What action may be most appropriate will always depend on the circumstances which we will consider on a case-by-case basis.
- 4.188 In relation to how enforcement may work where the licensee allows a third party to be in control of their radio equipment (for example, on a ship), it is ultimately the licensee’s responsibility to ensure compliance with all the terms and conditions of their licence. The EMF condition is no different to any other licence condition and the licensee will therefore need to take steps to ensure they comply with the ICNIRP general public limits.
- 4.189 Where a licensee may not be present when the radio equipment authorised under the terms of their licence is being used, the licensee will need to consider how they can ensure they comply with the ICNIRP general public limits. For example, they may consider it appropriate to:
- a) ensure any third party that will be in control of their radio equipment has been informed of the requirement to comply with the ICNIRP general public limits and provided with appropriate training on EMF risks;
 - b) ensure equipment is only used intermittently and for no longer than a specified period, for example, by introducing signs stating not to hold a button and use equipment for more than [x] seconds/minutes;
 - c) introduce barriers or locks to limit access to the antenna or move the antenna; and/or
 - d) install appropriate warnings and signs directing people where not to sit/stand when equipment is being used and simple explanations of risks.
- 4.190 Licensees may also wish to include contractual clauses relating to EMF compliance in any agreement authorising a third party to use their radio equipment.

- 4.191 As noted above, we will take all circumstances into account when deciding whether to take enforcement action against a licensee and if so, what enforcement action may be the most appropriate. One factor that may be relevant is whether the licensee has taken appropriate steps to ensure compliance with the ICNIRP general public limits and whether the licensee could reasonably have been expected to have done more to ensure compliance. We have added this factor to the list of factors that may be relevant in paragraph 14.3 of our “Guidance on EMF Compliance and Enforcement”. We may also take action against the captain or another person in charge of a ship for breach of the ICNIRP general public limits.¹⁹

Period of time before EMF compliance records should be in place and up-to-date

- 4.192 Most respondents that commented on this aspect thought that six months was too short and asked for a longer time period before the new condition comes into effect.
- 4.193 Arqiva welcomed the interim period but thought it was a little short and asked for it to be nine months.
- 4.194 Cellnex UK also welcomed the introduction of an interim period to ensure records are up-to-date but said that the administrative burden of such an exercise should not be underestimated, and suggested that this period be extended to 12 months. Shetland Islands Council also thought the period should be 12 months “so that any compliance could be fitted in around annual routine maintenance plans”.
- 4.195 The MCA thought that the six-month period was unrealistic, although it did not suggest an alternative time period. It noted that maritime transmitters are for the most part under manual control so there is a need for operator awareness because the existing radio operator certificates do not include this requirement. It added that thousands of installations were potentially affected and that compliance action may include new procedures, training or alterations to installations; this could cause unplanned financial overheads which may not be affordable at this time.
- 4.196 RSGB also argued for a longer time period; it said that requiring radio amateurs to establish analysis methods, agree them with Ofcom/PHE and then implement assessments within a six-month period is unreasonable and disproportionate to the actual risks. It asked Ofcom to consider the following points: a) The amateur service covers a frequency range far greater than any commercial communications licence; b) There are currently no standards relevant for assessing EMF exposure for the range of amateur activities; c) The time taken by commercial radio operators to respond to these types of changes is several years.
- 4.197 Carl Langley commented that the Federal Communications Commission (FCC) in the US allow two years for changes such as this to be complied with and suggested that 2022

¹⁹ See [section 105 of the Wireless Telegraphy Act 2006](#).

would be more realistic. Keith Bird suggested that 12-18 months is more suitable, accounting for the low risk level with most amateur stations.

Ofcom response

- 4.198 We note the concerns raised by respondents. However, we would also note that licensees will, at the latest, be made aware of this new requirement at the start of the licence variation process (and many licensees have already been made aware of this requirement through the consultation process). The licence variation process is expected to take approximately three months to complete, and the six-month period would commence no earlier than at the completion of the licence variation process (i.e. when we issue our final decision in relation to the variation of affected licences which we expect to issue no later than 18 May 2021). This means that licensees will in effect have approximately nine months from being notified of the proposed licence variation to ensure they have appropriate compliance records in place.
- 4.199 We recognise that there may be some licensees who need to physically visit their radio installation in order to check compliance details, and this may not be possible if travel restrictions relating to the ongoing coronavirus pandemic remain in place. We therefore propose to take this into account when deciding when the six-month period will commence. If local travel restrictions remain in place at the point when the licence variation process is complete, we will delay the start of the six-month period until restrictions are lifted. In this scenario we would publish the start date for the six-month period on our website once restrictions are lifted. Otherwise, the six-month period will start from the date on which we issue our final decision in relation to the variation of affected licences (which we expect to issue no later than 18 May 2021).
- 4.200 As discussed in paragraphs 4.139 – 4.144 above, we recognise that it may be more complex to demonstrate compliance where compliance distances are likely to be in the near field (especially the reactive near field). This is particularly likely to be the case for equipment operating at relatively low frequencies where, for example, the reactive near field will extend many metres from the antenna²⁰.
- 4.201 We have therefore decided that, for equipment which operates at frequencies below 10 MHz, existing licensees will have a period of 12 months following the variation of their licence to ensure that their EMF compliance records are in place and up-to-date. During this time however, where Ofcom carries out routine compliance checks and requests access to EMF compliance records for a specific site, licensees will need to provide evidence to Ofcom that the site is compliant with the ICNIRP general public limits within a period of 20 calendar days. We have updated our “Guidance on EMF Compliance and Enforcement” to include this point.

²⁰ For example, at a frequency of 10 MHz the reactive near field extends approximately 5 metres from the antenna for the cases where the antenna is typically equal to or less than half a wavelength in length.

- 4.202 We also note that, as discussed at 4.139 to 4.142 of this section, we have made amendments to our EMF calculator and the associated notes to clarify that the calculator cannot be used for frequencies below 10 MHz.

How licence conditions apply when spectrum is leased

- 4.203 Vodafone queried the application of the licence condition, and associated compliance regime, where spectrum leasing occurs. It noted that such leasing is possible, for example, to Vodafone's 28 GHz spectrum licences. It said that, in theory, the conditions apply to the licensee, and it is then for the licensee to then back-end these conditions into any spectrum lease, but questioned how this could happen with leases that have already been granted (other than at renewal).

Ofcom response

- 4.204 It is ultimately the responsibility of the licensee to ensure they comply with all the terms of their licence including the new EMF condition. As Vodafone notes, some WTA licences permit the licensee to lease spectrum. Our [Trading Guidance Notes](#) contain guidance for licensees who decide to lease spectrum.
- 4.205 As explained in that Guidance, any leaseholder must operate within the terms of the licensee's head licence and a failure to do so may constitute a criminal offence under section 8 of the Wireless Telegraphy Act 2006.²¹ Licensees are also required to:²²
- a) inform leaseholders of the terms and conditions of the head licence and give them information about these; and
 - b) inform leaseholders that failure to meet the licence terms and conditions may result in closedown of the equipment and incur penalties.
- 4.206 Where a licensee has leased spectrum under the terms of its licence (or where it intends to do so in the future), and that head licence is varied to include the new EMF condition, the licensee should inform any current and future leaseholder of the new EMF condition and that a failure to comply may result in the closedown of equipment and incur penalties.
- 4.207 Licensees are also required to ensure that leaseholders' use of radio equipment complies with the licensee's licence conditions.²³ How a licensee does that will depend on the particular circumstances including the type of leaseholder. For example, a licensee may decide that it is appropriate to provide specific EMF training to a leaseholder. Licensees may also seek to vary any existing lease agreements or include provisions relating to the new EMF condition in any future lease agreements. Whether they do so is a commercial decision for the licensee although our Trading Guidance Notes contain a list of the type of issues which licensees may wish to include in any lease agreement.²⁴

²¹ [Trading Guidance Notes](#), paragraph 4.12.

²² [Trading Guidance Notes](#), paragraph 4.10.

²³ [Trading Guidance Notes](#), paragraph 4.10.

²⁴ [Trading Guidance Notes](#), paragraph 4.24.

- 4.208 If we determine there has been breach of the new EMF condition, we may decide to take enforcement action against the licensee. As explained in our Trading Guidance Notes, we will act reasonably and proportionately and take all relevant circumstances into account. One factor we could consider is whether the licensee could reasonably have been expected to have done more to ensure that the leaseholder complied.²⁵ We have added this factor to the list of factors that may be relevant in paragraph 14.3 of our “Guidance on EMF Compliance and Enforcement”.

Inclusion of guidance in licence condition

- 4.209 The Burnham Beeches Radio Club (an amateur radio organisation) said that Ofcom is poor at communicating with licensees and that many may well be blissfully unaware of Ofcom’s current series of consultations. It said that Ofcom’s “Guidance on EMF Compliance and Enforcement” should form part of the licence rather than existing as a separate document, at risk of update without licensee notification.

Ofcom response

- 4.210 We have carried out two public consultations on our proposal to formally require licensees to comply with the ICNIRP general public limits. Licensees have therefore had two opportunities to comments on our proposals and many have done so - we have received nearly 500 responses on our proposals and have had additional discussions with key industry and stakeholder bodies including RSGB. Our proposals have been developed and refined taking into account all the comments we have received to date.
- 4.211 We also understand RSGB has made their members and the wider amateur community aware of these changes. We are writing to all affected licensees as part of the licence variation process and will continue to work with RSGB and other organisations to ensure all affected licensees are aware of the changes. Future changes to our “Guidance on EMF Compliance and Enforcement” will be the subject of public consultation and we would encourage licensees to keep updated on spectrum matters by signing up to receive Ofcom radio spectrum email updates. This can be done by navigating to the bottom of the Ofcom website homepage and clicking on the ‘Subscribe to email updates’ [link](#).
- 4.212 We note that clause 7 of the licence condition includes a specific obligation on licensees to take into account Ofcom’s “Guidance on EMF Compliance and Enforcement” that is in force at the relevant time when evaluating its compliance with the ICNIRP general public limits.

References to safety

- 4.213 A number of respondents thought that it was inappropriate to refer to ‘safety’ or ‘safe’ when discussing compliance with the ICNIRP general public limits or in connection with Ofcom’s EMF calculator. They suggested that we refer to a ‘compliance distance’ rather than a ‘safe separation distance’.

²⁵ [Trading Guidance Notes](#), paragraph 4.19.

Ofcom response

- 4.214 We agree that it would be more accurate to refer to a compliance distance. As noted by some respondents, the ICNIRP general public limits are set well below the level that ICNIRP consider could potentially lead to adverse health effects. As such, a breach of these limits is not necessarily 'unsafe'. In addition, as discussed earlier, our EMF calculator uses conservative parameters which results in a conservative separation distance relative to the ICNIRP general public limits.
- 4.215 We have therefore removed references to safe separation distance in our EMF calculator and replaced them with compliance distance.

Summary of revisions

- 4.216 In this section we have discussed a number of areas where we have decided to make additions, amendments and clarifications to our licence condition and our "Guidance on EMF Compliance and Enforcement". We summarise the key changes below. The final version of the EMF licence condition we will use for the licence variation process and a link to the final version of our "Guidance on EMF Compliance and Enforcement" are included at Annexes 1 and 2.

Revisions to licence condition

- 4.217 We have made the following key amendments to our licence condition:
- **Requirement for licensees to take account of all of their equipment on a site:**
 - We have added a definition of "Licensee's On-Site Radio Equipment" and amended the first clause to clarify that the licensee needs to take into account *all* of its own equipment that is authorised to transmit above 10 W EIRP or 6.1 W ERP on the same site.
 - **Clarification of shared site requirement:**
 - We have removed the definition of "Other Radio Equipment" and now make the requirement clear in the third clause of the licence condition itself.
 - **Clarification of the shared site exemption:**
 - We have amended the first exemption situation to clarify that it applies where a licensee's wireless telegraphy station(s) or apparatus "*do not transmit at a combined total radiated power in any particular direction that is higher than 100 Watts EIRP or 61 Watts ERP*", and have added a new footnote to explain the term "combined total radiated power".
 - We have amended the second exemption situation to clarify that it applies where the total EMF exposure levels produced by the licensee's wireless telegraphy station(s) or apparatus in any area where a member of the general public is or can be expected to be present when transmissions are taking place is no more than 5% of the ICNIRP general public limits.

- **Emergency situations:**
 - We have removed the previous requirement which limited the emergency exemption to situations where compliance was “likely to result in or create an immediate and serious threat to the safety of the public or public health”.
 - We have clarified that the emergency exemption applies to equipment being used in the vicinity of the emergency situation.
- **Areas accessible to the general public:**
 - We have replaced occurrences of “in any area that is accessible to the general public” with “in any area where a member of the general public is or can be expected to be present when transmissions are taking place”.
- **ICNIRP Guidelines:**
 - We have amended the footnote to the definition of the “ICNIRP Guidelines” to explain that licensees may demonstrate compliance with either the 1998 or 2020 version of the ICNIRP Guidelines for an initial period.

Revisions to our “Guidance on EMF Compliance and Enforcement”

4.218 We have restructured the introductory sections of our “Guidance on EMF Compliance and Enforcement” and added various new sections to provide further clarify and guidance for spectrum users. In particular, we have made the following key amendments:

- **Meaning of the general public**
 - We have provided additional guidance on who should and should not be considered members of the general public for the purposes of the EMF condition and included additional examples of individuals that are not covered.
 - We have explained that our EMF condition does not require amateur licensees to protect each other from EMF when they are visiting each other or working together.
- **Areas in which the general public may be present**
 - We have added a new section and provided guidance and examples of areas in which the general public can be expected to be present to support spectrum users in making a judgment on whether a member of the general public may be present when transmissions are taking place.
- **ICNIRP Guidelines**
 - We have clarified that spectrum users can initially comply with either the 1998 or the 2020 Guidelines and explained that we will consult in the future on updating the Guidance to require compliance with the 2020 Guidelines only.
 - We have included the relevant table numbers from the 2020 Guidelines (in addition to the table numbers from the 1998 Guidelines).

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

- Types of EMF assessment
 - We have clarified that spectrum users that are not currently authorised to transmit at power levels above 10 Watts EIRP or 6.1 Watts ERP will not need to take any action.
 - We have explained that compliance can be as simple as ensuring equipment never transmits above 10 Watts EIRP or 6.1 Watts ERP.
 - We have included two new assessment methods in the list of acceptable methods which we refer to as ‘Professional installer’s instructions’ and ‘Pre-assessed equipment configurations’.
 - We have included information on control measures spectrum users can use to ensure that the ICNIRP general public limits are not breached.
 - We have updated the list of recognised standards to include ITU-T Recommendations K.52 and K.61.
 - We have explained that EMF assessments should be based on the normal maximum operating conditions of the radio equipment.
 - We have explained that Ofcom intends to use a shared risk approach when making decisions about compliance, and what this means.
- Sites that are not shared with another user
 - We have included a new section and provided additional guidance on how spectrum users can take into account all their transmitters on the same site and the reasonable assumptions they can make.
- Sites that are shared with another user
 - We have provided additional guidance on the reasonable assumptions spectrum users can make in determining which other transmitters they need to take into account in their assessment.
 - We have set out some principles which spectrum users should take into account when assessing what information to obtain and share with other spectrum users in relation to compliance assessments.
- Last party to make a change to a site
 - We have explained that the ‘last party rule’ will apply from the point at which the EMF condition takes effect and how Ofcom will deal with compliance issues in situations where the last change occurred before the EMF condition took effect.
 - We have provided additional guidance on how spectrum users can deal with situations where more than one spectrum user may be planning to make changes to a site at a similar time or start transmissions simultaneously.
- Sites managed by a third party
 - We have added a new section and provided guidance on how we expect spectrum users to comply on sites that are managed by a third party including where the third party carries out EMF assessments on behalf of the spectrum user.

- Other equipment nearby that is not on the same site
 - We have added a new section and provided additional guidance on what Ofcom will expect of spectrum users, and what Ofcom may do, in situations where EMF exposure produced by radio equipment on more than one site results in a breach of the ICNIRP general public limits.
- Appropriate records demonstrating compliance
 - We have provided an updated list of the types of records that we would consider acceptable in demonstrating compliance.
 - We have clarified that spectrum users should keep records of the date when they made the last change to a site *which is likely to increase the EMF exposure levels above the levels in their most recent EMF assessment*.
 - We have explained that most spectrum users will have a period of 6 months following the variation of their licence to ensure that their EMF compliance records are in place and up-to-date, but spectrum users using frequencies below 10 MHz will have 12 months.
 - We have clarified that the EMF condition will apply immediately to any new authorisations that include the EMF condition, including new licences that are issued.
 - We have clarified that a spectrum user that has equipment on multiple sites can keep a central record of how they demonstrate compliance at each site.
 - We have clarified that records can be held by a third party but it is the responsibility of the spectrum user that is subject to an EMF condition to provide these records to Ofcom on request.
- Emergency situations
 - We have added a new section and provided guidance and examples to help licensees understand when the emergency exemption may or may not apply.
- Approach to enforcement
 - We have made some refinements to our enforcement approach including to recognise that enforcement in relation to family and friends is unlikely to be our priority.
 - We have confirmed that where a spectrum user allows a third party to be in control of their radio equipment, another factor that may be relevant to whether we decide to take enforcement action and if so what enforcement option may be the most appropriate, is whether the spectrum user could reasonably have been expected to have done more to ensure compliance.

Additional guidance

- 4.219 The licence condition requires licensees to take into account Ofcom's "Guidance on EMF Compliance and Enforcement" that is in force at the relevant time when evaluating its compliance with the ICNIRP general public limits.

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

- 4.220 In addition to our “Guidance on EMF Compliance and Enforcement” (available on our website via the link provided in Annex 2) we are working on a simplified version of the guidance and will shortly publish this in the [EMF section of our website](#). We hope this will be useful for licensees in providing a simple, accessible overview of the key points. However, we note that licensees should still refer to the detailed “Guidance on EMF Compliance and Enforcement” if in any doubt about the detail of how to assess and demonstrate compliance.
- 4.221 As noted earlier in this section, we are also producing some additional guidance documents for radio amateurs and maritime radio. We will shortly publish initial draft versions of these documents in the EMF section of our website. We welcome feedback on these documents and expect to update these over time to take into account feedback from licensees and provide additional worked examples of compliance assessments for some typical use cases. Interested parties can submit feedback on these documents by email to EMFImplementation@ofcom.org.uk. We would request that feedback be provided by 16 April 2021.

5. EMF Calculator

- 5.1 We received a large number of detailed comments from stakeholders in response to the trial EMF calculator published alongside our further consultation. Most respondents who commented on this subject welcomed the provision of a calculator but suggested changes they thought would make the calculator more useful.
- 5.2 In this section we summarise the main suggestions and comments on the trial calculator and provide our response to these. We also describe the changes we have made taking into account stakeholder feedback.

Key points raised on the EMF calculator

Need for a compliance assessment framework

- 5.3 RSGB commented that a compliance assessment framework is missing. It suggested that a framework is required to show how compliance may be demonstrated and how the Ofcom EMF calculator is applied in that framework. It thought that the EMF calculator should be presented as a screening tool, with a warning that it should *never* be used as evidence of non-compliance. It also included a flowchart showing a possible compliance assessment framework, noting that the example was an interpretation of ITU Recommendation K.52, applied to the Ofcom consultation and the amateur service.
- 5.4 The proposed compliance framework had three parts:
- First: use pre-assessed configurations of antenna, height and averaged transmit power, so that reference levels will not be exceeded in any practically accessible location.
 - Second: where no pre-assessed configuration is available, use the Ofcom EMF calculator subject to its technical applicability and appropriate guidance.
 - Third: apply more advanced methods (such as those applied in the RSGB/ARRL²⁶ research) to specific cases to establish compliance and to extend the available pre-assessed configurations.
- 5.5 John Rogers and a confidential respondent made similar comments. The confidential respondent said that, without context, any tool might be misapplied or misinterpreted e.g. the calculator may be interpreted as a requirement for compliance rather than a simple starting point. The respondent added that the calculator should be reviewed according to the framework in which it is intended to be used and how its results are to be interpreted.

Ofcom response

- 5.6 We are content for RSGB to use its proposed compliance flowchart in its guidance to its members. In line with this, we have updated our guidance documents to clarify that we will accept the use of pre-assessed configurations of antenna, height and averaged transmit

²⁶ ARRL is The American Radio Relay League.

power as a means to demonstrate compliance. We have also updated the technical notes for the calculator to clarify that separation distances that are smaller than those indicated by the calculator do not necessarily indicate non-compliance.

Ability to enter additional input parameters

- 5.7 Some respondents thought that it would be helpful to provide additional or alternative input fields including, for example, to take into consideration height and radiation patterns of common antennas.
- 5.8 Cellnex UK suggested that we could allow the user to enter additional information such as antenna gain and beam width, with separate entries for horizontal and vertical clearance.
- 5.9 Several from the amateur community thought that using EIRP as an input was not helpful and that the calculator should provide input fields which help the user to calculate the EIRP.
- 5.10 RSGB noted that it is developing add-on sheets to take well understood radio parameters (used by radio amateurs) as inputs and derive the inputs that the Ofcom EMF calculator requires.

Ofcom response

- 5.11 Our calculator is primarily aimed at licensees who have limited technical expertise or who lack alternative means to assess compliance and who may otherwise struggle to do so. We think it is important to maintain a calculator which is simple enough for all licensees to use. We recognise that there are many potential additions that would be helpful to some radio users but including these in our calculator would increase complexity and increase the risk of incorrect use by users without appropriate technical expertise.
- 5.12 We welcome RSGB's initiative in providing add-on sheets for the calculator which will provide input fields that are more helpful for the amateur community, while still being based on Ofcom's calculator. We confirm that we are content for this to be used by amateurs for assessing compliance.
- 5.13 We are also considering providing an additional EMF calculator which would provide greater flexibility for technically competent users to adjust certain parameters, including for example the dimensions of the antenna and the ground reflection factor. We will provide more information in the EMF section of our website in due course.

Ability to use the calculator for different types of antennas

- 5.14 Julian Gannaway commented that the calculator only seemed to be suitable for omnidirectional antennas, unless the user knows what he is doing, and does not give sensible figures for the situation in any other direction unless the sidelobe level is known.

Ofcom response

- 5.15 We agree that our calculator is not specifically designed to take account of antenna patterns in this way. As noted in the annex to the calculator, it “provides a conservative separation distance based on the following assumptions: antenna height and pattern are not taken into account”. It is a simple calculator designed to calculate a conservative separation distance based on a single EIRP figure. As noted above, RSGB is working on add-on sheets for the calculator for use by the amateur community and we understand that this will enable radio amateurs to choose from a number of commonly used antenna types.

Calculator too conservative

- 5.16 Several respondents suggested that the calculator was too conservative. One respondent went so far as to say that the calculator ‘may grossly over-estimate the exclusion zone and is therefore too conservative to be useful’ and noted that this was particularly the case for highly directional antennas. Some respondents suggested specific amendments to make the calculator less conservative.

Ofcom response

- 5.17 We noted in our October 2020 Statement that the calculator provides a conservative estimate of the separation distances that the licensee would need to maintain between the radio equipment and members of the general public. We also noted that licensees would be free to decide whether they (or a professional installer) should undertake a more detailed analysis using additional and/or less conservative assumptions (e.g. by taking into account the antenna characteristics), which would likely result in more accurate and thus potentially smaller separation distances.
- 5.18 We continue to consider that this is the appropriate approach. As explained above, our calculator is primarily aimed at licensees who have limited technical expertise or who lack alternative means to assess compliance and who may otherwise struggle to do so. The calculator should allow many licensees in this situation to assess and demonstrate compliance in a quick and simple way without undertaking a detailed analysis. In these circumstances we think that it is necessary and appropriate to use a conservative set of parameters.
- 5.19 We recognise that there are some types of radio use where use of our calculator may not be optimal. There are many different radio use cases, and it is not feasible to provide a calculator which is both simple to use for non-experts and, at the same time, optimised for all the different radio use cases.
- 5.20 As explained in our “Guidance on EMF Compliance and Enforcement”, licensees are free to use other calculators where these produce results that are accurate (i.e. do not result in a breach of the ICNIRP general public limits).
- 5.21 In addition, and as noted above, we are also considering providing an additional EMF calculator which would provide greater flexibility for technically competent users to adjust certain parameters, which would likely result in less conservative results.

Clarifying appropriate use of the calculator

- 5.22 Some respondents expressed concern that the calculator could be used inappropriately by non-EMF experts to argue that certain radio installations, e.g. mobile operator sites, do not comply with the ICNIRP general public limits. They thought it was important for Ofcom to clarify that just because the separation distances produced by our calculator indicate that EMF exposure levels may breach the ICNIRP general public limits in a particular area, this does *not* demonstrate that EMF exposure levels do in fact, or may be, in breach of the ICNIRP general public limits in that area.

Ofcom response

- 5.23 We agree that separation distances which are smaller than those indicated by our EMF calculator do not necessarily indicate that the exposure exceeds, or even might exceed, the ICNIRP general public limits. As discussed earlier in this section, the calculator uses conservative parameters and will in most cases overestimate the separation distance required. We have included an additional note with our calculator to make this clear. We have also explained that our calculator is for the purpose of a spectrum user calculating compliance distances from their own equipment.

Use for calculations in the near field and at low frequencies

- 5.24 Some respondents commented on the limitations of using the calculator where the calculated distance is within the near field of the antenna. Arqiva noted that the spherical far-field model is not adequate in the reactive near-field region where, in some parts of the spectrum, the reference levels are not a reliable guide to compliance with the basic restrictions. It commented that whilst the additional notes say that the tool is for the far-field region, a non-specialist user would not understand this.
- 5.25 A confidential respondent said that, while the calculator would in most circumstances offer a conservative assessment of the field strength at frequencies in the VHF and UHF bands, there are circumstances where this may not be the case, e.g., in the near field of a dish antenna in the small region on the centre of the main beam, and possibly in limited circumstances with multiple reflections in an unusual configuration. The respondent added that the level of confidence when the tool is applied to lower frequencies is uncertain due to the range of reference levels needed to be assessed and the complexities of near field assessment in proximity to the ground. The reliability of the tool therefore should be investigated at LF and HF and further guidance provided on its application and interpretation.

Ofcom response

- 5.26 Ofcom's EMF calculator is a simple calculator. We noted in the annex to the calculator that *"The formulae used by the calculator are suited for power density evaluation in the far-field antenna region and overestimate the results in the near-field."* However, we acknowledge

that there may be some circumstances where the calculator may not overestimate the results in the near field, particularly in the reactive near field.

5.27 We have made the following amendments to the calculator to address the issues raised by respondents:

- a) We have included an additional check in the calculator to ensure that the compliance distances it produces are never shorter than the outer boundary of the reactive near-field of the antenna, calculated as: $\lambda/2\pi$; where λ is the wavelength in metres. It should be noted that this formula is, strictly speaking, applicable to electromagnetically ‘short’ antennas (i.e. where the largest dimension, or the diameter of the antenna is no greater than half the wavelength of its operating frequency).
- b) We have added a note to suggest that more advanced tools may need to be used for electromagnetically “long” antennas (i.e. where the largest dimension, or the diameter of the antenna is longer than half the wavelength of its operating frequency).
- c) We have included a new lower cut-off frequency for the calculator of 10 MHz. Our simple calculator is not suitable for calculating compliance distances in the reactive near field as the electric and magnetic fields in this region are complex and are very difficult to predict (they depend on the nature of the antenna and its immediate surroundings). At low frequencies the outer boundary of the reactive near field occurs at a relatively large distance from the antenna. We have chosen 10 MHz as the practical lower limit of the reliability of our calculator, as at lower frequencies it becomes increasingly likely that the separation distances calculated will fall within the reactive near field and hence will be unreliable. For example, at 10 MHz the outer boundary of the reactive near field extends approximately 5 metres from electrically short antenna (where the $\lambda/2\pi$ formula applies); at 1 MHz the distance extends to approximately 50 metres.

Use by mobile operators

5.28 One respondent was concerned that the calculator should not be used by mobile network operators (MNOs), e.g. for complex scenarios at shared sites.

Ofcom response

5.29 MNOs have already implemented and use advanced procedures and toolsets to calculate EMF exposure levels around mobile sites. We note that BT and Telefónica both made this point in their responses. We are content for MNOs to continue using the toolsets they currently use. We confirm that the Ofcom calculator is not suitable for MNO needs and we do not expect them to use it. We have added a note to the calculator to explain this.

Use for multiple transmitters

5.30 Some respondents commented that the calculator was not really suitable for multiple transmitter scenarios. RAYNET-UK said that the method outlined on page 44 of our October 2020 Statement for using the calculator to assess multiple transmitters was

‘massively conservative’. Steve Carter also commented that the proposed method for adding powers would only be correct if all transmitters were operating simultaneously and pointing in the same direction.

Ofcom response

- 5.31 We recognise that the calculator will produce very conservative results if used to assess multiple transmitters in the way described. However, this approach may still be helpful for some licensees in performing an initial compliance check. Where this approach produces a compliance distance which the licensee can comfortably comply with, the licensee can use the results of this calculation to demonstrate compliance. If the licensee cannot comply using this approach, this does not demonstrate that its intended installation was not compliant. Rather it would indicate the need to carry out a more detailed analysis (which could for example include the use of a different assessment tool which is designed to handle multiple transmitters, carrying out measurements, etc). Further guidance may be found in the ICNIRP Guidelines in the section ‘Simultaneous Exposure to Multiple Frequency Fields’.²⁷

Calculating average power

- 5.32 Two respondents from the maritime sector commented that they did not understand the suggested approach for calculating average power provided in the instructions for use section of the calculator. The MCA said that the inclusion of values for both duty factor and maximum percentage time transmitting was not understood and that it would be subject to interpretation and therefore risks inconsistent evaluation by users of the tool. The RNLI asked what the term ‘duty factor’ meant and queried why we have introduced an additional factor to the more usual transmit/receive time ratio typically used in two-way radio communications.

Ofcom response

- 5.33 In our October 2020 Statement we said that average power could be calculated by multiplying the maximum transmit power of the equipment by the duty factor of the equipment and then by the maximum percentage of time that the equipment will be operating within the averaging period.
- 5.34 We used duty factor (or cycle) here to refer to the built-in percentage of time that the radio equipment transmits (which is a feature of how the radio operates and is not controllable by the end user). As an example, some radio equipment operates in a mode called time division duplex (TDD) where equipment alternately transmits for a certain period of time and then receives (on the same frequency) for another period of time. The percentage time the equipment is transmitting is the duty factor which might for example

²⁷ This section (Simultaneous Exposure to Multiple Frequency Fields) is contained in both the 1998 and 2020 versions of the ICNIRP Guidelines.

exceed the basic restrictions³⁶ in the relevant tables for general public exposure identified in the ICNIRP Guidelines³⁷ in any area where a member of the general public is or can be expected to be present when transmissions are taking place.

Sites which are shared with another licensee

2. *In the case of a shared site where the Shared Site Exemption applies to the Licensee, the Licensee shall comply with paragraph 1 above.*
3. *In the case of a shared site where the Shared Site Exemption does not apply to the Licensee, the Licensee shall only establish, install, modify or use the Relevant Radio Equipment if:*
 - a) *the total electromagnetic field exposure levels produced by the Licensee's On-Site Radio Equipment, together with*
 - b) *the total electromagnetic field exposure levels produced by all other wireless telegraphy stations and wireless telegraphy apparatus operated by another licensee on the same site for which the Licensee can reasonably assume that a Shared Site Exemption does not apply,*

do not exceed the basic restrictions³⁸ in the relevant tables for general public exposure identified in the ICNIRP Guidelines³⁹ in any area where a member of the general public is or can be expected to be present when transmissions are taking place.

Emergency Situations

4. *The obligations in paragraphs 1, 2 and 3 above will not apply if the Relevant Radio Equipment is being used for the purpose of seeking emergency assistance or reporting and responding to an emergency situation (in the vicinity of that situation) including for search and rescue activities and maritime emergency communications.⁴⁰*

Relationship with authorised transmission levels

5. *The Licensee shall comply with paragraphs 1, 2 and 3 above notwithstanding the maximum transmission levels authorised in the Licence.*

Records

6. *The Licensee shall keep, or shall procure that a third party shall keep, and shall make available to Ofcom on request, records (including the type of records identified in Ofcom's "Guidance on EMF*

³⁶ Compliance with the reference levels for general public exposure identified in the ICNIRP Guidelines will ensure compliance with the basic restrictions.

³⁷ The relevant tables for general public exposure are identified in Ofcom's "Guidance on EMF Compliance and Enforcement".

³⁸ Compliance with the reference levels for general public exposure identified in the ICNIRP Guidelines will ensure compliance with the basic restrictions.

³⁹ The relevant tables for general public exposure are identified in Ofcom's "Guidance on EMF Compliance and Enforcement".

⁴⁰ Further information on emergency situations is set out in Ofcom's "Guidance on EMF Compliance and Enforcement".

