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

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A [Welsh version of the Overview](#) is available

## UPDATE

Publication Date: 1 March 2021

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# 1. Overview

All uses of radio spectrum generate electromagnetic fields (EMF) and there are internationally recognised guidelines to help ensure services operate in a way that will not adversely affect health. The guidelines are published by the [International Commission for Non-Ionising Radiation Protection](#) (ICNIRP) and include limits for EMF exposure. These guidelines are endorsed by Public Health England (PHE) in its advice to the UK Government.

Ofcom is responsible for managing spectrum in the UK. To ensure spectrum users continue to operate services which will not adversely affect peoples' health, in our [October 2020 Statement](#) we decided to formally incorporate the limits in the ICNIRP Guidelines for the protection of the general public into spectrum licences.

## In this Update:

We provide the final versions of:

- the EMF licence condition for the licence variation process; and
- our "Guidance on EMF Compliance and Enforcement"

We are also publishing an update to the trial version of our EMF calculator.

- 1.1 Alongside our October 2020 Statement we published a [further consultation](#) which included draft versions of the EMF licence condition and our "Guidance on EMF Compliance and Enforcement". We also published a trial version of a simple EMF calculator. This calculator was designed to allow licensees to simply and easily assess compliance, without the need for technical knowledge.
- 1.2 We received 85 responses to our further consultation, many of which provided detailed comments on the licence condition, guidance and calculator. We have carefully reviewed these comments and have further refined and clarified the licence condition and our "Guidance on EMF Compliance and Enforcement". We have now produced final versions of the EMF licence condition which we will use for the formal licence variation process and our "Guidance on EMF Compliance and Enforcement".
- 1.3 We are also publishing an update to the trial version of our EMF calculator and will shortly publish draft user-friendly guidance, including guidance for radio amateurs and maritime licensees. We welcome further comments by 16 April 2021 on the updated calculator and user-friendly guidance documents and will publish further versions of these in the future.

## Next steps

- 1.4 To implement our decisions in our October 2020 Statement, we will shortly start the formal licence variation process by proposing to vary all existing licences in classes which authorise transmit powers above 10 Watts EIRP (or 6.1 Watts ERP) to include the new EMF licence condition. This licence variation process will be carried out in accordance with the

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requirements of the Wireless Telegraphy Act 2006 and the terms and conditions of spectrum licences.

## 2. Introduction

- 2.1 Radio spectrum is used for a variety of communications and is used by mobile operators, TV and radio broadcasters, the emergency services, radio amateurs, taxi companies and many other industries. It is also used for things like mobile phones, Wi-Fi at home and keyless entry to cars.
- 2.2 Demand for radio spectrum is increasing, driven by the development of new technologies opening up new services and applications. Against this background, some people have raised concerns around exposure to EMF, particularly from new technologies such as 5G.
- 2.3 All uses of radio spectrum generate electromagnetic fields (EMF) and there are international guidelines to help ensure services operate in a way that will not adversely affect health. In normal conditions, most uses of radio spectrum for wireless communications present no health risk to humans - but exposure to very high levels of radiofrequency EMF can be harmful.
- 2.4 In the UK, Public Health England (PHE) takes the lead on public health matters associated with radiofrequency electromagnetic fields, and has a statutory duty to provide advice to Government on any health effects that may be caused by exposure to EMF. PHE's main advice is that EMF exposure should comply with the Guidelines published by the [International Commission for Non-Ionising Radiation Protection](#) (ICNIRP). These Guidelines include internationally recognised limits on EMF exposure for the protection of the general public. We refer to these limits as the "ICNIRP general public limits". They are widely understood and applied by spectrum users in the UK - including by Mobile Network Operators (MNOs).
- 2.5 Ofcom authorises and manages the use of the radio spectrum in the UK through the issue of licences and/or by setting conditions for spectrum use on a licence-exempt basis. In performing that role, we take into account PHE's advice on EMF exposure.
- 2.6 We also measure EMF levels near to mobile phone base stations and publish the results of these measurements. We have seen no evidence that spectrum users are operating radio equipment in breach of the ICNIRP general public limits. Our own [measurements](#) of EMF to date around 5G mobile base stations show EMF levels well below the ICNIRP general public limits.
- 2.7 However, as the organisation that authorises spectrum use, and that has expertise in measuring EMF levels, we recognise that we are well placed to help ensure spectrum users continue to operate services which will not adversely affect people health.
- 2.8 As a result, in February 2020, we published a [consultation](#) on proposals to formally require spectrum licensees to comply with the ICNIRP general public limits.
- 2.9 After considering all consultation responses, in October 2020 we published a [statement](#) setting out our decision to go ahead with our proposals. We noted that there is a risk that some spectrum users may not be fully aware of the ICNIRP Guidelines and may not be fully taking EMF exposure levels into account when installing, using or modifying radio

equipment. Some spectrum users may also not have appropriate processes in place to monitor EMF exposure levels and ensure compliance with the ICNIRP general public limits on an ongoing basis. We also noted that current regulatory regimes on EMF exposure do not formally require spectrum users to comply with the ICNIRP general public limits and do not put Ofcom in a position where we could take appropriate enforcement action in the event the limits are breached.

- 2.10 We therefore decided to include a specific condition in Wireless Telegraphy Act licences requiring licensees to comply with the ICNIRP general public limits. This condition will apply to all licence classes which authorise equipment to transmit at powers higher than 10 Watts EIRP<sup>1</sup> or 6.1 Watts ERP<sup>2</sup> (including, for example, the licences of mobile phone companies, TV and radio broadcasters and most point-to-point microwave links).
- 2.11 In addition, we decided to require affected licensees to keep records that demonstrate how they have complied with the ICNIRP general public limits.

## **Proposals in our October 2020 further consultation**

- 2.12 Alongside our October 2020 Statement, we published a short, focused further consultation to give stakeholders an opportunity to provide feedback on the implementation of the decisions we made in our October 2020 Statement. We consulted further on:
- a) The specific drafting changes we made to the wording of the licence condition to implement our decisions on its scope; and
  - b) The changes we made to our “Guidance on EMF Compliance and Enforcement” as well as our EMF calculator.

## **Consultation responses**

- 2.13 We received 85 responses to our further consultation. As with the original consultation, the majority of responses came from two distinct groups – the radio amateur community and the groups and individuals that are opposed to expansion of the 5G network.
- 2.14 We also received responses from three of the mobile network operators (BT, Telefónica and Vodafone), equipment suppliers and installers, volunteer emergency services and those interested in the operation of equipment on boats/ships.
- 2.15 We have published all non-confidential responses on our website.

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<sup>1</sup> EIRP stands for Equivalent Isotropically Radiated Power. It is a measure of the strongest power emitted in any direction from an antenna.

<sup>2</sup> ERP stands for Effective Radiated Power which is the product of the power supplied to an antenna and its gain in a given direction relative to a half-wave dipole.

## Structure of this document

2.16 The rest of this document is structured as follows:

- In **section 3** we address the issues raised by respondents who expressed particular concerns about health issues.
- In **section 4** we address the additional points made in responses to our October 2020 further consultation in relation to the revised versions of our EMF licence condition and “Guidance on EMF Compliance and Enforcement”.
- In **section 5** we address comments on the calculator.

## 3. Health concerns over EMF exposure

### Consultation responses on health matters

- 3.1 Although our October 2020 further consultation was limited in scope to seeking views on how we proposed to implement the decisions we made in our October 2020 Statement, a number of respondents urged us instead to re-open some of the decisions we had made. These respondents cited their on-going concerns about the potential impact of EMF on health. In particular, many raised concerns about 5G mobile services.
- 3.2 In total, we received 38 responses addressing these issues, of which 18 were submitted as non-confidential. The other 20 responses were either submitted as confidential in their entirety – or with the name of the respondent confidential – or it was unclear whether the response was confidential or not.
- 3.3 All submissions in this group of responses addressed the same or very similar issues as the 107 responses we received on health concerns in response to our February 2020 consultation. As before, most urged Ofcom to reject the ICNIRP Guidelines on the basis that they are inadequate.
- 3.4 Many of these respondents included a pre-prepared text, either in full or in part, setting out the basis of their concerns. This text made similar points to those raised in response to the February 2020 consultation.
- 3.5 In summary, the main arguments presented by this group of respondents were:
- The ICNIRP Guidelines are inadequate and are being challenged in the UK courts.
  - ICNIRP itself is not an independent body and is influenced by MNO interests.
  - Ofcom should reach its own conclusions on health concerns and not rely on the guidance of PHE.
  - There is a large body of scientific opinion that says EMF is more dangerous than suggested by ICNIRP.
  - Ofcom should adopt a precautionary approach in the circumstances and prevent the roll-out of 5G services until it is proven to be safe.
- 3.6 Some respondents said Ofcom had failed to listen to arguments put forward in response to the February 2020 consultation, and that we were failing in our duty to protect the public. They did not agree that we should follow guidance from PHE and ICNIRP. One confidential respondent said Ofcom could be responsible for serious harm to children.
- 3.7 A detailed response was submitted by Electrosensitivity UK, outlining particular concerns for people with that condition. There were also three responses from people who suffer from electro-sensitivity themselves, or had a close relative who was affected.
- 3.8 As with other respondents, Electrosensitivity UK's concerns centred on the role of ICNIRP and PHE, and on Ofcom's reliance on their guidance as the basis for regulation. Its response quoted alternative scientific sources to suggest the dangers of EMF were underestimated.



- 3.9 Some, mainly confidential, respondents raised fears that 5G and other technologies could be used for surveillance and crowd control purposes. Some said we should adopt the tighter limits included in IGNIR standards (International Guidelines on Non-Ionising Radiation). Some said MNOs should be forced to publish maps of their masts and clearly indicate exclusion zones.
- 3.10 Most respondents in this group did not provide feedback on the detail of our licence condition or “Guidance on EMF Compliance and Enforcement”.
- 3.11 However, three respondents commented on our plan to exempt radio used by the emergency services (including volunteer services) from compliance in specific safety-of-life situations. Some saw this as a loophole allowing operators to transmit at excessive powers with no justification with one respondent commenting that *“This will open the door to extremely high frequencies being used in all sorts of situations.”* We address these points in paragraphs 4.88 – 4.95 below.

## **Conclusions on EMF and health**

- 3.12 We acknowledge the very strong feelings of some individuals and organisations about the safety of 5G and other mobile technologies.
- 3.13 We have considered all responses to our October 2020 further consultation. However, we note that most responses relating to health raised the same or similar issues to those which we had previously considered before reaching the decisions set out in our October 2020 Statement. Our previous assessment of the health issues raised in relation to EMF exposure is set out in section 3 of our October 2020 Statement.
- 3.14 Our aim in managing the use of radio spectrum in the UK is to make sure that all radio equipment, including 5G equipment, continues to be used in a way which will not adversely affect peoples’ health.
- 3.15 We are not however responsible for setting EMF exposure levels. In the UK, PHE is the expert health body that currently has statutory responsibility for public health issues in England. It advises the Government on all aspects of public health including exposure to radio waves; the appropriate standards of protection for the general population; and any measures necessary to protect sensitive groups.<sup>3</sup> Its guidance on EMF exposure is also

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<sup>3</sup> PHE fulfils the Secretary of State for Health’s statutory duties to protect health and address health inequalities, and executes the Secretary of State’s power to promote the health and wellbeing of the nation. PHE inherited its responsibilities from the former Health Protection Agency and PHE continues to develop and provide a range of published information about radiofrequency topics.

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taken into account for public health advice in Scotland, Wales and Northern Ireland.<sup>4 5</sup> PHE's [advice](#) is that EMF exposure should comply with the ICNIRP Guidelines.

- 3.16 Our October 2020 Statement noted that ICNIRP is a non-profit independent scientific organisation set up specifically to investigate possible adverse health effects from non-ionising radiation.<sup>6</sup> It is formally recognised by the World Health Organisation and is consulted by the European Commission. We understand IGNIR, referred to by some respondents, is not an internationally recognised standards body.
- 3.17 Ofcom is a statutory body created by the Office of Communications Act 2002. Ofcom is legally independent of and not part of Government. Ofcom's role, duties and remit were set by Parliament and we can only act within the powers given to us by Parliament. Ofcom's general duties are set out in the Communications Act 2003 and our duties and powers in relation to our spectrum functions are set out in the Wireless Telegraphy Act 2006 (the 2006 Act). Consistent with these powers, Ofcom authorises and manages the use of radio spectrum in the UK through the issue of licences and/or by setting conditions for spectrum use on a licence-exempt basis.
- 3.18 As explained in Annex A1 of our October 2020 Statement, we have powers under section 9ZA(1) and (2)(b) of the 2006 Act to impose licence conditions for the protection of the public from electromagnetic fields, both in new licences and by varying existing licences. These powers are also consistent with Ofcom's role as the 'competent authority' – as determined by the UK Government – for ensuring the UK complies with its obligations under the [European Electronic Communications Code](#) (EECC).<sup>7</sup>
- 3.19 In our October 2020 Statement we explained that whilst Ofcom has expertise in measuring EMF levels, we are not a public health body and do not ourselves have medical or health expertise.<sup>8</sup> It is therefore entirely appropriate for us to follow the guidance published by the more qualified and recognised bodies (i.e. PHE and ICNIRP).
- 3.20 We note the comments of some respondents calling for the publication of detailed maps showing the location of mobile phone masts and identifying 'exclusion zones' (i.e. areas close to a mast where the ICNIRP general public limits may be breached and the general public should not therefore have access). MNOs already take EMF compliance into account

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<sup>4</sup> The Scottish Government set out its position on 5G and public health in a [statement](#) published alongside its [5G strategy](#) in August 2019. This noted that *"the advice provided by PHE is fully endorsed by the Chief Medical Officer for Scotland"*. Public Health Wales notes on its [website](#) that *"specialist radiation protection information and advisory services are provided in Wales by Public Health England's Centre for Radiation, Chemical and Environmental Hazards (CRCE)"*.

<sup>5</sup> In July 2020, the UK Government announced that PHE was to be replaced from the end of March 2021 by a new body, the National Institute for Health Protection. It is not yet clear if the remit of this new body will extend to all policy areas currently assigned to PHE.

<sup>6</sup> See paragraphs 2.9 to 2.16.

<sup>7</sup> Government has confirmed Ofcom is the "competent authority" for ensuring the UK complies with its obligations under the EECC (see pages 31-32 of [Government response to the public consultation on implementing the European Electronic Communications Code](#)). Recitals 106 and 110 and Articles 45(2)(h) and 45(4) EECC suggest the competent authority should take into account [Council Recommendation 1999/519/EC](#). The restrictions in this Recommendation are based on the ICNIRP general public limits and our decision to formally incorporate the ICNIRP general public limits into spectrum authorisations is therefore consistent with the EECC.

<sup>8</sup> See paragraphs 3.23 to 3.24.

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when operating their radio equipment. Our licence condition will further enhance these pre-existing levels of compliance by formally imposing a requirement on MNOs to comply with the ICNIRP general public limits. Indeed, all of our measurements to date – including our [most recent measurements published](#) alongside this Update – have consistently shown EMF exposure levels at busy publicly accessible locations near 5G-enabled mobile phone base stations are well within the ICNIRP general public limits. We have seen no evidence that MNOs are operating radio equipment in breach of the ICNIRP general public limits.

- 3.21 We do not therefore consider it necessary to require MNOs to publish maps of their masts and identify exclusion zones. In any event, Government has raised significant concerns with Ofcom about the release of information on the location of mobile phone masts – which would create an increased threat to the UK’s critical national infrastructure – and has advised that disclosure would adversely affect national security.<sup>9</sup>
- 3.22 There have also been a significant number of attacks on mobile sites in recent months and publishing information on the location of sites risks further sites being attacked. Such attacks always have an adverse impact such as customers losing mobile signal and mobile operators incurring additional costs but they can have severe consequences, for example, where a mobile site that supports critical communications for the emergency services is attacked; the impact can be particularly serious if there is disruption to public services such as a hospital’s communications systems. Such attacks can also cause physical harm to employees of mobile operators, emergency services personnel and the general public.
- 3.23 We will continue to measure EMF levels in busy publicly accessible areas near to mobile phone masts where we can expect to see high levels of mobile phone use. We also conduct measurements of EMF exposure levels close to mobile phone masts [on request](#). This is provided as a free service to qualifying schools and hospitals that do not have base stations installed on their site. In other cases, a fee is charged.
- 3.24 We note that the purpose of our October 2020 further consultation was to seek views on how we proposed to implement the decisions set out in our October 2020 Statement. The further consultation was not intended to reassess the decisions set out in our October 2020 Statement. Nevertheless, submissions to both our February 2020 consultation and our October 2020 further consultation have been considered in full. We have concluded that no significant new argument or evidence has been presented since our October 2020 Statement that might justify revision of our earlier decisions in relation to health matters.

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<sup>9</sup> For further information on Government’s advice, please see an example of our assessment of whether to provide information on the location of mobile sites in response to a freedom of information request, available here: [https://www.ofcom.org.uk/data/assets/pdf\\_file/0028/198550/database-of-base-stations.pdf](https://www.ofcom.org.uk/data/assets/pdf_file/0028/198550/database-of-base-stations.pdf) (see pages 4-6).

## 4. The EMF licence condition and guidance

- 4.1 In this section we review the additional points made in responses to our October 2020 further consultation in relation to the revised versions of the EMF licence condition and “Guidance on EMF Compliance and Enforcement” and provide our response to these comments.

### Comments on specific aspects of the licence condition

#### Definition of ‘general public’

- 4.2 We received a large number of comments from respondents on our proposed definition of the general public. A number of respondents from the amateur community said our definition of the general public was too wide and should not include family, friends and other amateur licensees, while some other respondents suggested our definition was too narrow and should include some workers who may not have received training on radio frequency (RF) safety.

#### Family, friends and visitors

- 4.3 The Burnham Beeches Radio Club said it is not appropriate to categorise family, friends and other visitors to a licensee’s property as members of the general public. It said that other countries with EMF compliance requirements do not appear to take the same approach and instead accept that the property is a controlled area. It added that the effect of such a categorisation would be to require analysis of propagation into licensees’ own homes and gardens, and that the current calculator would not be adequate for this purpose. It suggested that licensees would have the ability to make family members and friends aware of risks and suitable mitigation, such as keeping away from antennas while in use, and that they may well be in a position to know if family members and friends are likely to be particularly susceptible to EMF because of health or other issues.
- 4.4 A number of other amateurs made similar points. Julian Gannaway argued that it is surely up to the amateur, not Ofcom, to make decisions about the risks to the amateur’s family when at home. He said Ofcom was taking a big step in effectively declaring the amateur’s home to be a “public” place. A respondent who wished to remain anonymous said that members of the same household as the radio amateur and members of the general public who voluntarily choose to visit an amateur station should not be subject to any greater EMF restrictions than the amateur station operator. A confidential respondent said that it was unclear whether or not other members of the licensee’s family are defined as “general public”.
- 4.5 Some maritime stakeholders also told us in stakeholder meetings that treating family and friends as members of the general public could be an issue for boats at sea. They noted that the available options in terms of where to put a radio on a motor vessel are very

limited and that they were concerned it may be difficult to comply with the ICNIRP general public limits on some small vessels.

*Ofcom response*

- 4.6 There are a range of scenarios in which family, friends and visitors may be exposed to EMF ranging from the pregnant wife of an amateur licensee to the young child of the owner of a recreational vessel and maritime licensee to the friend of a taxi company operator and business radio licensee. None of these individuals should be exposed to EMF in breach of the ICNIRP general public limits and we would be surprised if any licensee considers it appropriate to expose family, friends and visitors to EMF in breach of the ICNIRP general public limits simply because they are a family member, friend of visitor.
- 4.7 We have however considered whether it is appropriate for our licence condition to protect family, friends and visitors from EMF in all scenarios or whether there may be a more appropriate and less intrusive alternative to managing EMF risks in certain scenarios.
- 4.8 We recognise that family and friends may be more likely than other members of the general public to be in a position where they can obtain information on EMF risks and take an informed decision to accept EMF risks or control or mitigate the risk of exposure, for example, by influencing the way in which the licensee uses their radio equipment. However, family, friends and visitors may still have no knowledge of their exposure to EMF and are not in any event in a position to *fully* understand, control or mitigate the risk of exposure to EMF. We have therefore decided that our licence condition should generally require licensees to ensure all family, friends and visitors are not exposed to EMF in breach of the ICNIRP general public limits.
- 4.9 To assist licensees, we have updated our “Guidance on EMF Compliance and Enforcement” to include a more comprehensive list of ways in which licensees can ensure no family, friends or visitors are exposed to EMF in breach of the ICNIRP general public limits. For example, licensees can ensure no family, friends or visitors are present in any area in which the ICNIRP general public limits may be exceeded when transmissions are taking place. There are also various control measures licensees can implement such as:
- a) Ensuring 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.
  - b) Introducing barriers or locks to limit access to the antenna or moving the antenna.
  - c) Installing appropriate warnings and signs directing people where not to sit/stand when equipment is being used and setting out simple explanations of risks.
- 4.10 As noted above, we recognise that family and friends may be more likely than other members of the general public to be in a position where they can understand, control and/or mitigate the risk of exposure to EMF. We will take all relevant circumstances into account when deciding whether to take enforcement action and what enforcement action may be the most appropriate, noting that enforcement in relation to family and friends is

unlikely to be our priority. We have included this point in our “Guidance on EMF Compliance and Enforcement”.

*Amateur radio licensees*

- 4.11 We have decided that the approach set out above will apply to amateur radio licensees. We will not therefore revise our decision in our October 2020 Statement and make an exemption which would allow an amateur licensee to expose members of their household to EMF in breach of the ICNIRP general public limits.
- 4.12 We recognise that members of an amateur’s household may be more likely than other members of the general public to be in a position where they can understand, control and/or mitigate the risk of exposure to EMF.
- 4.13 We also recognise that many amateurs will operate their radio equipment within their own private property and that Ofcom carrying out enforcement related activities within a family home may be considered particularly intrusive.
- 4.14 We further recognise that appropriate training for amateur licensees provided by the Radio Society of Great Britain (RSGB) can help licensees ensure members of their household are not exposed to EMF in breach of the ICNIRP general public limits. We will encourage RSGB to update their training to include the most relevant and effective ways (identified in our “Guidance on EMF Compliance and Enforcement”) in which amateurs can comply with the EMF condition as well as training on our Additional Guidance for Radio Amateurs (which we will publish a draft version of shortly). Such training should not be treated as a one-off tick-box exercise.
- 4.15 Taking into account the points recognised above, we do not currently anticipate carrying out proactive enforcement related activities in relation to EMF exposure within an amateur’s household. However, we reserve the right to amend this approach if we become concerned about EMF compliance and/or the effectiveness of RSGB’s training on EMF risks within an amateur’s household.
- 4.16 As well as members of a radio amateur’s household, our licence condition will require amateurs to protect any visitors to an amateur’s property (that are not other amateur licensees) as well as any neighbours or other individuals outside of an amateur’s property that may be exposed to EMF in breach of the ICNIRP general public limits. Such individuals are less likely to be in a position to fully understand, control and/or mitigate the risk of exposure to EMF. However, in many cases it should be simple to implement control measures to ensure such individuals are not exposed to EMF in breach of the ICNIRP general public limits. For example, an amateur could stop transmitting if they have a visitor that is temporarily on their property, or they could restrict such a visitor to areas where they can be certain exposure levels are below the ICNIRP general public limits. We also note that RSGB has developed pre-assessed equipment configurations to help amateur licensees comply with the ICNIRP general public limits.

*Maritime licensees*

- 4.17 We recognise that family and friends on a recreational vessel owned by a maritime licensee may also be more likely than other members of the general public to be in a position where they can understand, control and/or mitigate the risk of exposure to EMF. We have however decided not to revise our decision in our October 2020 Statement and will therefore require maritime licensees to ensure family and friends (as well as visitors and paying customers) on a boat are not exposed to EMF in breach of the ICNIRP general public limits.
- 4.18 As noted above, we have updated our “Guidance on EMF Compliance and Enforcement” to include a more comprehensive list of ways in which licensees can comply with the ICNIRP general public limits and consider there are a variety of simple ways in which maritime licensees should be able to comply. For example, they (or a professional installer) can install and operate radio equipment in accordance with manufacturers’ instructions relating to EMF compliance. There are also various control measures they may be able to implement to ensure compliance (such as those identified in paragraph 4.9 above). In particular, we note that radio equipment on a vessel may only be used intermittently, and licensees can take this into account when calculating the compliance distance. There may also be cases where radio equipment is only used in emergency situations (which are exempt from the requirement to comply).
- 4.19 We will also shortly publish on our website our draft Additional Guidance for Maritime Radio Users to help maritime licensees comply.
- 4.20 We also note that radio equipment on a vessel may be operated by a third party rather than the licensee. In such situations, it is particularly important that the licensee has taken appropriate steps (such as training on EMF risks and implementing control measures) to ensure compliance with the ICNIRP general public limits.

**Visiting amateurs and multiple amateur stations**

- 4.21 RSGB suggested that where a visitor to an amateur radio station is also a radio amateur, we should make an exemption so that our licence condition does not require the amateur licensee to protect the amateur visitor from EMF.
- 4.22 Julian Gannaway thought that if more than one amateur is present, then all should be treated as operators for the purposes of the EMF calculations. RAYNET-UK similarly said that our proposed definition of the general public is overly restrictive in that it only accounts for a single licensee or operator responsible for the transmitter. It asked who would be considered as the licensee in scenarios where there are multiple operator stations, and whether an ‘off duty’ operator in the vicinity would be defined as a member of the general public when they do not have a microphone in their hand.

*Ofcom response*

- 4.23 We have decided that our licence condition will not require amateur licensees to protect each other from EMF when they are visiting each other or working together.

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- 4.24 This is because other amateur licensees should be in a position where they can take a *fully-informed* decision to accept any EMF risks or control or mitigate the risk of exposure.
- 4.25 We expect RSGB's training to include training on the risks of EMF exposure when amateur's visit each other or work together including control measures they can implement to mitigate risks.
- 4.26 We have reflected our decision in our guidance documents.<sup>10</sup>

### Areas accessible to the general public

- 4.27 RSGB and Peter Zollman said that they had concerns about the use of "accessible to the general public" as the criterion for identifying areas of non-compliance. RSGB suggested that it is not accessibility that is a problem but rather it is someone being there when transmission takes place, while Peter Zollman said that the current definition was far too open-ended and would lead to restrictions where none are actually necessary. Both RSGB and Peter Zollman suggested that every occurrence of "...in any area that is accessible to the general public" should be amended to: "...in any area where a member of the general public is present when transmissions are taking place".
- 4.28 They added that in order for EMF exposure to exceed the relevant restrictions, the following two conditions must apply concurrently: i) the EMF levels exceeding a threshold at a location of interest; and ii) one or more persons being present. They said that regulations should recognise that compliance may be achieved through mitigation and/or management of either of these conditions.
- 4.29 In a similar vein, Julian Gannaway suggested that the phrase "in any area that is accessible to the general public" should be replaced by "in any area where a member of the public is present when transmissions are taking place." A respondent who wished to remain anonymous also suggested that the condition should only apply to areas where the general public are actually present.
- 4.30 Stephen Hartley asked for clarification on which areas would be covered by the definition. He provided an example of a roof top that may be accessible by a neighbour using a ladder but is not routinely accessed, and asked whether the absence of a permanent ladder meant that it should be considered as not accessible. He suggested some alternative definitions: "in any area that is routinely accessed by the general public" or "where the general public is likely to be present".
- 4.31 RAYNET-UK said that no definition is provided for a place accessible to the general public, noting that there is a definition in other legislation e.g. "public place includes any highway and any other premises or place to which at the material time the public have or are permitted to have access, whether on payment or otherwise".

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<sup>10</sup> Where we refer in this Update to our guidance documents, we are referring to our "Guidance on EMF Compliance and Enforcement" as well as our draft simplified user-friendly guidance, draft "Additional Guidance for Radio Amateurs" and/or draft "Additional Guidance for Maritime Users".



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4.32 The Maritime and Coastguard Agency (MCA) said that its radio sites are generally surrounded by a perimeter fence, locked gate and comprise a radio tower, mast, and/or pole with anti-climb measures, but are largely unmanned. It asked whether it could assert that such facilities are not accessible to the general public or whether further measures would be required.

*Ofcom response*

4.33 We agree that we are only concerned about protecting members of the general public that are present when transmissions are taking place. We do not intend to require licensees to ensure their radio equipment complies with the ICNIRP general public limits in an area that may be accessible to the general public but where it is clear that no member of the general public is in fact present when they are transmitting.

4.34 Indeed, one way in which licensees can demonstrate compliance with our licence condition is by satisfying themselves that no member of the general public will be present in any area in which the ICNIRP general public limits may be exceeded when transmissions are taking place (and recording the basis on which they have made that decision). For example, an amateur licensee may be aware that their use of equipment may breach the ICNIRP general public limits in areas their neighbour may be able to access but they may ensure they only transmit when they are sure their neighbour will not be present in those areas.

4.35 However, in many scenarios the licensee may not know if a member of general public is or will be present when transmissions are taking place. This may be the case if radio equipment transmits while it is unattended or where a licensee is not sure if a neighbour or other member of the general public may be present. Licensees may be able to put procedures in place to determine if a member of the general public will be present when transmissions are taking place. However, if a licensee cannot be sure whether one or more members of the general public will be present when transmissions are taking place, they should take a conservative view and presume a member of the general public will be present in an area where the general public *can be expected to be present*.

4.36 Importantly, members of the general public (as defined in our licence condition) can be present on both public and private property. Examples of where the general public can be expected to be present include any:

- a) public property or space including a public pathway, park, playground or car park;
- b) private residential or business property including in a garden or on a balcony;
- c) on a boat or other vessel or public or private quayside or harbour area.

4.37 Even if members of the general public may not regularly or ordinarily be present in any of these types of areas where the ICNIRP general public limits may be breached, if a licensee cannot be sure whether they will be present when they are transmitting, then the licensee should presume they will be present. If, for example, a neighbour generally only goes in their garden once a month or the general public infrequently use a public pathway, that does *not* mean the licensee can expose them to EMF in breach of the ICNIRP general public limits on the occasions that they are present in those areas.

- 4.38 There are however some areas where licensees do not need to expect members of the general public to be present. These include:
- a) areas where a licensee or other person has installed appropriate warning signs, barriers and/or locks designed to prevent members of the general public from accessing areas in which the ICNIRP general public limits may be exceeded;
  - b) areas which may be public property but which in practice have become and remain inaccessible, for example, due to overgrown vegetation.
- 4.39 We cannot account for every possible circumstance in which a member of the general public may be present. It is ultimately for licensees to ensure they take appropriate steps to ensure compliance with the ICNIRP general public limits and to record the basis on which they have determined compliance.
- 4.40 For the reasons set out above, we have decided to amend our licence condition to reflect the intended scope of our licence condition. We have removed the reference to requiring compliance *“in any area that is accessible to the general public”* and now require compliance *“in any area where a member of the general public is or can be expected to be present when transmissions are taking place”*.<sup>11</sup> We have reflected our decision in our guidance documents.

**Definition too narrow and should include some workers**

- 4.41 In contrast to other respondents, two respondents thought that our definition of the general public was too narrow and should be expanded to include workers not working in the radiocommunications industry.
- 4.42 Eric Peel and Hub Telecoms Consultancy Ltd thought our definition of the general public should include all workers who may have no knowledge, understanding or training of EMF risks on a site (e.g. window cleaners, roofers, scaffolders, lift/air conditioning engineers, insurance inspectors, surveyors, architects and street lighting maintenance contractors). They suggested such workers may not know what EMF risks there may be on a particular site. Hub Telecoms Consultancy Ltd suggested that ICNIRP distinguish between workers employed within the radio industry (e.g. antenna riggers, installers, commissioning/testing and maintenance technicians) and other workers who may need to access rooftops, and said that our licence condition should also make that distinction. Eric Peel added that workers not working in the radio industry should be entitled to undertake their work activities in areas outside Public Exclusion Zones rather than areas outside Occupational Exclusion Zones (where workers can be exposed to higher EMF levels).
- 4.43 Hub Telecoms Consultancy Ltd said there were difficulties in obtaining relevant information about EMF risks for particular sites and Eric Peel argued that mobile network operators must be easily contactable to allow the power to be reduced whenever workers wish to access the vicinity of the antennae on a site for work-related reasons.

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<sup>11</sup> For simplicity, we refer to these areas as areas where members of the general public *may be* present.

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- 4.44 Hub Telecoms Consultancy Ltd noted that working at height courses often include a “RF overview” lasting 2 or 3 minutes which simply informs the trainee not to touch anything and to obey signage. It queried how employees could know there is an exclusion zone if the exclusion zones are not marked, or if the antennas are hidden behind fake chimneys or walls. It also cited the example of a female employee who may be pregnant and asked how an employer could protect her if she needed to work on a rooftop.
- 4.45 RAYNET-UK queried whether volunteers are captured by our definition of the general public, noting that they may not necessarily be acting for purposes connected with their trade, business or profession.

*Ofcom response*

- 4.46 As explained in our October 2020 Statement, our licence condition is intended to complement – and not overlap – with the regulatory regimes that currently exist. In the UK, there is already health and safety at work legislation (including [The Control of Electromagnetic Fields at Work Regulations 2016](#) (the EMF Worker Regulations)) that requires employers to protect all workers from EMF regardless of whether they work in the radiocommunications industry. Employers should therefore already be taking appropriate steps to mitigate the risk of EMF exposure to workers – including window cleaners, roofers, scaffolders, lift/air conditioning engineers, insurance inspectors, surveyors, architects and street lighting maintenance contractors – in accordance with pre-existing health and safety legislation.
- 4.47 If we were to expand our definition of the general public to include some workers then our licence condition would overlap with pre-existing health and safety legislation which is enforced by HSE. We have therefore decided not to expand our definition of the general public to include some workers.
- 4.48 As noted by some respondents, the [ICNIRP Guidelines](#)<sup>12</sup> differentiate between occupationally-exposed individuals and members of the general public. The ICNIRP Guidelines define occupationally-exposed individuals “*as adults who are exposed under controlled conditions associated with their occupational duties, trained to be aware of potential radiofrequency EMF risks and to employ appropriate harm-mitigation measures, and who have the sensory and behavioral capacity for such awareness and harm mitigation response. An occupationally-exposed worker must also be subject to an appropriate health and safety program that provides the above information and protection.*”
- 4.49 The ICNIRP Guidelines do not differentiate between individuals that work in the radiocommunications industry (such as an antenna rigger) and those that do not. All workers are occupationally-exposed individuals and are not members of the general public whilst they are working.
- 4.50 UK health and safety legislation imposes a duty on all employers and self-employed persons to take reasonable steps to prevent harm in the workplace. Consistent with the

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<sup>12</sup> See pages 484 and 485.

definition of occupationally-exposed individuals in the ICNIRP Guidelines, this duty includes considering any risks to their workers arising from exposure to EMF. The EMF Worker Regulations impose specific obligations on employers in relation to exposing their workers to EMF including limits on EMF exposure which are based on the ICNIRP Guidelines. HSE has also published [Guidance](#) explaining the steps employers are required to take to assess and mitigate EMF risks including the type of training it may be appropriate to give to their workers. HSE also explains that employers are required to give special consideration to employees that may be at particular risk such as pregnant workers.<sup>13</sup>

- 4.51 We recognise that some employers may not operate radio equipment themselves or have information on EMF risks at a particular site immediately to hand. This does not however mean that an employer can ignore EMF risks. All site owners or landlords should have information on any EMF risks at a particular site including any ICNIRP exclusion zones and should be in a position to provide the necessary information to any employer seeking to assess any EMF risks to their workers at a particular site. We understand both Cornerstone (a network infrastructure joint venture between Vodafone and Telefónica) and MBNL (a network infrastructure joint venture between EE and Three) provide information on EMF risks to site owners. We also note that HSE's Guidance 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.<sup>14</sup>
- 4.52 As noted above, the EMF Worker Regulations fall within HSE's remit and are not within the scope of our licence condition.
- 4.53 In relation to whether volunteers are covered by our definition of the general public, this is likely to depend on the circumstances. In the case of RAYNET-UK volunteers, our definition of the general public does not require the licensee to protect themselves from EMF exposure. If radio amateur licensees are acting as volunteers, they will not therefore be required to protect themselves or, as explained in paragraphs 4.23 – 4.26 above, each other from EMF exposure.
- 4.54 Other individuals carrying out public functions, whether as a volunteer or otherwise, for organisations including the MCA, the Royal National Lifeboat Institution (RNLI) and mountain rescue teams, are not covered by our definition of the general public. We note that volunteers should be protected from EMF exposure under pre-existing health and safety legislation which requires employers to ensure as far as reasonably practicable they do not expose workers and other persons to risks to their health or safety.<sup>15</sup>

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<sup>13</sup> We note that many workers that may be exposed to EMF may also be working at heights. HSE has also published various [Guidance](#) on the steps employers are required to take to assess risks arising from workers working at heights.

<sup>14</sup> [HSE Guidance](#), paragraph 34.

<sup>15</sup> See, for example, the [Health and Safety at Work etc. Act 1974](#), [The Management of Health and Safety at Work Regulations 1999](#) and [The Merchant Shipping and Fishing Vessels \(Health and Safety at Work\) Regulations 1997](#).

## References to the ICNIRP Guidelines

### Use of 2020 ICNIRP Guidelines

- 4.55 Several respondents commented on our proposal to require compliance with the 1998 version of the ICNIRP Guidelines rather than the 2020 version of the ICNIRP Guidelines.
- 4.56 RSGB, John Rogers and Peter Zollman suggested that we should allow licensees to assess compliance based on either the 1998 ICNIRP Guidelines or the 2020 ICNIRP Guidelines. RSGB noted that it is developing guidance and advice based on the 2020 Guidelines. A confidential response explained that there are no adequate IEC, CENELEC or Ofcom standards that cover the scope of the amateur licence and would enable an amateur licensee to assess compliance based on either the 1998 or 2020 ICNIRP Guidelines. As a result, the respondent suggested it is better to develop guidance based on the 2020 Guidelines rather than have to go through a multi-stage process again.
- 4.57 Telefónica questioned why Ofcom refers to the 1998 ICNIRP Guidelines as a defining reference, even though this has been superseded by the 2020 version of the Guidelines. It noted Ofcom’s reasoning that “the relevant standards explaining the methodology for assessing compliance with the 2020 Guidelines have not been developed” but opined that the ICNIRP Guidelines and the methodology for assessing compliance are separate topics. It said that it was working to the 2020 Guidelines now and suggested that references to the 1998 Guidelines should be removed and replaced with references to the 2020 Guidelines.
- 4.58 Cellnex UK expressed concerns with the licence condition continuing to reference the 1998 Guidelines for now. It said it could imagine that referencing guidance that has been superseded will neither engender confidence from the public nor allay their fears. It added that Ofcom could be accused of being unnecessarily restrictive in situations where the 2020 Guidelines are less restrictive and insufficiently protective in situations where the 2020 Guidelines are more restrictive. It suggested that if Ofcom’s decision is based on the content in standards, then an alternative approach would be to refer to the Normative reference, EC Recommendation (1999/519/EC). Arqiva also noted that the industry refers to Recommendation 1999/519/EC in policy documents and on “ICNIRP” certificates rather than referring directly to the ICNIRP Guidelines and queried whether it might be appropriate for Ofcom to do the same.
- 4.59 The Joint Radio Company (JRC) noted that Ofcom’s October 2020 Statement included a graph (Figure 5.1) which provides a straightforward way of assessing separation distances in accordance with the 1998 ICNIRP Guidelines and said it would be helpful if Ofcom could provide an updated version based on the 2020 ICNIRP Guidelines.

### Other comments on the ICNIRP Guidelines

- 4.60 Respondents also made some detailed comments about the references to the ICNIRP Guidelines in the licence condition and our “Guidance on EMF Compliance and Enforcement”.

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- 4.61 Burnham Beeches Radio Club commented on clause 6 (Records) of the licence condition, saying that Ofcom should be clear that compliance is required with the reference levels in the ICNIRP Guidelines rather than the basic restrictions as some basic restrictions cannot be measured in practice e.g. current density in the head.
- 4.62 Keith Bird suggested that the wording “exposure levels...are below the basic restrictions” in the licence condition should be changed to read “exposure levels...do not exceed the basic restrictions”.
- 4.63 Cellnex UK noted that Ofcom had taken on board suggestions to no longer include in the licence condition references to the relevant table numbers in the ICNIRP Guidelines but said that the “Guidance on EMF Compliance and Enforcement” still refers to the relevant table numbers and recommended those references are also removed. Arqiva made a similar point.

*Ofcom response*

- 4.64 As explained in our October 2020 Statement, our rationale for identifying the 1998 ICNIRP Guidelines in our “Guidance on EMF Compliance and Enforcement” for an initial period of time was based on the fact that relevant compliance standards had not yet been updated to take account of the 2020 version of the ICNIRP Guidelines. We did not therefore wish to introduce a requirement on licensees which many licensees may find it difficult to comply with.
- 4.65 However, we note that all responses that provided feedback on this issue were supportive of allowing licensees to demonstrate compliance against the 2020 Guidelines now. We also note the points raised by the amateur community that there are no existing IEC, CENELEC or Ofcom standards that cover the scope of the amateur licence and would enable an amateur licensee to assess compliance, and that if guidance is going to be developed for assessing compliance, it would be more efficient to base that on the 2020 Guidelines rather than go through a multi-stage process again.
- 4.66 We have therefore decided to allow licensees to demonstrate compliance with the 2020 Guidelines. We do not however consider it appropriate to prevent licensees from demonstrating compliance with the 1998 Guidelines while work is still ongoing to update relevant standards and methodologies to take into account the 2020 Guidelines. In our view, requiring all licensees to comply with the 2020 Guidelines now is likely to cause difficulties for some licensees. For example, we note that the EC Recommendation 1999/519/EC, which Arqiva suggested that industry refer to, still refers to the 1998 Guidelines.
- 4.67 In view of this, we have decided that we will provide greater flexibility by allowing licensees to demonstrate compliance with either the 1998 ICNIRP Guidelines or the 2020 ICNIRP Guidelines for an initial period until we are satisfied that work on updating the relevant standards and methodologies to take full account of the 2020 Guidelines, is sufficiently well advanced. Once this is the case, we will consult on amending our “Guidance on EMF Compliance and Enforcement” to remove reference to the 1998

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Guidelines, and subject to the result of that consultation, require all licensees to demonstrate compliance with the 2020 Guidelines going forward. Our consultation would propose allowing licensees a transition period to update their compliance records as necessary to ensure compliance with the 2020 Guidelines.

- 4.68 Where a licensee decides to demonstrate compliance with the 2020 Guidelines before work on updating the relevant standards and methodologies are sufficiently advanced, they will need to ensure any EMF calculations or measurements they undertake are based on methods the licensee can demonstrate produce accurate results (i.e. do not result in a breach of the ICNIRP general public limits).
- 4.69 Regarding JRC's request for an updated version of the graph in our October 2020 Statement based on the 2020 Guidelines, we note that this graph only included data for three power levels and was included for illustrative purposes. It was not provided for the purpose of assessing compliance distances. Licensees should use the simple EMF calculator or other assessment methods as set out in our "Guidance on EMF Compliance and Enforcement".
- 4.70 In response to Burnham Beeches Radio Club's point about clarity on compliance with the reference levels, we note that there are footnotes in the licence condition which confirm that compliance with the reference levels for general public exposure identified in the ICNIRP Guidelines will ensure compliance with the basic restrictions.
- 4.71 We agree with Keith Bird's suggested amendment to the wording in the licence condition and have replaced references to "are below" with "do not exceed". This change is consistent with the way the ICNIRP general public limits are expressed in the ICNIRP Guidelines.
- 4.72 In response to Cellnex UK's point, our licence condition requires licensees to comply with the version of the ICNIRP Guidelines identified in our "Guidance on EMF Compliance and Enforcement" that is in force at the relevant time. In our October 2020 Statement, we proposed to initially require compliance with the 1998 Guidelines and for that reason had included the relevant table numbers from the 1998 Guidelines in our "Guidance on EMF Compliance and Enforcement". Now we have decided to initially allow compliance with either the 1998 or the 2020 Guidelines, we have updated our "Guidance on EMF Compliance and Enforcement" to refer to the relevant table numbers from both the 1998 and the 2020 Guidelines. We consider it helpful to provide the relevant table numbers in the ICNIRP Guidelines rather than delete them.

### **Definition of "site"**

- 4.73 We received a small number of comments on our definitions of "site" and "shared site" in the licence condition. Telefónica said that it thought the definitions were somewhat loose and could be open to interpretation. It said that a "physical structure" could be interpreted to be anything, and a "building" sometimes doesn't have clearly defined boundaries. It requested that Ofcom provide further clarity and use more definite terms when describing a "physical structure" and "building". It also asked at what distance from a shared site it

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would be reasonable to assume it was not sharing in any practical sense and queried at what point the separation distance between equipment operated by different MNOs is large enough such that a “shared site” analysis is no longer required.

- 4.74 A confidential response said that a literal interpretation of the definition would restrict the compliance requirement to only those places accessible on that specific “physical structure, building, vehicle or moving platform” and suggested a compliance assessment would not need to take into account adjacent locations such as the ground area around a pole/tower, adjacent buildings etc. It added that, in the event there are multiple towers in a compound, the definition literally means that the EMF from each physical support structure should be assessed independently of any others and argued that this is not what is needed to manage potential EMF exposure appropriately, so some rethinking on definitions would be appropriate.
- 4.75 Arqiva said there were many examples where there are several towers and/or rooftops close together, each with one or more radio systems. It said the real requirement is to consider the combined effect of contributions from all sources at each location; however, the current definition meant that Ofcom would not be requiring licensees to take account of contributions from equipment not located on the same site, but would be expecting licensees to co-operate. It said this would probably work to some extent but would be likely to fail in some cases.

*Ofcom response*

- 4.76 As explained in our October 2020 Statement, we included a definition of site with the purpose of providing additional clarity to stakeholders and to limit the scope of EMF assessments at shared sites. Without a definition of site, licensees could face an unbounded task in identifying all other radio transmitters within the proximity of its site that may contribute to the total EMF exposure levels.
- 4.77 We recognise that due to the large number of possible shared site scenarios, the definitions we proposed are an imperfect solution and there will always be scenarios which are not neatly captured.
- 4.78 One possible alternative would be to define a radius within which a licensee would need to identify, and take into account EMF exposure from, all other radio transmitters. However, making a judgment on the appropriate size for such a radius is challenging as it depends on several factors including transmit power, frequency, antenna type and directionality, etc.
- 4.79 Having carefully reviewed this point, we have decided to retain the definition of site included in our October 2020 Statement and further consultation. However, there may be circumstances on a shared site where a licensee can reasonably assume that the target coverage area of other radio equipment on a site will not overlap with the target coverage area of its own radio equipment. This situation may arise if, for example, two licensees have equipment located on opposite ends of the same building, where the equipment is providing coverage to different areas. By way of additional guidance, if a licensee considers it appropriate to make such an assumption then it will not need to take into account any



EMF exposure levels from that other equipment. Licensees should however record the basis for making such an assumption.

- 4.80 As stated in our October 2020 Statement, we recognise our definition of a site will mean that the licence condition will not specifically require licensees to consider radio equipment located on another site (for example, radio equipment on neighbouring buildings in a built-up area; other transmitters on separate structures within a compound or on newsgathering trucks parked nearby; or equipment temporarily set-up in the vicinity of other equipment directly on the ground in an open public space). If Ofcom becomes aware of a breach of the ICNIRP general public limits in any area in which the general public may be present when transmissions are taking place which is the result of EMF exposure produced by radio equipment on more than one site, Ofcom expects licensees to cooperate and take action to ensure the ICNIRP general public limits are not exceeded. If licensees fail to cooperate and/or take such action, we may consider using soft enforcement tools (which, if considered appropriate in the circumstances, may include identifying the names of such licensees).
- 4.81 We also expect licensees to take a reasonable view of what is a site and not for example to categorise different transmitters located on the same building as being on different sites simply because they are attached to different support structures.

## **Emergency situations**

- 4.82 In our October 2020 Statement, we set out our decision to include an additional clause in the EMF licence condition explaining that licensees would not need to comply with the ICNIRP general public limits in certain emergency situations.
- 4.83 Most respondents that commented on this point welcomed this new addition, but some asked for us to broaden the scope of this exemption or asked for further clarification. Some respondents expressed their opposition to this condition on the basis of health concerns.
- 4.84 The MCA said that it was broadly content with the proposals and was pleased that emergency use is exempt. However, it noted that the proposed wording of the condition only referred to “the safety of the public or public health” which appeared to exclude distress in respect of workers or for instance environmental harm; it suggested amending the wording to allow a broader interpretation of emergency use, including by deleting part (b) of the condition. It also noted that our proposed exemption clearly includes GMDSS Distress communications as defined in Radio Regulations §32.40, but asked for clarification on whether GMDSS Urgency and Safety communications would also be included.
- 4.85 The MCA also noted that training for emergency situations would not be covered by the condition and said this would create an additional burden for response organisations, for example by having marshals in place, which risks reducing operational effectiveness through diminished training. It asked whether, for example, mobile units with fixed installations (e.g. vehicles, RIBs and other small craft undergoing training for search and rescue activities) could be included in the exemption.

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- 4.86 RAYNET-UK - a national voluntary communications service provided by amateur licensees - also commented on training aspects; it said that training activities may be 'no notice' activities to provide the best training experience but the relatively narrow scope of Ofcom's exemption for emergency situations may limit these activities. Michael White also commented on the impact on RAYNET's activities, saying that emergency deployment by RAYNET on behalf of Category 1 responders would be more problematic, thus reducing the resilience capabilities and contributions of radio amateurs.
- 4.87 Jocelyn Gardner, Stef Russell and Nicky Beele disagreed with the emergency exemption on the basis of health concerns. Jocelyn Gardner said that Ofcom's proposal to permit exposure levels above the ICNIRP safety guidelines in order to avoid a threat to public health was an 'absurd contradiction'.

*Ofcom response*

- 4.88 The purpose of the emergency exemption is to avoid the situation where the licensee or a third party using the licensee's radio equipment:
- a) does not seek (or is delayed in seeking) emergency assistance or reporting an emergency situation; or
  - b) is prevented from (or delayed in) using radio equipment in an emergency situation, because of a concern that they may breach the EMF licence condition.
- 4.89 The risk of harm to the health and safety of a member of the general public from communications not taking place or being delayed in an emergency situation will almost certainly be greater than the risk of harm related to any temporary levels of EMF exposure above the ICNIRP general public limits. As a result, seeking emergency assistance or reporting or responding to an emergency situation should take precedence above compliance with the ICNIRP general public limits.
- 4.90 Taking into account some of the comments received in response to our further consultation, we have however decided to refine our emergency exemption. We agree with the MCA's suggestion and have decided to remove part (b) of our exemption which said the exemption would only apply if complying with the ICNIRP general public limits "*is likely to result in or create an immediate and serious threat to the safety of the public or public health*". This may have resulted in licensees having to take the time to consider whether part (b) applied and in an emergency situation that delay could result in harm to the general public. We have instead decided to tighten part (a) of our exemption so it only applies in circumstances where 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).
- 4.91 This means that the use of radio equipment by a licensee or third party that is actively and directly involved on the ground in seeking emergency assistance or reporting or responding to an emergency situation is exempt. This includes the scenario where radio equipment is being used by first responders such as mountain rescue teams, the MCA and RNLI to respond to emergency situations, regardless of whether the relevant radio equipment is a

portable device or a mobile installation (e.g. on a vehicle or boat). It also includes all distress communications in a maritime context (by which we mean communications in circumstances where there is a grave and imminent danger to a ship or person and assistance is required).<sup>16</sup>

- 4.92 The emergency exemption does not exempt a licensee from complying with the ICNIRP general public limits in the following scenarios:
- a) Where radio equipment is being used by a licensee that has temporarily set-up their radio equipment in the vicinity of an emergency situation (such as in a car park) in order to assist first responders (for example, by acting as a relay facility) but where the licensee is not actively and directly involved in the emergency response. Whilst the licensee may not know the exact surroundings in which they may be required to set-up their equipment, we expect licensees to know in advance how they need to set-up their equipment to ensure it complies with the ICNIRP general public limits.
  - b) Where radio equipment is set-up in a fixed remote location to help facilitate seeking emergency assistance or reporting or responding to an emergency situation i.e. where radio equipment is not being temporarily used in the vicinity of an emergency situation. Where equipment is being used in a fixed remote location, the licensee should have already ensured its equipment is set-up in a way which ensures it complies with the ICNIRP general public limits.
  - c) Where radio equipment is being used for training activities. Whilst we acknowledge the importance of training activities replicating real-life scenarios as far as possible, training activities are not ultimately emergency situations. There is no serious risk to the safety of the general public in a training exercise and we have decided it is not therefore appropriate for us to allow licensees to breach the ICNIRP general public limits during training activities. Training activities are also likely to be planned and we would expect a risk analysis (including risks relating to EMF compliance) to be carried out prior to any training activity. If a licensee does not consider it can comply with the ICNIRP general public limits during a training exercise then it can consider undertaking the exercise where no member of the general public will be present in any area where the ICNIRP general public limits may be exceeded when transmissions are taking place. Further, if only workers may be exposed to EMF during a training exercise then the higher limits in the EMF Worker Regulations will be applicable.
- 4.93 The emergency exemption is a temporary exemption that only applies for as long as an emergency situation exists; it is not an exemption that permanently applies to radio equipment that is sometimes used in an emergency situation. Licensees will need to ensure they comply with the ICNIRP general public limits in all non-emergency situations. Licensees relying on the emergency exemption should also record the basis on which they are relying on it.

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<sup>16</sup> This is consistent with the terms and conditions of the Ship Radio Licence which does not restrict the use of radio equipment “in the event of an emergency where there is a risk to life” (see Condition 12 of the [Ship Radio Licence](#)).

- 4.94 We do not agree that the emergency clause should result in any increased risk to public health. As explained above, this clause will only apply to emergency situations. Organisations that use radio equipment for this purpose will still need to ensure they comply with the ICNIRP general public limits when they are not responding to an emergency situation.
- 4.95 It is also important to understand that EMF levels in excess of the ICNIRP general public limits will not necessarily result in any harm to a member of the general public. This is because the ICNIRP general public limits are set at a precautionary level which is below the level that could potentially lead to adverse biological effects<sup>17</sup>.

### Sites that are not shared with other licensees

- 4.96 The MCA raised concerns about the complexity of assessing compliance for multiple transmitters on the same site. It noted that on some structures, both land-based and ship-based, there would be combinations of transmitting antennas on different frequency bands all operating on various duty cycles and used by a single licensee. It added that radar uses both very short pulses and a rotating antenna, and asked how EIRP for radar should be represented in Ofcom's calculator.

#### *Ofcom response*

- 4.97 Licensees should be assessing EMF exposure levels taking into account *all* of their own equipment (that is authorised to transmit above 10 Watts EIRP or 6.1 Watts ERP) on a site, regardless of whether the site is shared with other licensees and regardless of whether their equipment is authorised under the same or a different licence. We have amended the first clause of our licence condition to make this clearer. We now refer to the *total* EMF exposure levels produced by the "*Licensee's On-Site Radio Equipment*". This new definition includes all a licensee's radio equipment on the same site which is authorised to transmit above 10 Watts EIRP or 6.1 Watts ERP regardless of which licence contains that authorisation.
- 4.98 In order to assist licensees assess compliance with the ICNIRP general public limits in relation to their own equipment on a site, licensees may be able to make the following reasonable assumptions:
- a) **No overlapping target coverage areas:** There may be circumstances where a licensee can reasonably assume that the target coverage area of some of its radio equipment on a site will not overlap with the target coverage area of its other radio equipment. In this scenario, the licensee does not need to calculate the aggregate EMF exposure produced by the relevant transmitters and can calculate the compliance distance of each transmitter on an individual basis. For example, we have decided it is reasonable for maritime licensees to make this assumption in relation to radar or satellite equipment on a boat provided the equipment has been installed and maintained in line

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<sup>17</sup> See for example the response to the question "How are specific populations, such as children, pregnant women, sick and elderly people, protected in the RF EMF guidelines?" on ICNIRP's website: <https://www.icnirp.org/en/rf-faq/index.html>.

with the manufacturer's instructions. There is in our view a low risk of the target coverage areas of radar or satellite equipment overlapping with the target coverage areas of other radio equipment that may be used on a boat. Maritime licensees can therefore assess whether such equipment complies with the ICNIRP general public limits on an individual basis.

- b) **No simultaneous transmissions:** Where a licensee does not use one piece of radio equipment at the same time as it uses another piece of equipment, it can reasonably assume that both pieces of radio equipment will not produce EMF at the same time. In this scenario, the licensee would not need to calculate the aggregate EMF exposure produced by both pieces of equipment and can calculate the compliance distance of each transmitter on an individual basis. It may be reasonable to make this assumption in relation to the use of radio equipment on a boat where some equipment is only used intermittently.
- 4.99 Licensees should always record the basis of any assumptions they make and why they consider them to be appropriate in their specific circumstances.
- 4.100 In response to the MCA's point on radar, we note the helpful information on marine radars and EMF published by the [World Health Organisation \(WHO\)](#) and the [Health and Safety Executive \(HSE\)](#). Based on this, we would expect that, provided radars are installed and operated in accordance with the manufacturer's instructions, any risk of marine radar breaching the ICNIRP general public limits is likely to occur when boats are in a port or harbour and where it is possible for members of the general public to come close to the radar in its main beam. In cases where licensees cannot be sure that EMF exposure from the radar would comply with the ICNIRP general public limits, an option for ensuring compliance could be to ensure that radars are always put into 'standby' or 'switched off' when in port.
- 4.101 We have included these points in our guidance documents.

### **Sites that are shared with another licensee**

- 4.102 Most respondents that commented on this aspect welcomed the inclusion of shared site exemptions, although some requested clarification or thought that it was unclear how they applied.
- 4.103 JRC said it was supportive of Ofcom's approach and believed that the exemptions were pragmatic and proportionate. It suggested that Ofcom could establish a flow diagram to depict the process steps to make it more accessible and remove the risk of any ambiguity. It also thought that it would be difficult for 'non-exempt' operators to identify other 'non-exempt' operators and that, without a centralised register, the process of identifying 'non-exempt' systems could become unnecessarily complex and may lead to regulatory uncertainty / risk of regulatory failure. It suggested that one solution to the potential coordination risk could be to designate the highest power operator on a shared site (not subject to an exemption), as the responsible party for coordinating and demonstrating compliance.

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

- 4.104 Julian Gannaway thought that the exemptions seemed to have been created by picking certain disparate combinations of users for a few special cases for administrative convenience and did not show the basis of a sound, evidence based, policy. He also said that it was unclear how the exemption applies, stating: "Para 1 applies to "Sites which are not a shared site". Para 2 applies to "Sites which are a shared site", but then says the Licensee must comply with para 1 anyway. The Shared Site Exemption seems to be illusory. Para 1 still seems to apply. This doesn't make sense."
- 4.105 Eric Peel argued that the exemptions should not be allowed to apply to MNOs, including for small cells. He said that MNO transmissions were "the most problematic because they point at public areas whereas other radio use generally doesn't" and suggested that MNOs must be required to look at aggregate exposure even at small cells as these are closer to the general public. He queried whether the shared site exemption could be narrowly interpreted as applying to individual transmitters, even where one licensee has multiple transmitters on the same shared site, and thought this should not be allowed to happen. He was also concerned that mobile operators are still adding infill 2G/3G/4G coverage at 5G sites and didn't see why this was necessary when there is 5G; he suggested that Ofcom issue guidance to stop this happening.
- 4.106 Telefónica noted that the shared site exemption applies if the EMF exposure levels are "...no more than 5% of the basic restrictions". It suggested that this be amended to state "...no more than 5% of the basic restrictions or X% of the reference levels", since it is easy to calculate or measure reference levels on a site (RF power) but hard to establish basic levels (Specific Absorption Rates).
- 4.107 RAYNET-UK noted that the shared site exemption does not apply if the licensee is 'authorised' to transmit at powers exceeding 100W EIRP. It suggested that a distinction should be made between the authorisation and the actual capability of the installed equipment.

*Ofcom response*

- 4.108 We have designed the shared site exemptions with the aim of ensuring licensees (e.g. mobile networks and broadcast transmitters) that are likely to contribute most to the total EMF exposure in areas around a shared site where the general public may be present, will need to assess the aggregate EMF exposure, while other users that contribute less to the overall EMF exposure will not need to. We continue to believe there is a sound policy basis for the exemptions. We note that we did not receive any suggestions to implement alternative exemptions.
- 4.109 It is important to note that the shared site exemption is not an exemption from complying with the EMF condition. Licensees who are covered by the shared site exemption *must still assess the EMF exposure produced by their own equipment*. As explained above, this assessment should include *all* of their equipment on a site that is authorised to transmit above 10 Watts EIRP or 6.1 Watts ERP, whether or not it is shared with another licensee.

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

- 4.110 The shared site exemption only exempts licensees from taking the EMF exposure of some or all of *other* licensees' radio equipment into account. We have amended our licence condition to remove the definition of "Other Radio Equipment" and now make the requirement clear in the third clause of the licence condition itself.
- 4.111 We note the concerns raised by JRC about identifying 'non-exempt' systems without the use of a centralised register. However, we consider that it should in most cases be possible for licensees on shared sites to identify which other equipment is exempt and non-exempt under this condition. The first and third situations of the shared site exemption mean that the vast majority of private mobile radio (PMR)/business radio and fixed link equipment will be exempt. We expect that most users of non-exempt equipment on shared sites will be able to identify PMR/business radio and fixed link antennas and recognise that they do not need to take these into account in their assessments. We discuss issues around sharing information with other licensees in paragraphs 4.167 – 4.169 below.
- 4.112 Taking into account some of the comments received in response to our further consultation, we have however decided to refine the shared site exemptions as explained below.
- 4.113 First, we have clarified that when licensees are assessing whether a shared site exemption applies in relation to their own or another licensee's equipment, they only need to take into account equipment that is authorised to transmit at powers above 10 Watts EIRP or 6.1 Watts ERP.
- 4.114 Second, we agree with RAYNET-UK's point that, in determining whether the first shared site exemption situation applies, it is the actual power being transmitted rather than the authorised power which is important. We have therefore amended the first exemption situation so that it will apply where a licensee's radio equipment *does not transmit* higher than 100 Watts EIRP or 61 Watts ERP.
- 4.115 Third, in response to Eric Peel's point, we have further amended the first exemption situation so that it only applies if *all a licensee's radio equipment on a site* transmits at a *combined total* radiated power in any particular direction does not exceed 100 Watts EIRP or 61 Watts ERP. For the purpose of this situation, the combined total radiated power is a simple sum of the radiated powers (in EIRP or ERP) of all of the licensee's radio equipment on the shared site that transmits signals covering the same or overlapping areas. A licensee cannot therefore simply assess whether the exemption applies to each piece of the licensee's radio equipment on a site individually; it must assess whether the exemption applies to all of the licensee's radio equipment on a site.
- 4.116 As discussed in paragraph 4.98 above, there may however be circumstances on a shared site where a licensee can reasonably assume that the target coverage area of some of the licensee's radio equipment on a site will not overlap with the target coverage area of some of the licensee's other radio equipment on the same site. This situation may arise if, for example, equipment is located on opposite ends of the same building, where the equipment is providing coverage to different areas. In these cases, licensees may not need to calculate the aggregate EMF exposure produced by both transmitters and can calculate

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

the compliance distance of each transmitter on an individual basis. However, where there are multiple transmitters covering the same or overlapping areas, they should use the combined total radiated power of this equipment for the EMF assessment using the approach outlined above. Licensees should also record the basis of any assumptions they have made. We have included these points in our guidance documents.

- 4.117 Fourth, taking into account Eric Peel's comment, we have similarly amended the second exemption situation so that it only applies if the *total* EMF exposure levels produced by *all a licensee's radio equipment* in any area where a member of the general public may be present when transmissions are taking place is no more than 5% of the ICNIRP general public limits.
- 4.118 Fifth, we agree with Telefónica's point and have clarified that the second exemption situation will apply if the total EMF levels are no more than 5% of the relevant basic restrictions or the reference levels identified in the ICNIRP Guidelines.
- 4.119 As suggested by JRC, we have also published alongside this Update [a simple flowchart](#) to assist licensees to determine what equipment on a site they need to take into account when assessing their compliance with the ICNIRP general public limits.
- 4.120 In response to the other points raised by Eric Peel, we expect that most mobile operator macrocell deployments are unlikely to be covered by the shared site exemption. We note Vodafone's response in which it said it did not anticipate that many of its sites would benefit from the shared site exemption.
- 4.121 With regard to small cells, we note that these will operate at far lower powers than typical mobile macrocells. Urban small cells may for example transmit at power levels between around 0.25 and 6.0 Watts, whereas those that provide wider geographical coverage (and will therefore be placed in a higher position) may transmit at powers around 10 Watts. Small cells that are not authorised at powers higher than 10 Watts EIRP (or 6.1 Watts ERP) will not be required to comply with our licence condition.
- 4.122 In general, we expect that small cells that are positioned near to places that are accessible to the general public will operate at very low powers such that they comply with the ICNIRP general public limits. Small cells that operate at higher powers (i.e. above 10 Watts EIRP), are likely to be positioned in places that the general public cannot access, e.g. mounted on a pole some metres above ground level.
- 4.123 We would also note that, as evidenced by the hundreds of measurements that we have carried out to date, mobile operators have consistently demonstrated a firm commitment to compliance with the ICNIRP general public limits, and we expect this to continue with the further deployment of small cells. We also intend to continue carrying out measurements of new 5G mobile deployments, including deployments in higher frequency bands as and when these commence, and will publish these on our website.
- 4.124 We do not agree that there is any need to prevent 2G/3G/4G infill coverage at 5G sites. Ofcom has carried out a programme of measurements around 5G-enabled mobile base stations and we are publishing an [updated version of our summary test report](#) alongside



this Update. The measurements presented in this report covered all frequencies currently used by mobile networks and considered the aggregate exposure from all transmitters (2G, 3G, 4G and 5G) at these sites. All of our measurements to date have shown EMF exposure levels that are well within the ICNIRP general public limits.

## **A different threshold for amateur radio licences**

- 4.125 RSGB said that Ofcom should consider exempting amateur foundation licensees, who are permitted to transmit up to 10 Watts PEP (peak envelope power). It thought that providing additional guidance to these licensees explaining that any antenna (that is not integral to the radio equipment) should be “out of reach” of anyone when transmitting should be sufficient for compliance.
- 4.126 A number of other radio amateurs also called for a higher threshold for amateur use (e.g. 100 Watts and below), or for all amateur use to be exempt.

### *Ofcom response*

- 4.127 We do not agree that we should exempt amateur foundation licensees from the requirement to comply with the ICNIRP general public limits (or, as some have argued, for higher power amateur use). The maximum allowed transmit power for foundation licences is 10 Watts PEP. However, depending on the antenna used, this can still mean that foundation licensees can use a relatively high EIRP, both for fixed and mobile use. We consider that the suggested approach of ensuring the antenna is ‘out of reach’ may ensure compliance in some, but not all, cases.
- 4.128 We have therefore decided that amateur foundation licensees must also comply with the EMF condition. However, as discussed in section 5 below, we note that it may be possible for RSGB and/or others to create pre-assessed configurations of antenna, height and averaged transmit power that would comply with the ICNIRP general public limits, and these could be shared in guidance to foundation licensees to help them more easily demonstrate compliance.

## **Additional threshold for equipment with a low conducted transmit power**

- 4.129 Siklu encouraged Ofcom to expand the definition of “Relevant Radio Equipment” and include radiators where the EIRP is higher than 10 Watts, and the conducted transmit power is higher than 20mW. In other words, the EMF licence condition should not apply to radiators where the EIRP is less than or equal to 10 Watts or the conducted transmit power is less than or equal to 20mW. They said that this suggestion is based on:
- a) The basic restriction (as defined in Table 5 of the 1998 ICNIRP Guidelines) refers to 10W/m<sup>2</sup>, and further stipulates that the power density, “averaged over 1cm<sup>2</sup>, should not exceed 20 times” that. A conducted transmitted power of up to 20mW over 1cm<sup>2</sup> waveguide is equivalent to power density of 20mW/cm<sup>2</sup>, or 200W/m<sup>2</sup>, and hence automatically complies with the basic restriction.
  - b) BS EN 50385, which specifies 20mW as the threshold for EMF compliance.

- 4.130 Julian Gannaway said that a threshold in EIRP would be completely arbitrary, and that the threshold should be meaningful in terms of likely risk of harm if it is to be objective and proportionate. He cited an example of a 10mW transmitter with a 40dBi antenna (100W EIRP) at 10GHz and said that this would not be a hazard to anyone, whatever the distance. However, a 100W Tx into an omni (100W EIRP) would be a very different matter.

*Ofcom response*

- 4.131 We agree that the examples highlighted by Siklu and Julian Gannaway of very low transmit powers may mean that the equipment automatically complies with the ICNIRP general public limits. We did not find any information in BS EN 50385 about a 20mW threshold but are aware that such a threshold is included in BS EN 62479. However, we do not think it is necessary to amend the threshold in the licence condition to incorporate this point. Compliance with a power threshold would normally be included in information from the equipment manufacturer and, in these instances, the licensee can use the manufacturer's instructions as evidence of compliance.

## **Use of EIRP**

- 4.132 A number of respondents from the amateur community continued to suggest the use of EIRP (effective isotropic radiated power) in the context of EMF is inappropriate. Most comments on this matter highlighted that EIRP is applicable in the far field but not a valid concept in the near field.
- 4.133 RSGB argued that use of EIRP as the only threshold criterion is not always appropriate. It suggested that the thresholds and/or a pre-screening compliance approach should consider real power available as well as, or instead of, the EIRP. RSGB also noted that at amateur power levels and frequencies below 100 MHz, compliance with the ICNIRP general public limits is almost exclusively a near-field issue.
- 4.134 Steve Carter suggested that using a far-field parameter (EIRP) to assess near-field strengths could lead to misleading and even potentially dangerous results. He said that a simple example of where this could occur is if the EIRP based sidelobe pattern from an antenna was used to make an EMF assessment and that this could lead to a completely false assessment of the separation distance.
- 4.135 Steve Carter also commented that the performance of any antenna, particularly at frequencies up to UHF, will be significantly affected by the presence of external conductors e.g. surrounding metalwork, cables, and in particular the ground. Therefore, the installation position of the antenna may cause the performance to deviate, potentially significantly, from the theoretical performance in free space, or from the manufacturer's published specifications. He asked us to clarify whether we were proposing that an assessment of EMF values should be based on the theoretical performance of the antenna, or whether we would require actual measurements to be made in circumstances where it was possible that the performance may deviate from the theoretical or specified parameters. He added that basing it on the theoretical performance could result in an EMF

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

cases, where external metalwork is very close to the antenna, licensees will need to take special care when undertaking their compliance evaluations.

4.142 These points form part of the rationale for the following two key changes that we have made to our calculator:

- we have introduced a new lower cut-off frequency of 10 MHz;
- we have adjusted the calculator so that it does not produce compliance distances shorter than the outer boundary of the reactive near-field of the antenna.

4.143 We discuss these points in more detail in paragraphs 5.24 - 5.27 below.

4.144 We recognise that it may be more complex to demonstrate compliance in the near field (especially the reactive near-field) and that this is particularly likely to be the case for equipment operating at relatively low frequencies. We have therefore decided to allow a longer period of time for licensees to ensure that their EMF compliance records for use of frequencies below 10 MHz are in place and up-to-date. We discuss this in more detail in paragraphs 4.198 to 4.202 below. We will also consider whether further guidance on these matters may be helpful and understand that RSGB is also considering further guidance for the radio amateur community.

## **Comments on our “Guidance on EMF Compliance and Enforcement”**

### **Proportionality of record-keeping and frequency of reassessment**

4.145 RSGB thought that the requirement in our “Guidance on EMF Compliance and Enforcement” (at A2.26 of our October 2020 further consultation) to “keep records of the date when [the licensee] made the last change to the site and any EMF assessment that [the licensee] undertook at that time” may not be proportionate for radio amateurs whose “self-training” includes experimentation and leads to frequent changes of equipment configuration.

4.146 It said that the continual experimentation inherent in the objectives of the amateur service indicates that the requirements relating to the frequency of reassessment should be considered further and guidance provided that takes into account proportionate risk management. It noted for example that it would be commonplace for antennas to be tried out, modified, moved, raised, lowered, rotated etc. on a continual basis. It said that reassessing compliance with the ICNIRP general public limits and recording this level of detail could be extremely onerous for amateurs and that good practice needs to be defined in practical terms before the condition comes into force. It added that this was also counter to the 2006 removal of mandatory logbooks for amateurs.

4.147 Keith Bird made a similar comment, noting that record-keeping should be proportionate to the risk.

*Ofcom response*

- 4.148 In the ‘Frequency of assessments’ section of our “Guidance on EMF Compliance and Enforcement”, we have explained that we expect licensees to reassess compliance when they make any change or addition to a site *which is likely to increase the EMF exposure levels* above the levels in their most recent EMF assessment in any area in which the general public may be present when transmissions are taking place. This means that not all changes to the equipment configuration will necessarily require a reassessment or the creation of a new record. It may be possible in some cases to carry out an assessment for a realistic ‘worst-case’ equipment configuration (e.g. in terms of antenna gain and transmit power), which would cover most future changes to configuration of the relevant equipment.
- 4.149 We have also updated our “Guidance on EMF Compliance and Enforcement” to include a more comprehensive list of various ways in which licensees can demonstrate compliance. This can be as simple as keeping a copy of the output of the calculator results (either from Ofcom’s EMF calculator or an alternative calculator) or keeping a record showing a pre-assessed equipment configuration developed by RSGB that has been used for assessing compliance. We expect that demonstrating compliance should be a relatively quick and simple task in most cases.

## **Temporary/mobile use**

- 4.150 RSGB said that the guidance on temporary and/or mobile use was useful, but needed to be reviewed in the context of the amateur service to be made practical.
- 4.151 Steve Carter said that it would be much more complex for temporary installations and for mobile users, whether in vehicles, boats etc, to assess and comply with the EMF condition. He said it would be extremely difficult for a mobile user to absolutely guarantee that no one can approach nearer to the antenna than would be permitted under the EMF requirements. He thought that, for example, users may be forced to enclose the antenna in a cage to limit access, or to mount the antenna in a far from optimum operating position. He added that in some cases it may be impossible to comply, such as in a very small boat.

*Ofcom response*

- 4.152 We have updated our “Guidance on EMF Compliance and Enforcement” to include additional ways that licensees may demonstrate compliance. This includes the use of control measures which could be particularly helpful in the scenarios highlighted by Steve Carter. For example, appropriate control measures may include:
- a) Introducing barriers or locks to limit access to the antenna or moving the antenna.
  - b) Installing appropriate warnings and signs directing people where not to sit/stand when equipment is being used and setting out simple explanations of risks.
  - c) Ensuring the licensee never transmits when a member of the general public may be present in an area in which the ICNIRP general public limits may be breached.

- d) Ensuring 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.
- 4.153 We have also clarified in paragraphs 4.33 – 4.40 above that licensees do not need to ensure they comply with the ICNIRP general public limits in areas in which the general public should not be expected to be present including:
- a) areas where a licensee or another person has installed appropriate warning signs, barriers and/or locks designed to prevent members of the general public from accessing areas in which the ICNIRP general public limits may be exceeded;
- b) areas which may be public property but which in practice have become and remain inaccessible, for example, due to overgrown vegetation.

### **Standards for amateur use**

- 4.154 RSGB said that, for the amateur service, there are no adequate IEC, CENELEC or Ofcom standards that cover the scope of the amateur licence and would enable amateurs to assess compliance with the ICNIRP general public limits. It said there is therefore a need for new standards / guidelines endorsed by Ofcom to clarify how amateurs can assess compliance. It said that before the licence condition becomes enforceable, Ofcom should work with RSGB (and others) to develop appropriate compliance standards and practices for amateurs. It added that there should be an adequate implementation period for radio amateurs to adopt and comply with the new standards.
- 4.155 John Rogers also commented that standards do not exist that cover the range and depth of amateur service use.
- 4.156 A confidential respondent made similar comments, noting that the extensive set of EMF standards (e.g. IEC/CENELEC) do not cover the range or types of activities commonly undertaken by radio amateurs. It suggested that Ofcom's "Guidance on EMF Compliance and Enforcement" is missing key aspects for amateur radio licensees, indicating that:
- The decision rules associated with Ofcom's compliance assessment have not been stated.
  - The reference conditions of the radio equipment to be assumed for a compliance evaluation have not been considered.
  - Guidance on what assessment methods are acceptable to Ofcom, or the requirements to be met for such methods to be accepted is lacking.
- 4.157 The confidential respondent added that Ofcom should support the concept of "continued improvement" so that the new guidance documents can acknowledge and reference developments in relation to how amateurs can assess compliance.
- 4.158 The Burnham Beeches Radio Club said that none of the standards mentioned by Ofcom are readily accessible to the majority of licensees due to their high cost. It suggested that methods set out in ITU documents may be appropriate and that Ofcom should also include any suitable ITU documents such as ITU-T K.52 and K.61, which are freely available. It

added that the methodology set out in standards documents may not be appropriate for amateur licensees.

*Ofcom response*

- 4.159 We acknowledge that there do not currently appear to be any standards that specifically deal with the full range of amateur activities. We welcome the work that RSGB and others are doing to identify appropriate methods for assessing amateur radio compliance.
- 4.160 We note that, as set out in our October 2020 Statement, we included standards BS EN 50665:2017 and BS EN 62311:2020 in the list of acceptable standards which can be used to demonstrate compliance, noting that these are designed to cater for “electronic and electrical equipment for which no dedicated product standard or product family standard regarding human exposure to electromagnetic fields applies”. The assessment methods and criteria in BS EN 62311:2020 can also be used to assess amateur radio equipment.
- 4.161 We also confirm that we will accept assessments which are conducted in accordance with the assessment methods and criteria contained in ITU-T Recommendations K.52 and K.61, and have included these in our updated “Guidance on EMF Compliance and Enforcement”.
- 4.162 In response to the points raised by a confidential respondent:
- Ofcom intends to use a shared risk approach when making decisions about compliance. This means that in cases where Ofcom conducts its own measurement, we will assess compliance based on whether the measured value (e.g. electric field strength, power density, etc.) averaged over the relevant time interval (e.g. 6 or 30 minutes) is above or below the ICNIRP general public limits. We will use this approach for cases where our expanded measurement uncertainty, at a confidence interval of 95%, does not exceed a target of  $\pm 4$  dB. In cases where our expanded measurement uncertainty, at a confidence interval of 95%, does exceed  $\pm 4$  dB, the measured value will be reduced by an appropriate amount (based on the difference between the target uncertainty and the actual uncertainty) before comparison with the ICNIRP general public limits.
  - When carrying out an EMF assessment (e.g. to establish compliance distances), it would be reasonable for a licensee to base this on the normal maximum operating conditions of the radio equipment concerned. For example, if a piece of radio equipment is capable of transmitting at 100 Watts EIRP but a licensee normally restricts their transmit power to a maximum of 50 Watts EIRP, they may use 50 Watts EIRP in their assessment. However, if the licensee decides at some point to transmit at the full 100 Watts EIRP that their equipment is capable of, they should carry out a re-assessment using 100 Watts EIRP to ensure they are still compliant. Another example may be where a licensee has taken into account in their assessment that they only transmit for a certain maximum length of time during the relevant averaging period, say 1 minute in any 6 minute period. If they later decide that they want to extend the maximum transmit time, for instance to 2 minutes in any 6 minute period, they should likewise carry out a re-assessment to ensure they are still compliant under the new operating conditions.

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

- 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.<sup>18</sup>

### **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

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<sup>18</sup> [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 15.4 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 15.3 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 15.3 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.<sup>19</sup>

### **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

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<sup>19</sup> 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 antenna<sup>20</sup>.
- 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.

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<sup>20</sup> 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.<sup>21</sup> Licensees are also required to:<sup>22</sup>
- 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.<sup>23</sup> 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.<sup>24</sup>

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<sup>21</sup> [Trading Guidance Notes](#), paragraph 4.12.

<sup>22</sup> [Trading Guidance Notes](#), paragraph 4.10.

<sup>23</sup> [Trading Guidance Notes](#), paragraph 4.10.

<sup>24</sup> [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.<sup>25</sup> We have added this factor to the list of factors that may be relevant in paragraph 15.3 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’.

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<sup>25</sup> [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](mailto: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/ARRL<sup>26</sup> 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

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<sup>26</sup> 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  $\lambda$  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’.<sup>27</sup>

## **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

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

be 75%. This duty factor (or cycle) may be included in the specifications from the equipment manufacturer.

- 5.35 Where the radio equipment transmits a signal that is continuous, the duty factor would be 100%, and in this case, the duty factor should not be considered when calculating the average power.
- 5.36 We used 'maximum percentage of time that the equipment will be operating' to refer to situations where the end user can control the percentage of time that a radio is transmitting.

## **Ground reflection factor**

- 5.37 We explained in our October 2020 Statement that we would apply a ground reflection factor (or reflection coefficient) of  $|\Gamma| = 0.6$  in our calculator for typical ground reflection conditions. A number of respondents commented on the ground reflection factor included in the calculator. Burnham Beeches Radio Club did not think a ground reflection factor should be included, noting that a calculator accepted by other administrations did not include it. It also noted examples of radio use where the ground reflection factor would be negligible or lower than that used in our calculator. A confidential response said that it was inappropriate to use this ground reflection factor, noting that it had originally been developed for use in the VHF band and not other bands and that it was not intended to properly estimate spatially averaged fields. It added that it was unfortunate that standards had yet to catch up. The MCA asked whether the ground reflection factor we used was representative for sea water.

### *Ofcom response*

- 5.38 As explained earlier in this section, the calculator is designed to allow licensees to simply demonstrate compliance without conducting a more detailed analysis. As we are proposing to accept this calculation result as evidence of compliance with the ICNIRP general public limits, we think that it is necessary and appropriate to use a conservative set of parameters in this calculator.
- 5.39 We note the points raised by the confidential respondent. However, as recognised by the respondent, this ground reflection factor is already widely used and referred to in standards. We do not currently have evidence to suggest that an alternative ground reflection factor would be more appropriate.
- 5.40 In response to the question from the MCA, sea water has a high conductivity and the reflection coefficient  $|\Gamma|$  can theoretically approach 1, which would result in larger separation distances being required. However, we consider that applying a value of 1 in the calculator would be likely to result in very pessimistic separation distances for the vast majority of cases. It is worth noting that onboard a vessel, reflections from the deck or other parts of the vessel's superstructure are more relevant than reflections from the surrounding sea water.

- 5.41 We have therefore decided to continue to use a ground reflection factor of  $|\Gamma| = 0.6$  for the time being and will review this in the future if additional evidence comes to light. We are however considering providing an additional EMF calculator which would provide greater flexibility for technically competent users to adjust certain parameters, potentially including the ground reflection factor, which would likely result in less conservative results.

### **Confirmation that the calculator output will be sufficient to demonstrate compliance**

- 5.42 Carl Langley asked whether the final version of the calculator would be the standard such that if one complied with the separation distance it generated, compliance with the ICNIRP guidelines would then be assured.

#### *Ofcom response*

- 5.43 We confirm that, where licensees can demonstrate that they are complying with the separation distances generated by the calculator (and have used the calculator correctly in line with the instructions), we will treat this as sufficient evidence of compliance.
- 5.44 Licensees should keep a record (e.g. print-out) of our calculator's results to help demonstrate compliance.

### **Disclaimer for the calculator**

- 5.45 Dr Doug Fenna commented that there seemed to be a conflict in that the "Guidance on EMF Compliance and Enforcement" states that licensees may rely on the calculator to demonstrate compliance, but the disclaimer on the calculator says that Ofcom do not accept responsibility for its accuracy or fitness for purpose.

#### *Ofcom response*

- 5.46 The disclaimer we included in the trial version of the calculator was the standard text used for draft spreadsheet models published by Ofcom. Whilst the calculator is still a trial version, we have made some amendments to the disclaimer taking into account Dr Fenna's comments. We will further amend the disclaimer when we publish the final version of the calculator.

### **Additional detailed comments on the annex notes**

- 5.47 Inmarsat thought that the table in the annex of the calculator could confuse people. It noted that the default frequency in the calculator was 450 MHz, and the power density limit given in the table was the limit for this frequency, but could be viewed as being the limit that applies for the whole 400-2000 MHz frequency range. It suggested that, to avoid potential confusion, Ofcom could add a note to clarify that the power density limit for this frequency range of 400-2000 MHz is given by  $f/200$  and the value of  $2.250 \text{ W/m}^2$  power density corresponds to an operating frequency of 450 MHz. It noted that the same applies to the E-field and H-field limits for the 400-2000 MHz frequency range.

- 5.48 Cellnex UK noted that the calculator annex uses the phrase, “E-field and H-field limits” but that the ICNIRP reference levels are not limits. It pointed to text in the 1998 ICNIRP Guidelines: “If the measured or calculated value exceeds the reference level, it does not necessarily follow that the basic restriction will be exceeded.” It also noted that the 2020 ICNIRP Guidelines take the same approach; compliance with the reference levels is not mandatory. It recommended that the word “limits” is replaced with “reference levels”. It also said that the same comment applies to “power density” for frequencies below 10 MHz (1998) or 6 MHz (2020).
- 5.49 Cellnex UK also commented that the technical notes in the annex do not distinguish between “E”, “H” and “S” as used in the base formulae (general far-field relationships between electric field strength, magnetic field strength and power density) and the expressions for “R” in (a) and (b), where they denote the reference levels.

*Ofcom response*

- 5.50 Depending on the operating frequency entered in the calculator page, the row of the table corresponding to its frequency range would be highlighted and relevant reference levels would be imported for calculating the separation distance. As Inmarsat suggested, we have added a note in the calculator annex to clarify this point.
- 5.51 We have updated the calculator annex so that the term “limit” is now replaced by “reference level”.
- 5.52 In line with the changes to our calculator, only the reference levels for power density “S” are used to determine the compliance distance. In the far-field, the electric field strength “E”, the magnetic field strength “H” and “S” have a fixed relationship, i.e.  $E/H \approx 377$  ohms (the impedance of free space) and  $S = E \times H$ . In the radiative near-field, the relationship between “E” and “H” is not strictly fixed but remains a reasonable approximation. Our simple calculator is, however, not suitable for assessment in the reactive near-field where the relationship between E and H field is not fixed and can be very complicated.

## **Summary of changes to the EMF calculator**

- 5.53 We summarise below the key changes we have made to the calculator following our review of responses:
- 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  $\lambda$  is the wavelength in metres).
    - A new lower cut-off frequency for the calculator of 10 MHz.
  - We have updated the notes for the calculator to:
    - Suggest that more advanced tools may need to be used for electromagnetically “long” antennas.
    - Refer to compliance distance rather than safe separation distance.

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

- Clarify that:
  - The calculator uses conservative parameters and will in most cases overestimate the separation distance required.
  - Separation distances that are smaller than those indicated by the calculator do not necessarily indicate non-compliance.
  - The calculator is not appropriate for all spectrum users such as MNOs with complex radio installations.
- We have made some refinements to the disclaimer and clarified that the calculator is provided for the sole purpose of assisting spectrum users assess compliance distances from their own radio equipment.

### Next steps for the calculator

- 5.54 We are publishing an updated version of our trial Excel based EMF calculator alongside this Update document on our website. We welcome further informal feedback on this revised version of the calculator. Feedback can be submitted by email to [EMFImplementation@ofcom.org.uk](mailto:EMFImplementation@ofcom.org.uk). We would request that interested parties provide feedback by 16 April 2021. Following this date, we will:
- consider any feedback and make any additional changes to the calculator as required;
  - publish an updated version of the Excel based calculator on our website in spreadsheet format;
  - commence work to produce a web-based version of the calculator which will replace the Excel version. This will then be published on our website at a later date.
- 5.55 In addition, as noted earlier in this section, we may provide another EMF calculator with additional functionality at a later date and will provide any updates on this on the EMF section of our website.



## 6. Next steps

- 6.1 Following the publication of this Update, we will shortly start the formal licence variation process by proposing to vary all existing licences in classes which authorise transmit powers above 10 Watts EIRP (or 6.1 Watts ERP) to include the new EMF licence condition.
- 6.2 In accordance with the requirements of the Wireless Telegraphy Act 2006 and the terms and conditions of spectrum licences, we will shortly be writing to all affected licensees to inform them of our proposal to vary the terms and conditions of their licence to include the new EMF condition. Depending on the terms and conditions of their licence, we will either be giving licensees notice of our proposal by:
  - a) publishing a General Notice on our website (although we also intend to contact licensees to make them aware we have done this);<sup>28</sup> or
  - b) sending an individual notification to the affected licensee.
- 6.3 We expect to publish our final decision in relation to the variation of affected licences no later than 18 May 2021. Where we decide to vary licences to include the EMF condition, licensees will then have six months to ensure their EMF compliance records are in place and up-to-date (which is extended to 12 months in relation to equipment which operates at frequencies below 10 MHz). We may decide to extend these deadlines for compliance if there are ongoing travel restrictions as a result of the Covid-19 pandemic and will publish an update on our website if we do decide to extend these deadlines.
- 6.4 Following the conclusion of the licence variation process, we also intend to include the EMF licence condition in all new licences in the affected licence classes. The EMF condition will apply immediately to any licences that are issued and include the new EMF condition. Whilst the licence variation process is ongoing, we will still accept new licence applications and issue new licences. If a licensee decides to apply for a licence (or continue with a licence application) during this time, they will be doing so on the basis they agree to have the new EMF condition inserted into their licence following the conclusion of the licence variation process.
- 6.5 We are also publishing an update to the trial version of our EMF calculator and will shortly publish draft user-friendly guidance, including our additional guidance for radio amateurs and maritime licensees. We welcome further comments by 16 April 2021 on the updated calculator and user-friendly guidance documents and will publish further versions of these in the future.

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<sup>28</sup> Where permitted under the terms and conditions of a licence, in the future we intend to make greater use of General Notices published on our website and may not individually contact licensees to inform them that we have published one. We would therefore urge all licensees to regularly check the Ofcom website or subscribe to [spectrum email updates](#).

## A1. EMF licence condition

*The final version of the EMF licence condition which we are using for the formal licence variation process – which will be carried out in accordance with the requirements of Schedule 1 of the Wireless Telegraphy Act 2006 and the terms and conditions of spectrum licences - is set out below. The EMF condition is the same across all licences we are proposing to vary (subject only to paragraph, schedule and footnote numbering which will depend on the existing contents of the licence).*

### Definitions applicable to Licence Condition

*“dBi” means the ratio in dB (decibel) when comparing the gain of the antenna to the gain of an isotropic antenna. An isotropic antenna is a theoretical antenna which radiates power uniformly in all directions.*

*“EIRP” means equivalent isotropically radiated power which is the product of the power supplied to an antenna and the absolute or isotropic antenna gain in a given direction relative to an isotropic antenna.*

*“ERP” means effective radiated power which is the product of the power supplied to an antenna and its gain in a given direction relative to a half-wave dipole.*

*“general public” means any person who is not: (a) the Licensee, owner, operator or installer of the Relevant Radio Equipment; or (b) acting under a contract of employment or otherwise acting for purposes connected with their trade, business or profession or the performance by them of a public function.<sup>29</sup>*

*“ICNIRP Guidelines” means the version of the Guidelines published by the International Commission on Non-Ionizing Radiation Protection for limiting exposure to electromagnetic fields which are identified in Ofcom’s “Guidance on EMF Compliance and Enforcement” that is in force at the relevant time.<sup>30</sup>*

*“Licensee’s On-Site Radio Equipment” means the Relevant Radio Equipment and any other wireless telegraphy station(s) and wireless telegraphy apparatus on the same site which is authorised by*

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<sup>29</sup> There is pre-existing health and safety legislation which already requires employers to protect workers from exposure to electromagnetic fields (“EMF”) including the following legislation specifically relating to EMF: [The Control of Electromagnetic Fields at Work Regulations 2016](#), [The Control of Electromagnetic Fields at Work Regulations \(Northern Ireland\) 2016](#) and [The Merchant Shipping and Fishing Vessels \(Health and Safety at Work\) \(Electromagnetic Fields\) Regulations 2016](#).

<sup>30</sup> Ofcom’s “Guidance on EMF Compliance and Enforcement” will initially require the Licensee to comply with the ICNIRP Guidelines for limiting exposure to time-varying electric, magnetic and electromagnetic fields (up to 300 GHz), published in: Health Physics 74(4):494-522, dated April 1998 and available at: <https://www.icnirp.org/cms/upload/publications/ICNIRPmfgdl.pdf> (“1998 Guidelines”) or the ICNIRP Guidelines for limiting exposure to electromagnetic fields (100 KHz to 300 GHz), published in: Health Physics 118(5): 483–524; 2020 and available at: <https://www.icnirp.org/cms/upload/publications/ICNIRPrfgdl2020.pdf> (“2020 Guidelines”). However, once work on the relevant standards explaining the methodology for assessing compliance with the 2020 Guidelines has progressed sufficiently, Ofcom will consult on updating its “Guidance on EMF Compliance and Enforcement” to explain that going forward Ofcom will be requiring the Licensee to comply with the 2020 Guidelines only. Following consultation, Ofcom will publish an updated version of Ofcom’s “Guidance on EMF Compliance and Enforcement” on its website. Ofcom will follow the same process for any subsequent versions of the ICNIRP Guidelines.

another licence held by the Licensee to transmit at powers higher than 10 Watts EIRP or 6.1 Watts ERP.<sup>31</sup>

**“Relevant Radio Equipment”** means all the Radio Equipment that is authorised by this Licence to transmit at powers higher than 10 Watts EIRP or 6.1 Watts ERP.<sup>32</sup>

**“Shared Site Exemption”** means any of the following three situations apply on a shared site in relation to the Licensee’s or another licensee’s wireless telegraphy station(s) or wireless telegraphy apparatus that is authorised to transmit at powers higher than 10 Watts EIRP or 6.1 Watts ERP:

- The first situation is that all of the licensee’s wireless telegraphy station(s) or wireless telegraphy apparatus on a shared site do not transmit at a combined total radiated power in any particular direction<sup>33</sup> that is higher than 100 Watts EIRP or 61 Watts ERP.<sup>34</sup>
- The second situation is that the total electromagnetic field exposure levels produced by the licensee’s wireless telegraphy station(s) or wireless telegraphy 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 basic restrictions or 5% of the reference levels in the relevant tables for general public exposure identified in the ICNIRP Guidelines.<sup>35</sup>
- The third situation is where the licensee’s wireless telegraphy station or wireless telegraphy apparatus has an antenna gain that is equal to or higher than 29 dBi and has a fixed beam.

**“shared site”** means a site that is shared by the Licensee and at least one other licensee for the purposes of establishing, installing, modifying or using wireless telegraphy stations or wireless telegraphy apparatus.

**“site”** means a physical structure, building, vehicle or moving platform.

**“wireless telegraphy apparatus”** has the meaning given to it in section 117 of the Wireless Telegraphy Act 2006.

**“wireless telegraphy station”** has the meaning given to it in section 117 of the Wireless Telegraphy Act 2006.

## Licence Condition

### Sites which are not shared with another licensee

1. The Licensee shall only establish, install, modify or use Relevant Radio Equipment if the total electromagnetic field exposure levels produced by the Licensee’s On-Site Radio Equipment do not

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<sup>31</sup> 10 Watts EIRP is equivalent to 6.1 Watts ERP. In linear units  $EIRP (W) = 1.64 \times ERP (W)$ ; in decibels  $EIRP (dB) = ERP (dB) + 2.15$ .

<sup>32</sup> 10 Watts EIRP is equivalent to 6.1 Watts ERP.

<sup>33</sup> For the purpose of this situation, the combined total radiated power is a simple sum of the radiated powers (in EIRP or ERP) of all of the licensee’s wireless telegraphy station(s) or wireless telegraphy apparatus on the shared site that transmits signals covering the same or overlapping areas.

<sup>34</sup> 100 Watts EIRP is equivalent to 61 Watts ERP.

<sup>35</sup> The relevant tables for general public exposure are identified in Ofcom’s “Guidance on EMF Compliance and Enforcement”.

*exceed the basic restrictions<sup>36</sup> in the relevant tables for general public exposure identified in the ICNIRP Guidelines<sup>37</sup> 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 restrictions<sup>38</sup> in the relevant tables for general public exposure identified in the ICNIRP Guidelines<sup>39</sup> 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.<sup>40</sup>*

## **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*

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

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

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

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

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

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

*Compliance and Enforcement”) that demonstrate how it has complied with the basic restrictions in the relevant tables for general public exposure identified in the ICNIRP Guidelines when Relevant Radio Equipment is established, installed, modified or used.*

**Ofcom’s “Guidance on EMF Compliance and Enforcement”**

7. *When evaluating its compliance with paragraphs 1, 2 and 3 above, the Licensee shall take into account Ofcom’s “Guidance on EMF Compliance and Enforcement” that is in force at the relevant time.*

## A2. Guidance on EMF Compliance and Enforcement

A2.1 Our "[Guidance on EMF Compliance and Enforcement](#)" is available.