

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

Executive Summary

JRC and its Members welcome the opportunity to respond to this consultation particularly as it proposes to introduce an administrative / operational burden on industry from a compliance perspective. We see no basis for the proposed regulatory intervention and more significantly that there is no justification based on the evidence provided to warrant the imposition of this additional regulatory burden on licensed operators.

Notwithstanding the lack of demonstrable justification for such a regulatory intervention if Ofcom seek to adopt such an approach then we encourage Ofcom to acknowledge the operational and physical characteristics of the systems licensed to our Members which render them free from harm in terms of their potential risk to the General Public and hence exclude them from the regulations.

We are keen to work with Ofcom to ensure that an unnecessary regulatory burden is not imposed on our Members with the resulting administrative burden leading to higher costs for UK Energy Consumers.

Background

Joint Radio Company Ltd is a wholly owned joint venture between the UK electricity and gas industries specifically created to manage the radio spectrum allocations for these industries used to support operational, safety and emergency communications.

JRC manages blocks of VHF and UHF spectrum for Private Business Radio applications, telemetry & telecontrol services and network operations. JRC created and manages a national cellular plan for co-ordinating frequency assignments for several large radio networks in the UK.

The VHF and UHF frequency allocations managed by JRC support telecommunications networks to keep the electricity and gas industries in touch with their field engineers. These networks provide comprehensive geographical coverage to support installation, maintenance and repair of plant in all weather conditions on 24 hour/365 days per year basis.

JRC's Scanning Telemetry Service is used by radio based Supervisory Control And Data Acquisition (SCADA) networks which control and monitor safety critical gas and electricity industry plant and equipment throughout the country. These networks provide resilient and reliable communications at all times to unmanned sites and plant in remote locations to maintain the integrity of the UK's energy generation, transmission and distribution.

JRC supports the European Utility Telecommunications Council's Radio Spectrum Group, and participates in other global utility telecom organisations. JRC participates in European Telecommunications Standards Institute (ETSI) working groups developing new radio standards, and European telecommunications regulatory groups and workshops.

JRC also manages microwave fixed link and satellite licences on behalf of the utility sector.

JRC works with the Energy Networks Association's Future Energy Networks Groups assessing ICT implications of Smart Networks, Smart Grids & Smart Meters and is an acknowledged knowledge source for cyber-security in respect of radio networks.

JRC's Response to Questions

Q 1. Do you agree with our proposal to take steps to mitigate risks related to EMF and be in a position to hold licensees, installers and users to account if issues are identified?

Please explain the reasons for your response.

JRC Response

Confidential? No.

JRC and its Members welcome the opportunity to respond to this consultation particularly as it proposes to introduce an administrative / operational burden on industry from a compliance perspective. We note that Ofcom places an emphasis on evidence based policy development and as such note that the evaluation of EMF emissions from active 5G systems alongside this consultation does not demonstrate any risk of harmful interference to the General Public based on real world emissions¹². To this end we see no basis for the proposed wholesale intervention and more significantly that there is no justification based on this evidence to warrant the imposition of this additional regulatory burden on all licensed operators. Moreover, anticipating that the analysis undertaken is a product of 'concerns' that emissions from public mobile networks may pose a risk to the General Public. If Ofcom perceive that there is a need, albeit unproven, to establish a specific licence obligation to avoid the risk of emissions from public mobile networks posing a risk of harm to the General Public then perhaps they should limit the proposed intervention to these networks only, noting that these are networks specifically designed and targeted to serve end consumers and hence are likely to be in closer proximity to the General Public than the operational communications systems deployed by industrial users, e.g. the energy network operators. JRC highlights that Fixed Links and Business Radio / Private Mobile Radio (PMR) systems are deployed by the Energy Network Operators to facilitate operational control of the energy networks and by the very nature of their technical characteristics and to ensure operational security are deployed well away from the General Public and hence do not pose a risk of harm. Furthermore, these are systems that are designed and installed by professionals to transmit towards the horizon and have antennas mounted above the local clutter. Indeed, licensed fixed links are designed so as not to be mounted where they may suffer intermittent obstructions along their bore-sight, e.g. caused by vehicles or people. These antennas will always be above the clutter and hence have a resulting separation distance from the General Public that is considerably greater than the corresponding predicted ICNIRP safe distance. Whilst, in the case of low-level ground mounted PMR, DMR or LTE remote terminals, low RF power together with intermittent duty cycles significantly reduce any potential risk of harm to the General Public.

Q 2. Do you agree with our proposal (a) to include a condition in spectrum authorisations requiring compliance with the basic restrictions for general public exposure identified in the ICNIRP Guidelines; and (b) that this condition should apply to equipment that can operate at powers greater than 10 Watts? If you do

¹ Figure 3.1: Highest recorded average exposure levels at all 5G-enabled sites visited, p. 14 Ofcom EMF Consultation, https://www.ofcom.org.uk/__data/assets/pdf_file/0013/190003/emf-condoc.pdf

² https://www.ofcom.org.uk/__data/assets/pdf_file/0015/190005/emf-test-summary.pdf

not agree with this proposal, please explain what alternative measures you think would be appropriate and why.

Q 2. JRC Response

Confidential? No.

2a) Inclusion of an ICNIRP Compliance condition:

As already noted in response to Question 1 the case for the inclusion of an ICNIRP compliance condition as part of the authorisation regime to address perceived 'concerns' of the risk of harm to the General Public has not been proven and such an imposition is unwarranted particularly when considering the nature of the Operational Control systems that JRC's Members deploy. To this end and in response to question 2b below we outline the types of wireless systems that are operated by our Members and how the operational characteristics or their use does not pose a risk of harm to the General Public.

2b)

Fixed Links:

JRC notes that the design and deployment of licensed fixed links is such that they are mounted away from the clutter to avoid line of sight disruption by intermittent obstructions along the bore-sights, e.g. caused by vehicles or people. Furthermore, fixed links are designed to focus the emissions along a thin bore-sight path between the two link ends. This means that the safe distance predictions will need to take the off-bore-sight antenna gain / attenuation into consideration. So, whilst the predicted safe distance along the bore-sight of a fixed link with 1,000 W EIRP is 1.01 m, the corresponding predicted safe distance off-bore-sight towards the ground / general public will be in the order of centimetres. Indeed, higher power Ofcom licensed fixed links are typically for long distances and their antennas are therefore mounted high above ground level to ensure robust line-of-sight performance. Once again, their predicted off-bore-sight safe distances will be considerably shorter than the antenna height above ground. Ideally, Ofcom licensed Fixed Links systems should be excluded from this Ofcom proposal, if however Ofcom do choose to impose a requirement within the authorisation regime for licensed operators to be able to demonstrate compliance with the ICNIRP General Public exposure guidelines then we encourage Ofcom to address this requirement only to fixed links licensed to operate at in excess of 50 dBW EIRP.

Outdoor Business Radio / Private Mobile Radio (PMR) base stations:

The predicted safe distance for 50W ERP / 82 W EIRP transmissions from a PMR base station is 0.76 m. However, as noted for fixed links antennas above, high-power PMR systems have their antennas mounted high above ground level. So, the predicted safe distance is significantly smaller than the height of the antenna from the ground.

Underground Business Radio / Private Mobile Radio (PMR) base stations:

JRC manages several underground BR / PMR systems. However, strict security measures ensure that the General Public cannot access those sites and hence be at risk of harm from these systems to warrant protection via ICNIRP compliance, notwithstanding that these systems are designed / deployed / operated in compliance with employee safe systems of work from an ICNIRP perspective.

Business Radio / Private Mobile Radio (PMR) mobile stations:

The predicted safe distance for 25W ERP / 41 W EIRP transmissions from a PMR mobile station is 0.54 m. However, the emissions from PMR mobile systems are dependent on their activity factors. An activity factor of 25%, e.g. 1.5 minutes within a 6-minute period, will reduce the predicted safe distance by half to 0.27 m. True activity factors are likely to be much lower. We encourage Ofcom to exclude outdoor licensed Business Radio / PMR systems from this regulatory intervention. However, if Ofcom decide to impose the obligation then only outdoor licensed PMR systems with greater than 100 W EIRP should be included.

Ofcom Guidance for Demonstrating Compliance

To establish the potential implications of Ofcom's proposals we have undertaken a detailed appraisal, summarised above, to examine whether the systems licensed to and operated by our Members pose a risk of harm to the General Public. We have undertaken this appraisal on the basis of established calculation tools independent of specific guidance from Ofcom. In the event that Ofcom choose to impose the regulatory intervention as described we encourage them to provide industry clear guidance on the analysis methodology to be used.

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

Q 3. JRC Response

Confidential? No.

JRC does not agree with the proposed regulatory intervention to require its Members to demonstrate compliance to the EMF guidelines for General Public exposure limits.

Shared Sites:

The proposal that 'it is the party who makes the last change to a site that is responsible for ensuring the total EMF emissions from the site continue to comply with the basic restrictions.' is unworkable. Only the site owner / operator has full knowledge and understanding of all the systems that are installed on a site and the potential to establish the characteristics of their operation. Therefore, in the case of sites with multi-occupancy if compliance to EMF emissions are to be imposed we believe that the responsibility for this would sit best with the site owner / operator rather than the licensee making the last change. Albeit, there is an inherent complexity to the co-ordination of EMF emissions on multi-occupancy sites particularly those hosting public mobile broadband systems that have the potential to be remotely operated and are subject to frequent changes from one day to the next to address user demand in particular where beam forming functionality is enabled. Additional complications with certainty over emission levels will result where Ofcom has licensed systems with Automated Transmit Power Control (ATPC) and Adaptive Modulation. We also encourage Ofcom to consider what would be the appropriate separation between wireless systems deployed on structures within the same compound and / or in close proximity for those structures to be considered discrete from the point of view of the proposed emissions regulations, i.e. the emission levels for the structures to be assessed separately. Finally, this regulatory intervention has the potential to reduce the likelihood for increased site share and run counter to Government policy to encourage the widespread deployment of Public Mobile Networks.

JRC Safe Distance Predictions

JRC's safe distance predictions³ for the licensed systems that it manages have all indicated that the General Public would not be at risk based on the ICNIRP Guidelines. Indeed, we note based on our analysis that the ICNIRP safe distance compliance of JRC-managed systems is enhanced further because the antennas are mounted higher above ground level than the predicted safe distances minus 1.5m to ensure robust operation and avoid clutter. Additionally, the predicted safe distances are reduced greatly when narrow beam width antennas are used. Finally, unlike systems deployed on street furniture, e.g. 5G the general public are not able to encroach towards the safe distance as utility systems are located on structures within secure compounds

Please see ANNEX I, for examples of systems licensed to JRC Members and their predicted ICNIRP safe distances.

In the event that Ofcom chooses to impose the EMF compliance regime as outlined we encourage Ofcom to address the following aspects;

ICNIRP Guidelines

Ofcom is recommending that the compliance regime be linked to the 2020 ICNIRP guidelines which replaces the older 1998 guidance, JRC notes this requirement.

Ofcom ICNIRP Guidance Notes

JRC suggests that, if this proposal is introduced, Ofcom publishes an ICNIRP Compliance Information Sheet that contains guidance on the method Ofcom will be using to benchmark the performance of installed systems. Such guidance would assist installers when undertaking ICNIRP Compliance tests and subsequently allow the installers to provide ICNIRP conformity reports to the licenced operator. The Licenced Operator can then use the ICNIRP Conformity Report to demonstrate compliance to Ofcom.

Ofcom Application Forms and ICNIRP Compliance

JRC recommends that Ofcom provides prominent notification within its Application Forms regarding the requirement for ICNIRP public safety compliance. This would encourage Applicants to ensure that the subsequent installer of their system provides suitable ICNIRP Compliance documentation.

³ For the methodology applied refer to Annex II

ANNEX I – Observations from JRC ICNIRP Analysis

Fixed Links:

JRC's fixed links ICNIRP predictions for 7.5 GHz fixed links with 10 dBW EIRPs suggest that the minimum safe distance in the direction of maximum signal strength, i.e. along the bore-sight, is 0.1m. Whilst, JRC's ICNIRP predictions for fixed links with 45 dBW EIRPs suggest that the minimum safe distance is 5.66m along the bore-sight.

JRC notes that fixed link dishes are typically mounted higher than 10m above ground level. So, the offset angle from the bore-sight path will reduce the safe distance towards the ground considerably. Additionally, unlike installations on street furniture, most utility sites are fenced off. So, the General Public are unable to encroach upon the safe distance of radio emissions from such utility sites.

Scanning Telemetry:

Point-to-Multi-Point Scanning Telemetry (ST) systems typically operate within the 400 MHz Band. Operation within frequency bands lower than those of microwave fixed links has the effect of shortening the safe distance. JRC ICNIRP predictions for ST Outstations operating at the maximum power of 24 dBW EIRP suggest a safe distance along the bore-sight of 1.33m. Whilst Outstation antennas may be mounted lower than fixed link dishes, the physical security measures of the site prevent the general public from breaching the safe distance from an emissions perspective.

Business Radio / PMR:

Business Radio systems typically operate within the VHF and 400 MHz UHF Bands. Operation within frequencies lower than those of microwave fixed links has the effect of shortening the safe distance. The JRC ICNIRP safe distance prediction for 10 W ERP / 12.15 W EIRP transmissions is 0.34m. The predicted safe distance for 25 W ERP / 41 W EIRP transmissions is 0.54m. Whilst, the predicted safe distance for 50 W ERP / 82 W EIRP transmissions is 0.76m. JRC therefore suggests that 50 W ERP / 82 W EIRP base station operation will not cause a breach to the ICNIRP requirement, neither will a typical 25 W ERP / 41 W EIRP mobile installation, e.g. with the antenna placed in the centre of the roof of the vehicle. Especially when the Activity Factor of the latter is taken into consideration.

ANEX II – Methodology Applied & Output

ICNIRP 2020 Guidelines formulae

2020 Guidelines General Public exposure limits (Table 6):

<https://www.icnirp.org/cms/upload/publications/ICNIRPrfgdl2020.pdf>

30 to 400 MHz:	10 W / m ²
Safe distance (m) =	$\text{SQRT}(\text{EIRP [W]} / (4 * \text{PI} * 10))$
0.400 to 2 GHz:	$f[\text{MHz}] / 200 / \text{m}^2$
Safe distance (m) =	$\text{SQRT}(\text{EIRP [W]} / (4 * \text{PI} * 0.058 * f[\text{MHz}]^{0.86}))$
2 to 6 GHz:	40 W / m ²
Safe distance (m) =	$\text{SQRT}(\text{EIRP [W]} / (4 * \text{PI} * 40))$
6 to 300 GHz:	20 W / m ²
Safe distance (m) =	$\text{SQRT}(\text{EIRP [W]} / (4 * \text{PI} * 55 * f[\text{GHz}]^{0.177}))$

Measured >0.159 Wavelength. Power densities are to be averaged over 6 mins, over the whole-body space.

The following tables show examples of predicted safe distances.

ICNIRP 2020: Fixed links emissions examples (7.5 GHz):

Predicted public safe distances (m):

$\text{SQRT}(45 \text{ dBW} / (4 * \text{PI} * 55 * 7.5[\text{GHz}]^{0.177}))$	= 5.66 m
$\text{SQRT}(41 \text{ dBW} / (4 * \text{PI} * 55 * 7.5[\text{GHz}]^{0.177}))$	= 3.57 m
$\text{SQRT}(35 \text{ dBW} / (4 * \text{PI} * 55 * 7.5[\text{GHz}]^{0.177}))$	= 1.79 m
$\text{SQRT}(27 \text{ dBW} / (4 * \text{PI} * 55 * 7.5[\text{GHz}]^{0.177}))$	= 0.71 m
$\text{SQRT}(21 \text{ dBW} / (4 * \text{PI} * 55 * 7.5[\text{GHz}]^{0.177}))$	= 0.36 m
$\text{SQRT}(15 \text{ dBW} / (4 * \text{PI} * 55 * 7.5[\text{GHz}]^{0.177}))$	= 0.18 m
$\text{SQRT}(10 \text{ dBW} / (4 * \text{PI} * 55 * 7.5[\text{GHz}]^{0.177}))$	= 0.10 m

Fixed links have narrow beamwidth antennas.

The antenna off-set angle also needs to be taken into consideration. So, 10m along the bore-sight may only be 0.1m towards the ground.

ICNIRP 2020 (Table 6): Business Radio ‘fixed’ emissions examples:

Predicted safe distances (VHF 150 MHz):

50W ERP: $\text{SQRT}(82.22 / (4 * \text{PI} * 10))$	= 0.81 m
25W ERP: $\text{SQRT}(41.11 / (4 * \text{PI} * 10))$	= 0.57 m
10W ERP: $\text{SQRT}(16.44 / (4 * \text{PI} * 10))$	= 0.36 m
3W ERP: $\text{SQRT}(4.93 / (4 * \text{PI} * 10))$	= 0.20 m

Predicted safe distances (UHF 450 MHz):

50W ERP: $\text{SQRT}(82.22 / (4 * \text{PI} * 0.058 * 450[\text{MHz}]^{0.86}))$	= 0.77 m
25W ERP: $\text{SQRT}(41.11 / (4 * \text{PI} * 0.058 * 450[\text{MHz}]^{0.86}))$	= 0.54 m
10W ERP: $\text{SQRT}(16.44 / (4 * \text{PI} * 0.058 * 450[\text{MHz}]^{0.86}))$	= 0.34 m
3W ERP: $\text{SQRT}(4.93 / (4 * \text{PI} * 0.058 * 450[\text{MHz}]^{0.86}))$	= 0.19 m

The Activity Factor needs to be taken into consideration (% of 6 mins):

25% Activity Factor equals a halving of the distances shown above.

ICNIRP 2020 (Table 6): Scanning Telemetry ‘fixed’ emissions examples:

Public safe distances (m):

$$100\text{W: } \text{SQRT}(100 / (4 \cdot \text{PI} \cdot 0.058 \cdot 460[\text{MHz}]^{0.86})) = 0.85 \text{ m}$$

$$50\text{W: } \text{SQRT}(50 / (4 \cdot \text{PI} \cdot 0.058 \cdot 460[\text{MHz}]^{0.86})) = 0.60 \text{ m}$$

$$20\text{W: } \text{SQRT}(20 / (4 \cdot \text{PI} \cdot 0.058 \cdot 460[\text{MHz}]^{0.86})) = 0.42 \text{ m}$$

$$10\text{W: } \text{SQRT}(10 / (4 \cdot \text{PI} \cdot 0.058 \cdot 460[\text{MHz}]^{0.86})) = 0.27 \text{ m}$$

The Outstations have 12-element directional antennas. So, the antenna off-set angle also needs to be taken into consideration. For example, 1.0m along the bore-sight may be only 0.25m downwards.