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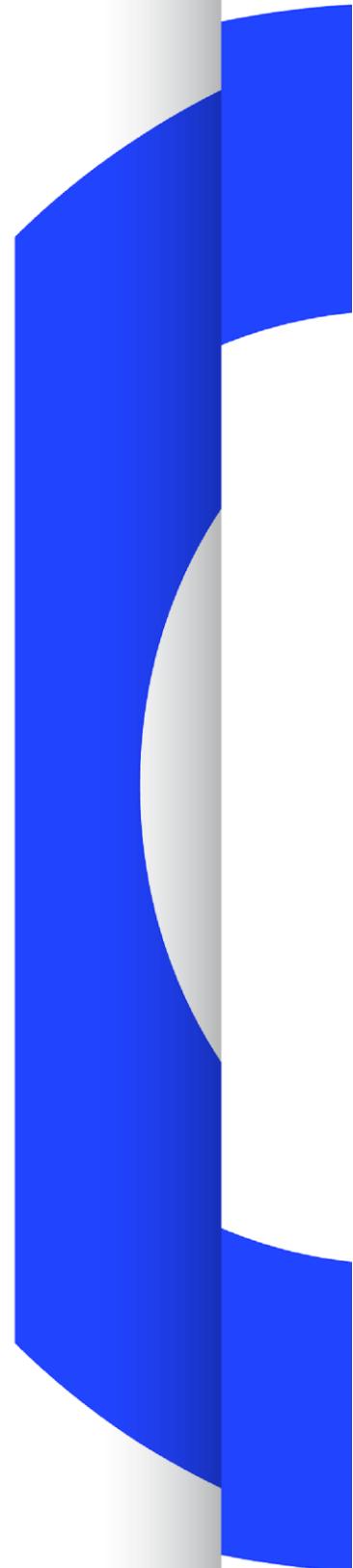
OPERATING EUROVISION AND EURORADIO

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RF RADIATION HAZARDS ARISING FROM BONDED CELLULAR ENG EQUIPMENT

Technical Report

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Abstract

Many Broadcasters are increasingly using Bonded cellular devices for ENG operations. The question of possible RF Hazard risk from these devices on the health of the users is raised.

This report provides information to EBU members to help them in assessing the risk of RF Hazard from bonded cellular ENG equipment and ensuring safe operation for their staff.

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RF radiation hazards arising from bonded cellular ENG equipment

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TC	2021		

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1. Introduction

In recent years there have been advances made in wireless production tools used in particular for electronic newsgathering. These advances have seen a move away from the traditional arrangement of a camera connected either with a cable or radio link to a satellite truck, to a camera connected using mobile cellular technology directly back to a broadcast centre. For news organisations these advances offer increased flexibility and reduced operational and capital costs.

Mobile cellular technology used for ENG in this way is typically arranged as either a camera mounted or backpack unit that is worn by the camera operator. Whilst the physical mounting arrangement differs between these units, they all contain a number (4 or more) of modems which operate together to provide sufficient bandwidth to backhaul full resolution broadcast quality sound and vision and to provide a return cue feed to the presenter.

Concerns have been raised by EBU members as to how the RF radiation from these units could be assessed and whether the simultaneous operation of the cellular modems causes the Radiofrequency field emitted by the system to exceed the ICNIRP exposure limits.

This report provides information to EBU members to help them in assessing the risk of RF Hazard from bonded cellular ENG equipment and ensuring safe operation for their staff.

2. Assessment of hazard

There are several factors that should be included in any general risk assessment for persons using / operating bonded cellular ENG equipment. In addition to assessing the maximum RF power output from the device any risk assessment should also consider the following:

- The operating frequency range of the device
- The maximum RF power emitted
- The number of modems (SIM cards) used by the device
- The likely duration of operation

There are two methods that broadcasters can use to assess the hazards arising from bonded cellular ENG equipment, either Measurement or risk assessment based on manufacturers data.

2.1 Measurement of RF Hazard

The measurement of the RF hazard arising from bonded cellular equipment is extremely difficult when compared with a traditional transmitter / receiver combination. The reason this is problematic is that it is not possible to measure the RF output from cellular devices in a simple screened room. The reason for this is that like all cellular user equipment the bonded cellular equipment requires a connection to the network base station and to be at the very edge of service to operate at full power.

If the requirement for a stable connection at the edge of service can be met, then content should be streamed in the usual operating manner of the device with all its modems operating. RF hazard measurements can be made using E and H field probes in the usual manner. It should be noted that if this is being done outside of a screened room that much care will need to be taken to ensure that other sources of cellular RF do not get included in the measurements.

2.2 Assessment of data

In practice it may be very much simpler to assess the risk arising from bonded cellular equipment using measurement data from the equipment manufacturers. Many manufacturers of bonded cellular equipment undertake their own measurement campaigns on their products and therefore should be able to produce test data for the unit operating at full power with all modems on. It is then straightforward to be able to assess whether there are any exposure risks arising whilst taking account of other key factors such as duration of use.

In principle, if the equipment used for ENG is labelled CE then it should be compliant with the relevant CENELEC EN standards and the related ICNIRP SAR limits. It is therefore recommended to use such labelled equipment; and to use it according to any manufacturer's instructions.

3. Specific Hazard cases

There are two specific hazard cases that may arise using bonded cellular equipment that are difficult to account for in any assessment or measurement campaign that is undertaken of any specific piece of equipment.

3.1 Alignment of radiating equipment with eyes

It is theoretically possible that if a camera operator were also the wearer of glasses that had a metallised lens coating a heating effect hazard could arise.

The human eye is a part of the body that is particularly sensitive to the heating effect of RF energy due to its high liquid content and poor blood supply. If a camera operator were a wearer of glasses that had a metallised coating, and the bonded cellular equipment were camera mounted it is possible that a situation could arise where the coating on the lens of the glasses could focus the RF energy into the eye of the operator. In practice most bonded cellular equipment is mounted on top of the camera so alignment is unlikely. It may also be possible depending on the design of the equipment to move the cellular ENG equipment further from the operator by the simple addition of a longer cable. For example, the addition of a 2 m SDI cable would allow the unit to be located at a significant distance from the operator.

3.2 Use of multiple bonded cellular ENG sets

If a number of news crews from multiple organisations were to attend a 'breaking news' event it is likely that many crews may be using bonded cellular technology simultaneously. It is almost impossible to assess the RF Hazard risks of such an event in general and the only way that compliance

with exposure limits could be assured would be to undertake a measurement campaign at every event.

4. Information from the ITU

The [ITU-T Study group 5](#) “Environment, climate change and circular economy” deals, among other subjects, with human exposure to electromagnetic fields (EMFs) due to digital technologies.

Regarding the subject of EMF exposure from bonded cellular devices, ITU-T SG5 indicates that the output power of cellular devices is adjusted depending on the network connection through a process called adaptive power control. In typical use, the output power is substantially below the maximum. The RF-EMF exposure from the uplink signal is generally larger than the downlink.

The combined exposure should comply with the ICNIRP EMF exposure guidelines (or national equivalents). The group confirms that according to WHO (World Health Organisation), where there is compliance with the international EMF exposure limits, no health risks are expected.

5. Experience of one EBU Member (BBC)

Whilst noting the difficulty in obtaining sufficient reliable data to fully assess all risks arising from the use of bonded cellular equipment, where such measurements and risk assessments have been made by the BBC, all bonded cellular equipment has, even when operating at full power, been found to produce RF fields well below the limits considered to be safe by ICNIRP.

6. Reference Standards and Guidelines

The acceptable levels of human exposure to radiation at a given frequency are defined by ICNIRP (International Commission on Non-Ionizing Radiation Protection). You can find in the Annex:

1. the list of relevant ICNIRP Guidelines that specify the limits on Specific Absorption Rate (SAR) levels from mobile phones.
2. the references of CENELEC standards related to the compliance of wireless communication devices, with the basic restrictions and exposure limit values related to human exposure to electromagnetic fields, and the related methods of measurement.
3. Extracts from published ICNIRP statements related to this subject.

7. Conclusions

Many Broadcasters are increasingly using Bonded cellular devices for ENG operations. The question of possible RF Hazard risk on the health of the users is legitimate and needs to be dealt with in a careful manner.

According to the research of references and experience shown in this report, the following conclusions/Recommendations can be formulated:

1. The combined exposure should comply with the ICNIRP EMF exposure guidelines (or national equivalents). According to WHO (World Health organisation), where there is compliance with the international EMF exposure limits, no health risks are expected.
2. The CE label attests that the equipment is compliant with the relevant CENELEC EN standards and the related ICNIRP SAR limits (references provided in the Annex to this document). It is therefore recommended to use such-labelled equipment and to use it according to any manufacturer’s instructions.

3. Measurements carried out by one EBU member on several types of equipment using Bonded cellular devices for usage in ENG, have shown that the RF fields produced by the equipment are well below the limits considered to be safe by ICNIRP.

Annex A: Information on Reference Standards and Guidelines

A1. References related to ICNIRP limits

- a. "ICNIRP GUIDELINES FOR LIMITING EXPOSURE TO TIME-VARYING ELECTRIC, MAGNETIC AND ELECTROMAGNETIC FIELDS (UP TO 300 GHz) - 1998".

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

(Further Guidelines were published in 2010 specific to the frequency range 1 Hz - 100 kHz): "ICNIRP GUIDELINES FOR LIMITING EXPOSURE TO TIME-VARYING ELECTRIC AND MAGNETIC FIELDS (1 Hz - 100 kHz) - 2010".

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

A revision of the ICNIRP guidelines has been published in March 2020: "[RF EMF GUIDELINES 2020](https://www.icnirp.org/cms/upload/publications/ICNIRPrfgdl2020.pdf)". <https://www.icnirp.org/cms/upload/publications/ICNIRPrfgdl2020.pdf>.

- b. Brief presentation and explanation of the ICNIRP 2010 guidelines.

<http://www.emfs.info/limits/limits-organisations/icnirp-2010/>

A2. References related to CENELEC standards

a. *IEC 62311:2019*

Assessment of electronic and electrical equipment related to human exposure restrictions for electromagnetic fields (0 Hz to 300 GHz). This document covers equipment with intentional or non-intentional radiators as well as a combination thereof. It provides assessment methods and criteria to evaluate equipment against limits on exposure of people related to electric, magnetic and electromagnetic fields. The frequency range covered is from 0 Hz to 300 GHz.

b. *EN 50360:2017*

Product standard to demonstrate the compliance of wireless communication devices with the basic restrictions and exposure limit values related to human exposure to electromagnetic fields in the frequency range from 300 MHz to 6 GHz: devices used next to ear.

c. *EN 50566:2017*

Product standard to demonstrate the compliance of wireless communication devices with the basic restrictions and exposure limit values related to human exposure to electromagnetic fields in the frequency range from 30 MHz to 6 GHz: hand-held and body mounted devices in close proximity to the human body.

d. *IEC 62209-1:2016*

Measurement procedure for the assessment of specific absorption rate of human exposure to radio frequency fields from hand-held and body-mounted wireless communication devices - Part 1: Devices used next to the ear (Frequency range of 300 MHz to 6 GHz).

e. IEC 62479:2010

Assessment of the compliance of low-power electronic and electrical equipment with the basic restrictions related to human exposure to electromagnetic fields (10 MHz to 300 GHz). This document provides simple conformity assessment methods for low-power electronic and electrical equipment to an exposure limit relevant to electromagnetic fields (EMF). If such equipment cannot be shown to comply with the applicable EMF exposure requirements using the methods included in this standard for EMF assessment, then other standards, including IEC 62311 or other (EMF) product standards, may be used for conformity assessment.

f. IEC 62209-2:2010

Human exposure to radio frequency fields from hand-held and body-mounted wireless communication devices - Human models, instrumentation, and procedures - Part 2: Procedure to determine the specific absorption rate (SAR) for wireless communication devices used close to the human body (frequency range of 30 MHz to 6 GHz).

A3. Extracts from published ICNIRP statements

HF effects on the body and health implications

(source: ICNIRP - Mobile phones High Frequency (<https://www.icnirp.org/en/applications/mobile-phones/index.html>)).

HF fields can penetrate the body (the higher the frequency, the lower the depth of penetration), with the effect of this being a temperature rise in body tissue. The body can accommodate a small increase in heat, in a similar way that excess body heat is dissipated when performing sporting activity. This is because the human body has a strong ability to regulate its internal temperature. However, above a certain level (referred to as the threshold) depending on the duration of exposure, HF exposure and the accompanying temperature rise can provoke serious health effects, such as heatstroke and tissue damage (burns).

Acute and long-term effects of HF exposure from the use of mobile phones have been studied extensively without showing any conclusive evidence of adverse health effects.

Among all this research, the risk of tumours near the ear where the phone is held, e.g., brain tumours, has been the focus of numerous epidemiological studies. A few of these epidemiological studies have reported a slight increase in risk of some brain tumours for the small group of long-term and heavy mobile phone users ([read more](#)). These findings may be explained by reporting biases and weaknesses identified in the studies. Several studies have not reported any increase in brain tumours with mobile phone use. Also, experimental studies on animals and cells have failed to confirm the findings of the epidemiological studies, and there is no biophysical mechanism that could explain carcinogenicity at such low exposure levels. In addition, the increased risk observed in some of the epidemiological studies is inconsistent with the stable frequency of occurrence of these tumours in the population. That is an important consideration, given the widespread and significant increase in the use of mobile phones in the general population during the last few decades.

A considerable amount of research has also been conducted on the relationship between HF fields and other outcomes such as headaches, concentration difficulty, sleep quality, cognitive function, cardiovascular effects, etc. To date, this research has not shown any such health effects. The only consistently observed finding is a small effect on brain activity measured by electroencephalography (EEG). The biological implication of these small changes is, however, unclear. For example, they have not been shown to affect sleep quality or be associated with any other adverse effects.

The overall evaluation of all the research on HF fields as emitted by mobile phones leads to the conclusion that HF exposure below the thermal threshold is unlikely to be associated with adverse health effects.

Protection

To avoid health hazards from HF exposure emitted by mobile phones, the temperature rise in the body must be restricted. This can be achieved by limiting the absorption of HF energy, expressed in terms of the Specific Absorption Rate (SAR). In its guidelines ICNIRP recommends distinct SAR values applying to whole-body exposure, which is typical from [base stations](#) and for the head, and other locations in the body that are relevant for exposures from mobile phones.

ICNIRP follows up the HF related scientific research and any new information relevant to health. A revision of the ICNIRP guidelines has been published in March 2020: "[RF EMF GUIDELINES 2020](#)".

(ICNIRP statement on the "GUIDELINES FOR LIMITING EXPOSURE TO TIME-VARYING ELECTRIC, MAGNETIC, AND ELECTROMAGNETIC FIELDS (UP TO 300 GHz)" - 2009)

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

For frequencies above 100 kHz, including frequencies used for modern wireless communications, several major national and international research programmes have been completed recently (e.g., MTHR 2007; Federal Office for Radiation Protection 2008) and others are ongoing. The new data need to be reviewed and assessed with respect to possible health hazards prior to a revision of ICNIRP's recommendations in this frequency band.

This process of review and assessment is currently in progress. However, it is the opinion of ICNIRP that the scientific literature published since the 1998 guidelines has provided no evidence of any adverse effects below the basic restrictions and does not necessitate an immediate revision of its guidance on limiting exposure to high frequency electromagnetic fields. The biological basis of such guidance remains the avoidance of adverse effects such as "work stoppage" caused by mild whole body heat stress and/or tissue damage caused by excessive localized heating (D'Andrea et al. 2007).

Regarding non-thermal interactions, it is in principle impossible to disprove their possible existence but the plausibility of the various non-thermal mechanisms that have been proposed is very low. In addition, the recent in vitro and animal genotoxicity and carcinogenicity studies are rather consistent overall and indicate that such effects are unlikely at low levels of exposure. Therefore, ICNIRP reconfirms the 1998 basic restrictions in the frequency range 100 kHz - 300 GHz until further notice.