35 Electromagnetic Fields 0 Hz – 300 GHz (Including Radio Frequency Radiations)

Scope

1. This Chapter provides guidance for the hazards from electromagnetic radiation in the frequency range 0 Hz - 300 GHz. This frequency range includes:

   a. static electric fields and magnetic fields;

   b. Low Frequency (LF) radiation;

   c. Radio Frequency (RF) radiation;

   d. microwave radiation; and

   e. Millimetre Wave (mmWave) radiation.

2. The electromagnetic radiation and Electromagnetic Fields (EMFs) mentioned in this Chapter, only refer to radiation and fields in the frequency range 0 Hz – 300 GHz. Higher frequency electromagnetic radiations in optical and ionising radiations are covered elsewhere in JSP 392 (See Figure 1 of Part 2) or specific JSP. The Defence requirement is in DSA01-2 Chapter 11. Applicable Statutory and Defence Regulations are referenced where practicable so to do.

3. This Chapter explains requirements for the keeping and using of equipment emitting Electromagnetic Fields (EMFs), or equipment containing components which emit EMFs. Such equipment includes (non-exhaustive):

4. Systems designed to emit EMF:

   a. communications systems (voice and data);

   b. diathermy;

   c. dielectric heaters;

   d. electronic countermeasures;

   e. gaussing / de-gaussing / de-perming;

   f. induction heaters;

   g. magnetic non-destructive testing;

   h. metal detectors;

   i. mobile telephony, Wi-Fi and Bluetooth;

   j. Radar; and

   k. RFID.

5. Systems that emit EMF as a by-product of other functions:

   a. battery charging, that is not by induced current;

   b. certain types of heating element;

   c. power lines, cables, busbars etc; and

   d. welding.

6. Systems emitting EMF can also have other conventional safety hazards[1] that are not desired (incl. some diathermal or dielectric properties) and need to be managed, in accordance with the hierarchy of risk controls[2].

Statutory Requirements

7. The Control of Electromagnetic Fields at Work Regulations 2016 (CEMFAWR16) lay down the minimum requirements for the protection of employees from risks to their health and safety arising, or likely to arise, from exposure to electromagnetic fields. The duty is placed on the employer to assess an employee's potential exposure to electromagnetic fields with reference to the legal limits.

8. There is an exemption in CEMFAWR16 which allows MOD to set alternative limits to those specified in Regulation 4. To reduce impact on operations and maintain interoperability with our NATO partners, MOD has chosen to adopt this disapplication. The limits used to demonstrate compliance with the legislation shall be those specified in the IEEE Standard for Military Workplaces – Force Health Protection Regarding Personnel Exposure to Electric, Magnetic and Electromagnetic Fields, 0 Hz to 300 GHz. This standard is known as IEEE Std C95.1-2345™ which is currently used by NATO countries on NATO operations. All other Regulations of CEMFAWR 16 apply.

9. For public protection, the general provisions of the Health & Safety at Work etc Act 1974 and the Management of Health and Safety at Work Regulations 1999 shall be extended to apply outside the geographic boundaries of GB, unless other primary Acts of parliament apply to specific operating domains and are associated with Defence Regulation. This chapter is the Accepted Means of Compliance (AMC) for Defence systems. In addition to compliance with this chapter, the relevant Defence Regulator shall be consulted, whenever systems emitting an EMF form part of larger capabilities where the risks shall be addressed in the appropriate safety case for the wider platform or system. The Health and Safety Executive (HSE) considers compliance with their regulations is achieved if advice given by the United Kingdom Health Security Agency Radiological Protection Division (UKHSA / RPD) is adhered to. Their advice considers exposure of the general public and is consistent with the European Council recommendations made in 1999 / 519 / EC.

Definitions

Occupational Exposure

10. Occupational exposure means any exposure to EMFs, from any man-made source, that occurs in the course of a person's employment. The hazards and limits are defined

[1] Such reasonably foreseeable hazards include fumes (for diathermy) and electric shock, fire, noise, confined space and health effects see JSP375 and DSA02 series Regulations.
[2] Management of health and safety at Work Regulations, Schedule 1.

below. Other safety impacts include interference with equipment within their workplace, that may induce a safety hazard.

Public Exposure

11. A public exposure is any exposure that is not an occupational exposure. This includes:

a. anyone outside the site boundary who is not at work; and

b. visitors to a site who are not at work, e.g. those attending a display or exhibition.

MOD Mandatory Guidance

12. This Chapter provides high level guidance concerning protection of workers and the general public from hazardous levels of electromagnetic field. Top Level Budget (TLB) organisations may derive service level policy and guidance documents from this Chapter. DSA Regulators may seek evidence of compliance according to the capability and domain. Applicable documentation to demonstrate compliance includes:

a. Royal Navy - BR2924 RF Hazards in the Naval Service;

b. Royal Air Force – CESO (RAF) Branch Guidance; and

c. Army - Army Safety Policy (system specific).

13. When using single service guidance, users should confirm that it is up to date and contact their single service focal points – see Table 1) if they have any queries.

Hazards

14. The established adverse effects, including health effects and unwanted sensory effects, from exposure to EMFs are:

a. the electrostimulation of tissue[3], whose effects may be mild, such as prickling of the hairs and small static shocks, increasing in severity to large static shocks, of their extremities, increasing risk of falling from height and subsequent injury;

b. partial body heating or whole-body heating[4], impacting personnel from RF waves by primarily heating causing tissue damage, heatstroke or deeper thermal burns which may be caused by grasping transmitting antennas;

c. effects similar to tinnitus have been experienced by some exposed personnel;

d. in some cases, cause interference with personal medical devices such as pacemakers and hearing aids and may cause medical implants to heat up; and

e. induced electrical currents in safety critical systems or interference to signals.

15. Personnel may suffer electric shock or burn from contact with sufficiently large conducting ungrounded objects, such as vehicles or mobile structures (cherry-pickers etc.) at field levels below the Exposure Reference Levels (ERLs) in Annex A. If there are

[3] By the induction of static-like from static and time varying fields. These effects are dominant up to 100 kHz.
[4] Called dielectric heating.

working areas adjacent to emitters of RF, in which it is established that large ungrounded objects are present on a regular basis, it will be necessary to ensure that measured contact currents with such objects do not exceed those given in Annex A Table 5, Table 6 and Table 7.

16. Spectrum-E3A can be consulted for advice and guidance on contact current risk assessment and contact current measurements.

17. Hazards include exposure from all manmade sources of EMF including those not under the direct control of the employer.

Duties

Commanding Officer / Head of Establishment (CO / HoE)

18. The CO for an activity and any HoE with EMF transmission sources within their establishment each hold a duty to the Secretary of State, and a personal responsibility, to protect the environment and secure the health, safety and welfare of their staff at work. The CO / HOE each hold general duties to protect persons not in MOD employment (e.g. members of the public) against risks to their health and safety arising from the MOD work activities. This includes radiation safety. The CO / HoE authority (but not responsibility) for EMF radiation safety management arrangements may be delegated to an appropriate, Suitably Qualified and Experienced Person (SQEP) such as an EMF Safety Officer (ESO).

EMF Safety Officer (ESO)

19. ESOs are to be appointed to ensure that there is at least one SQEP who is familiar with the specific EMF radiation hazards at the establishments, deployed unit capability or vessels for which they are responsible. They are to advise the relevant CO, HoE or Duty Holder whether adequate radiation protection arrangements are in place to minimise the radiation hazards. The ESOs exact duties will depend on the nature of the hazards on the sites, units or capabilities for which they are responsible, but may include:

a. undertake and maintain site / unit Exposure Assessment (CEMFAWR Reg 5);

b. provide first line advice to EMF Radiation Protection Supervisors (ERPS) and Workplace Supervisors EMF (WPSE);

c. ensure EMF Risk Assessments are in place;

d. ensure EMF local orders are in place;

e. attending Boards of Officers (Siting Boards);

f. undertake an annual audit of EMF safety; and

g. co-ordinate EMF safety training.

20. Historically, duties regarding EMF safety have fallen to medical, communication specialists or weapon engineers (according to service) often also holding a Radiation Safety Officer (RSO) responsibility. RSO is a predominately ionising radiation role which has a very different hazard profile and training requirements to non-ionising radiation associated with EMF safety. There is nothing to stop an RSO also being appointed as ESO to allow them to undertake both roles.

21. The ESO must be appointed in writing by the CO / HoE or by somebody with the delegated authority to make the appointment.

22. The ESO is supported in their role, where required, by ERPS and WPS(E). The ERPS and WPS(E) appointments are not required where there are no potentially hazardous sources of EMF.

EMF Radiation Protection Supervisor (ERPS)

23. An ERPS must be appointed for a system where a Risk Assessment has identified that an EMF overexposure is reasonably foreseeable **AND** there is an EMF Permit to Work system in place (or there is a requirement to put one in place). An ERPS should also be appointed where there may be a requirement to undertake safe distance calculations (to inform risk assessments and safe systems of work) for the exposure to EMF of personnel, fuels, flammable atmospheres or electro-explosive devices and ordnance containing them. Depending on the nature of the EMF hazards, their duties may include:

a. undertaking EMF Risk Assessments involving calculations;

b. setting up / managing an EMF Permit to Work system;

c. attending Boards of Officers (Siting Boards) for the installation of new EMF emitters;

d. generation of local orders for EMF;

e. ensuring local orders for EMF are followed;

f. issue of EMF Permits to Work;

g. EMF monitoring including record keeping; and

h. provision of local EMF safety training (see Para 63).

24. The ERPS should be appointed in writing by the CO / HoE or by the ESO if they have the delegated authority to make the appointment.

25. Under normal operations there is no requirement for an ERPS to be on-site while the system is in use, as long as there is a WPS(E) available to ensure local orders are being followed.

Workplace Supervisor EMF (WPS(E))

26. A Workplace Supervisor EMF (WPS(E)) must be appointed for a system where local orders for EMF safety are in place. The primary purpose of a WPS(E) is to ensure that the local orders EMF safety are followed. There may be more than one WPS(E) appointed for a system to ensure there is adequate supervisory cover[5]. Their duties may include:

a. ensuring local orders for EMF are followed;

b. issue of EMF permits to work;

[5] For example, a Ground Radio Maintenance Section (GRMS) may have 1 ERPS plus a number of WPS(E)s to ensure there is one available on each shift to facilitate the issue of Permits to Work etc.

c. EMF monitoring including record keeping; and

d. provision of local EMF safety training.

27. A WPS(E) must be appointed in writing by the CO / HoE or by the ESO if they have the delegated authority to make the appointment.

28. A WPS(E) must be available while the system is being used to ensure that local orders are being followed[6].

Employees

29. It is the responsibility of all employees to ensure that they are familiar with any local orders for EMF safety in their work area and to comply with them. Employees must also bring to the attention of the appropriate supervisor or manager any shortcomings in the measures that they identify, regardless of whether they are affected or not.

Focal Point Authorities for Electromagnetic Field Radiation

30. The single service focal point authorities are listed at Table 1.

Service	Address	Contact Details
Royal Navy	Navy Command Navy Safety Centre MPG.1 Leach Building Whale Island Portsmouth PO2 8BY	Mil: 93832 5085 BT: 02392 62 5085 Email: navysafetycentre@mod.gov.uk
Army	CESO (Army) IDL 2, Ground Floor Zone 1 Ramilies Bldg Marlborough Lines Monxton Road, Andover Hampshire, SP11 8HJ	Email: ASCen-Mailbox@mod.gov.uk
Royal Air Force	CESO (RAF) RAF High Wycombe Walters Ash High Wycombe Buckinghamshire HP14 4UE	Email: air-safetyctre-cesomailbox@mod.gov.uk Tel: 01494 493837 Out of hrs: 07812 491181
Strategic Command	CESO (UK StratCom) MOD Abbey Wood North BS34 8JH	UKstratCom-SCen-Team@mod.gov.uk

[6] Where a potentially hazardous EMF source is automatic / remote (un-staffed), available means readily contactable.

MOD/Dstl	Dstl c/o Institute of Naval Medicine Crescent Road Alverstoke Hampshire, PO12 2DL	PSTN: 02392 768130 Mil: 9380 68130
Information on EMF safety management and compliance with EMF safety law; characterisation of EMF sources/emitters; theoretical and practical EMF safety/RadHaz measurement can be obtained from:		
MOD/E3A Rad Haz	Spectrum Defence Digital F-25, Blumlein Building, Blandford Camp, Blandford Dorset, DT11 8RH	PSTN: 01258 48 5332/5330/5678 Mil: 94371 5332/5330/5678

Table 1. Single service contact details

Limitation

31. Dosimetric Reference Limits[7] (DRLs) are the legal limits for exposure to EMFs. They are set below the thresholds of biological damage and incorporate significant safety factors. Below 3 GHz DRLs are difficult to measure directly as they are based on parameters such as in-situ electric field strength and the Specific Absorption Rate (SAR).

32. Equipment manufacturers must conduct SAR testing to show compliance with DRLs where equipment is designed to be used in close proximity to the human body. The sponsoring Accountable Person to assure this testing is conducted is the equipment Delivery Team. The Exemption power from this requirement requires SAR testing or modelling is conducted to show compliance with DRLs where equipment is designed to be used in close proximity to the human body.

33. Below 6GHz, close proximity is defined in the applicable international standards as where a radiating element is within 200mm of the body. Above 6 GHz close proximity is defined as 50mm from the body.

34. The following list of standards are acceptable for an equipment manufacturer to claim compliance with SAR limits if it can produce a valid test certificate:

a. IEC / EN 62209-1 – now superseded by IEC / IEEE 66209-1528-2020;

b. IEC / EN 62209-2 – now superseded by IEC / IEEE 66209-1528-2020;

c. IEEE 1528-2013 – now superseded by IEC / IEEE 66209-1528-2020;

d. EN 50566;

e. IEC / EN 62232;

f. IEC / EN 62577; and

g. IEC / IEEE 62704-1.

[7] DRLs are analogous to the Exposure Limit Values (ELVs) detailed in the Schedule to CEMFAWR16 and the Basic Restrictions detailed in 1999 / 519 / EC.

35. There is no requirement for SAR testing or modelling where equipment has a maximum output power below the levels detailed in IEC EN 62479:2010.

36. Advice on compliance with DRLs for equipment used close to the body, or where the ERLs are exceeded can be obtained from ISS Spectrum E3A.

37. ERLs[8] provide a convenient means to determine compliance with the DRLs where sources are more than 200 mm away from the body. They are based on environmental fields, currents and voltages which are straightforward to measure. The ERLs are conservatively derived from the DRLs such that compliance with the ERL demonstrates compliance with the DRL, and therefore the legislation.

38. Compliance with DRLs must be demonstrated if ERLs are exceeded or sources of EMF are operated close to the body.

Employees at particular risk

39. An employee at particular risk is:

a. an employee who has declared to their employer a condition which may lead to a higher susceptibility to the potential effects of exposure to electromagnetic fields; or

b. an employee who works in close proximity to electro-explosive devices, explosive materials or flammable atmospheres.

40. Conditions which may lead to a higher susceptibility to the potential effects of electromagnetic field include (non-exhaustive):

a. use of Active Implanted Medical Devices (AIMDs) including pacemakers, implanted cardiac defibrillators (ICDs), cochlear implants, brain stem stimulators, implantable infusion pumps, implantable glucose monitors, internal blood pressure sensors;

b. use of Active Wearable Medical Devices (AWMDs) including insulin pumps and implant monitors;

c. having implanted passive medical devices such as bars, stents, plates, pins and replacement joints;

d. health conditions and the use of medicines which reduce the body's ability to thermoregulate; and

e. pregnancy (potential hazard to the foetus). There is no risk to the foetus at levels below the ERLs in Annex A, Table 8.

41. Interference with the normal operation of AWMDs and AIMDs such as cardiac pacemakers, and localised heating of metallic implants may occur below the ERLs. Personnel within the workforce who have these implants should be referred to the Senior Medical Officer for occupational medical assessment. Advice on acceptable levels of EMF exposure for the safe operation of pacemakers and the heating of metallic implants can be obtained from the radiation medicine specialists at the Institute of Naval Medicine.

[8] ERLs are analogous to the Action Levels detailed in the Schedule to CEMFAWR16 and the Reference Levels detailed in 1999 / 519 / EC.

42. All AIMDs are manufactured to standard EN 45502. Equipment made to this standard should not be influenced by EMFs below the General Public limits in Annex C unless an exception is stated.

43. A procedure for risk assessment for workers with AIMDs is provided in BS EN 50527-1:2016 (general), BS EN 50527-2-1 (for cardiac pacemakers) and BS EN 50527-2-2 (for workers with ICDs).

44. Hazards from the interaction of EMFs with fuels and flammable atmospheres are managed using the information in CLC / TR 50427 and HSE's new operator guidance should be considered during a Siting Board. ISS Spectrum E3A provide guidance on fuel and flammable atmosphere safe distances for transmitters as part of their emitter assessment work.

45. Hazards from the interaction of EMFs with electro-explosive devices, explosives and flight critical systems is managed through the Hazards of Electromagnetic Radiation to Ordnance (HERO) management process as detailed in JSP 482, Chapter 24 and derived service level documentation. HERO should always be considered during a Siting Board. In the first instance the Defence Ordnance Safety Group (DOSG) should be contacted for advice on HERO management.

Exposure Assessment

46. There is a requirement for each site / unit to undertake a suitable and sufficient assessment of the levels of electromagnetic field to which an employee may be exposed. The aim of the assessment is to determine which systems and work environments require an EMF Risk Assessment.

47. The Exposure Assessment must consider every part of the site / unit that is accessible to employees in normal operations and foreseeable accident conditions. It must also consider employees at particular risk.

48. Emissions from equipment and installations are to be assessed by a competent person such as an ESO or ERPS. For most systems this can be done using information already available such as:

a. emission information and other safety related data provided by the manufacturer or distributor of the equipment (including DE&S Project Teams);

b. information in UK Guidance / EU non-binding guide;

c. MOD guidance; and

d. information provided by trade associations and industry bodies.

49. For some systems and environments, measurement may be required to demonstrate compliance with the ERLs. Requests for measurement support should be made to ISS Spectrum E3A in the first instance.

50. The Exposure Assessment will identify those systems / environments that require an EMF Risk Assessment and shall provide a reference to that assessment.

51. The Exposure Assessment is an auditable document which needs to be maintained as EMF sources change around the site / unit.

52. Further advice on conducting Exposure Assessments should be obtained from the relevant service focal point in the first instance.

Risk Assessment

53. The general requirement to have a risk assessment that covers all workplace hazards as required by MHSWR 99 is dealt with in JSP 375 Volume 1, Chapter 8.

54. A suitable and sufficient EMF Risk Assessment is required, under CEMFAWR16 for the following:

a. a system or environment where the ERLs can be exceeded, either under normal operations or reasonably foreseeable accident conditions; and

b. a system or environment that could present a hazard to an employee at particular risk (unless it is determined that no employees at particular risk are present).

55. The EMF Risk Assessment must take into account the following, where relevant:

a. the ERLs and DRLs;

b. the frequency range, level, duration and type of exposure, including its distribution over the employee's body and the workplace;

c. direct biophysical effects;

d. replacement equipment designed to reduce the level of exposure;

e. information obtained from any health surveillance or medical examinations provided under CEMFAWR 16 Regulation 11;

f. multiple sources of exposure;

g. simultaneous exposure to multiple frequency fields;

h. indirect effects;

i. any effects on employees at particular risk; and

j. other health and safety related information.

56. Where relevant, the EMF Risk Assessment shall make recommendations to reduce the risks to employees from EMFs, according to the hierarchy of risk-control, through the use of:

a. engineering controls;

b. administrative controls; and

c. personal protective equipment.

57. If there is no EMF Risk Assessment in place, and the assessment cannot be completed locally, the CO / HOE is to report the issue to the focal point authority. The focal point authority for radiation safety is to arrange for an EMF Risk Assessment for the

equipment, installation or environment to determine any risk to the workforce or members of the public who may be exposed to the emissions.

58. EMF radiation risk is to be considered at all stages of the CADMID / T procurement cycle. All aspects of maintenance and operation are to be taken into account.

Control of Public Exposure

59. In general, the public should be excluded from areas where exposure exceeds the reference levels for public exposure. However, this may not be practicable in every case, e.g. site visitors and people transiting areas of public access that, for good reason, happen to be above the reference level. In these cases, the EMF Risk Assessment will have to determine whether the exposure may be “significant” in the terms of JSP 375 Volume 1, Chapter 8 (Health and Safety Risk Assessment); and the EU recommendation on the limitation of exposure of the general public to electromagnetic fields (0 Hz to 300 GHz) (1999 / 519 / EC).

Action Plans and Local Orders

60. Where an EMF Risk Assessment has identified that, under normal operating conditions or under reasonably foreseeable accident conditions, the ERLs could be exceeded - an Action Plan or Safe System of Work must be put in place to show how such an EMF overexposure will be avoided. The Action Plan / Safe System of Work must take into account the significant findings from the EMF Risk Assessment and show how the risk of overexposure will be kept ALARP through the use of the hierarchy of risk control. The Action Plan or Safe System of work must be included (or referred to from) local orders.

61. Local orders for EMF must contain:

a. details of the radiation safety post holders (ESO and WPS(E)(s) and/or ERPS(s));

b. details of the Action Plan or Safe System of Work (or a reference to the documents if they are stand-alone);

c. details of (or reference to) contingency plans for reasonably foreseeable accidents as identified in the EMF Risk Assessment; and

d. any requirements for monitoring (where relevant).

62. The local orders must be signed by all personnel working with the system stating that that they understand the content of, and will abide by, the local orders.

Information and Training

Awareness training

63. To operate under the limits specified in Annex A, personnel working on military establishments where General Public limits could be exceeded require suitable and sufficient information and / or training. Delivery and content of the information or training will depend on the hazards present on the site but may include:

e. hazard warning signs and notices;

f. health and safety brief on entry to a site; and

g. health and safety induction training.

64. Any such information should include consideration for employees at particular risk.

Working under an EMF Risk Assessment

65. Suitable and sufficient information and training must be provided to all personnel working under an EMF Risk Assessment. The information / training must include, where relevant:

a. measures taken to reduce the risk of exposure;

b. concepts and values of ERLs and DRLs and the possible risks associated with them;

c. indirect effects of exposure;

d. results of the most recent Exposure Assessment;

e. how to detect and report sensory and health effects;

f. the circumstances under which employees are entitled to health surveillance and medical examinations;

g. safe working practices; and

h. any additional measures taken in respect of employees at particular risk.

66. The provision of information and training should be recorded, and a record of the training kept.

ESO, ERPS and WPS(E)

67. ESO, ERPS and WPS(E) EMF safety training must include the following topics:

a. legislation and MOD regulation;

b. basics of electromagnetic radiation;

c. awareness of sources;

d. biological effects;

e. employees at particular risk including fuels, flammable atmospheres and explosives;

f. EMF radiation protection in MOD;

g. monitoring and monitoring equipment; and

h. awareness of Siting Boards.

68. In addition, ERPS training should include:

a. fields and Antennas; and

b. hazard calculations including safe distances for personnel, fuels, flammables and explosives.

69. EMF / RF safety training should be refreshed every 5 years.

Hazard Areas

70. An EMF hazard area is that area within which the exposure to EMF can exceed the ERLs.

Marking of hazard areas

71. The boundary of a hazard area is to be marked using signs and barriers, as appropriate. It may be necessary to prevent unauthorised entry. All signs and RF hazard warning notices should be in accordance with the Health and Safety (Safety Signs and Signals) Regulations 1996. A notice giving the name and telephone number of the WPS(E) or ERPS responsible for the area is to be displayed with the RF hazard warning notice.

Responsibilities in relation to hazard areas

72. General responsibilities in relation to EMF hazard areas are as follows:

a. the person in charge of an installation is to ensure, before activating the installation, that no unauthorised persons are present;

b. personnel are not to enter the area without the authority of the person in charge of the installation;

c. an ERPS and/or WPS (E) must to be appointed, for equipment, system-plants or installations having an associated hazard area[9]. The appointee is to co-ordinate all safety measures relating to the area;

d. local orders must be in place for all EMF hazard areas. These must be readily available to and read and understood by all relevant personnel; and

e. personnel authorised to enter and work within an area are to be instructed as to the hazards that they may be exposed to and are to be trained in safe techniques to be used. Otherwise, access to the area is to be controlled by a "Permit to Work" system as described in Para 73.

Permit to Work System (EMF)

73. Permit to Work systems are required for hazardous Defence activities with a high level of residual risk (such as entering an EMF hazard area).

74. When an EMF Permit to Work system is used, the permit is to give the name(s) of the person(s) who are required to enter the area and state the following as a minimum:

a. whether the installation is radiating;

b. conditions for entry and working in area;

[9] This is not required for Bowman radio systems used in accordance with Bowman system safety documentation.

c. if the installation is radiating;

(1) the approximate radiated power;

(2) the arrangements for preventing an increase in radiated power; and

(3) the arrangements for preventing over-exposure, e.g. time averaging exposure.

d. if the installation is not radiating, the arrangements for maintaining that condition;

e. date and time of entry into the area and when work may start; and

f. when work is to cease and the time of exit from the area.

75. The EMF elements of a Permit to Work system should be set up and managed by a SQEP such as an ERPS.

76. EMF permits to work can be issued by somebody SQEP to do so such as an ERPS or WPS(E).

EMF Monitoring

77. EMF monitoring may be required where an EMF Risk Assessment has identified the potential for ERLs to be exceeded. The purpose of most EMF monitoring is to ensure that barriers have been placed correctly around antennas, that waveguide / transmission line is not leaking EMF into occupied workspaces and that engineering controls such as RF absorbing material hoods and screens, anechoic chambers etc. are operating effectively. Monitoring may also be carried out to ensure a work area is safe prior to an EMF Permit to Work being issued.

78. Any requirement for monitoring should be specified in local orders. The requirement should include the frequency and location of monitoring, the monitoring equipment to be used, the action level for the monitoring and the resultant action that should be taken should this level be exceeded.

79. Those undertaking monitoring should be competent in the use of the monitor. Pre-use checks must be carried out before commencing the monitoring activity. The pre-use checks shall include:

a. condition check;

b. battery check;

c. check calibration date;

d. ensure the correct probe has been selected;

e. ensure the correct measurement unit has been selected; and

f. function check using a suitable check source.

80. EMF monitoring equipment should be calibrated in accordance with instructions given by the issuing authority or, where there is no issuing authority, the manufacturer’s

recommendations. Equipment which is not in date for calibration should not be used for health and safety measurements.

81. A record of the pre-use checks and the results of EMF monitoring should be kept for a minimum of 2 years.

Overexposure to EMF Radiation

82. Any person known, or suspected, to have been exposed to EMFs above the ERLs in Annex A *and* who reports a health effect is to be seen by the responsible medical officer as soon as possible following the incident.

83. Any incident involving an over-exposure, whether there is a health effect or not, is to be reported (with a copy to Dstl) to the ERPS / WPS(E) or ESO and investigated in accordance with JSP 375 Volume 1 Chapter 16.

Provisions for the Protection of the Public

84. The following measures are to be taken to protect the public from EMF emissions on units and establishments:

a. no EMF hazard area should include places to which the public has a legal right of unrestricted access. This includes heights above ground, for example, if an emission crosses a road used by a double-decker bus or public footpath, it will be necessary to ensure that the height of the emission is such that the public access is outside the area. Persons may suffer electric shock or burn from contact with sufficiently large conducting ungrounded objects, such as vehicles or mobile structures, at electric field strengths below the ERLs in Annex A. In areas of public access adjacent to an EMF hazard area where large ungrounded objects are likely to be present on a regular basis (roads, etc) it will be necessary to ensure that measured contact currents with ungrounded objects do not exceed those given in Annex C Table 12. If the local assessment shows that there is no risk from this hazard, or that arrangements have been made to prevent public exposure to the hazard, it will not be necessary to measure contact currents with ungrounded objects;

b. if an EMF hazard area includes places to which the public normally has access by ‘grace and favour’, such access is to be prevented by means of adequate physical barriers and warning signs;

c. if an EMF hazard area includes places where members of the public might trespass, such trespass is to be prevented; and

d. if a proposed EMF hazard area includes any place legally occupied by a member of the public, as owner or tenant, their consent must be obtained before it is established.

85. The CO / HoE is responsible for applying these provisions to any mobile equipment capable of emitting EMF radiation which is under the direct control of personnel under their command – see also JSP 604 Chapter 3032 (MOD Radio Site Clearance and Protection).

Provisions for Liaison with Contractors

86. The Management of Health and Safety at Work Regulations 1999 requires that where two or more employers share a workplace, they must co-ordinate the preventative and protective measures, identified as a result of the hazard identification and risk assessment undertaken by the separate employers. The employers are also required to co-operate with each other by exchanging health and safety information with all that are considered at risk. The MOD policy for the management of contractors and other visiting workers at MOD establishments is detailed in JSP 375 Volume 1 Chapter 34. This management system is commonly known as the 4C's (co-operate, communicate, co-ordinate and control). The competent person responsible for the emitting equipment is to liaise with the 4C's Area Custodian and is to provide the appropriate information to enable the Area Custodian to compile the master hazard register for their area. This information will include:

a. the boundaries of the EMF hazard area;

b. areas adjacent to EMF emitters where contact with large ungrounded objects may cause electric shock or burn;

c. details of special hazards associated with the operation of the installation; and

d. details of hazards that might be encountered during maintenance (hidden obstacles for grass cutters, etc).

Associated Documents

87. Related Documents:

a. Control of Electromagnetic Fields at Work Regulations 2016;

b. IEEE Standard for Military Workplaces – Force Health Protection Regarding Personnel Exposure to Electric, Magnetic and Electromagnetic Fields, 0 Hz to 300 GHz (IEEE Std C95.1-2345™-2014);

c. JSP 375, Volume 1 Chapter 16 – Accident / Incident Investigation;

d. Council Recommendation of 12 July 1999 on the limitation of exposure of the general public to electromagnetic fields (0 Hz to 300 GHz) (1999 / 519 / EC);

e. JSP 375, Volume 1 Chapter 34 – The management of contractors and other visiting workers (including MOD agencies) within the MOD;

f. JSP 375, Volume 1 Chapter 8 – Health and Safety Risk Assessment;

g. JSP 375, Volume 1 Chapter 16 – Accident / Incident Reporting and Investigation;

h. JSP 604 Chapter 3032 (MOD Radio Site Clearance and Protection);

i. Electromagnetic Fields at Work – A Guide to the Control of Electromagnetic Fields at Work Regulations 2016, HSE, HSG281;

j. non-binding guide to good practice for implementing Directive 2013 / 35 / EU – Electromagnetic Fields, European Commission;

k. DSA02-MAA Regulations;

l. DSA02-DMR Regulations;

m. DSA02-DLSR Regulations; and

n. DSA-02-DOSR Regulations.

Exposure Reference Levels for Occupational Exposure

1. The ERLs for continuous whole-body exposure to electric and magnetic fields set out in this Annex are the Zone 1 levels taken from IEEE STD C95.1-2345™-2014.

Electrostimulation limits: 0 Hz – 5 MHz

Table 2 Magnetic field ERLs for exposure of the head or torso: f = 0 Hz to 5 MHz

Frequency Range (Hz)	Exposure Reference Level	
	B (mT)	H (A/m)
<0.153	353	2.81×10^5
0.153 – 20	54.3/f	4.32×10^4/f
20 – 751	2.71	2160
751 – 3350	2060/f	1.64×10^6/f
3350 – 5×10^6	0.615	490
NOTE 1 – Tabulated values are given as rms quantities. NOTE 2 – f is expressed in Hz. NOTE 3 – Values for frequencies below 0.153 Hz apply to exposure of the head. NOTE 4 – For frequencies ≤ 25Hz, the averaging time is such that at least 5 cycles are included in the average, but with a maximum of 10s. The averaging time for frequencies > 25 Hz is 0.2s. NOTE 5 – The environmental magnetic field ERL below 10 Hz shall be restricted to a peak value of 500 mT. Note that the *in-situ* and environmental magnetic fields are virtually identical.		

2. When the magnetic field is not constant in magnitude, direction, or relative phase over the head, torso, or limbs, the values in Table 2 shall apply to the maximum field over the head, torso, or limbs.

Table 3 Magnetic field ERLs for the limbs: f = 0 Hz to 5 MHz

Frequency Range (Hz)	Exposure Reference Level	
	B (mT)	H (A/m)
<10.7	353	2.81×10^5
10.7 – 3350	3790/f	3.02×10^6/f
3350 – 3×10^6	1.13	900
NOTE 1 – Tabulated values are given as rms quantities. NOTE 2 – f is expressed in Hz. NOTE 3 – The averaging time is 0.2s for frequencies > 25 Hz.		

3. When the magnetic flux density waveform is non-sinusoidal, such as with pulsed or multiple frequency fields, the maximum exposure shall conform to either a restriction based on the peak field or a restriction based on the Fourier components of a waveform consisting of multiple frequencies. Details can be found in Section 4.1.2.4 of IEEE C95.1-2345™-2014.

Table 4 Electric field ERLs – whole body exposure: f = 0 Hz to 100 kHz

Frequency Range (Hz)	Exposure Reference Level
	E (V/m)
0 – 276	20,000[a,b]
276 – 3000	5.53×10^6/f
3000 – 100,000	1842

NOTE 1 – Tabulated values are given as rms quantities.
NOTE 2 – The ERLs below 1 Hz may be more conservative than necessary, but due to insufficient biological data, the values in the table were chosen to be consistent with data for frequencies above 1 Hz.
NOTE 3 – For dc (i.e., 0 Hz), the ERLs in the 1st row are multiplied by √2
NOTE 4 – The averaging time for frequencies greater than 25 Hz is 0.2s.
NOTE 5 – For Zone 1, the downwardly sloping part of the curve (2nd row) was intended to limit contact current to 1.5 mA for a 1.75 m tall person. This adjustment increases the contact current defined by the curve to 1.52 mA (i.e., by about 1.5%). This is not considered consequential given the variability inherent to the coupling of living bodies to electric fields.

[a] Painful discharges are readily encountered at 20 kV/m and are possible at 5 kV/m – 10 kV/m without protective measures.
[b]The limit of 20 kV/m may be exceeded in the restricted environment when a worker is not within reach of a grounded conducting object. A specific limit is not provided.

4. When the external electric field is not constant in magnitude, direction, and relative phase over the dimensions of the human body, the spatially averaged external field shall be restricted to the ERL in Table 4. Where an exposed individual is not within reach of a grounded conducting object, it may be acceptable to exceed the ERL in Table 4. Limits are not specified for such cases. In no case shall the DRLs or contact current limits be exceeded.

5. When the external electric field waveform is non-sinusoidal, such as with pulsed or mixed frequency waveforms the maximum exposure shall conform to either a restriction based on the peak field or a restriction based on the Fourier components of a waveform consisting of multiple frequencies. Details can be found in Section 4.1.3.3 of IEEE C95.1-2345™-2014.

Contact and induced currents

6. Contact and induced current shall be limited as specified in Table 5, Table 6 and Table 7 subject to the following conditions:

a. grasp and touch contact current limits apply to a freestanding individual who is insulated from the ground while touching a conductive path to ground. These limits may not protect against aversive sensations from spark discharges just prior to, and just after, the moment of direct contact with the ground path;

b. for personnel standing in an electric field while grounded through the feet, exposure shall not exceed the induced current values;

c. the limits for peak exposure refer to instantaneous values measured through a bandwidth from 0 Hz to the maximum meaningful frequency determined by Fourier decomposition of the waveform of interest;

d. limits for grasping contacts apply where personnel are trained to make grasping contact and to avoid touch contacts with conductive objects that present the possibility of painful contact current. A grasp contact area is assumed to be 15 cm^2. Grasp contact should be made as rapidly as possible. Hesitant approach or release increases the chance of arcing and burn. The use of frequency-appropriate protective gloves, the prohibition of metal objects, or the training of personnel may be sufficient to assure compliance with the contact current limit;

e. a touch contact is assumed to have a contact area of 1 cm^2;

f. limits for induced and contact current from 100 kHz to 110 MHz are shown in Table 7. For long exposure duration (t>>1 s), the values of induced and contact currents protect against heating effects in the RF range and are more restrictive than the corresponding values of currents in Table 5 and Table 6 extrapolated to frequencies greater than 100 kHz. Hence, for long exposure duration, compliance at frequencies greater than 100 kHz will be associated with meeting the limits of Table 7; and

g. the limits in Table 5 and Table 6 protect against adverse electrostimulation effects; the ERLs in Table 8 apply to effects associated with whole body heating. Note that all 3 tables shall be considered and the corresponding values for the appropriate exposure group satisfied at all applicable frequencies.

Table 5 Induced and contact current limits for continuous sinusoidal waveforms, f = 0 Hz to 3 kHz

Condition	**Exposure Reference Level Current (mA)**
Induced, each foot	3.0
Contact, grasp[a]	3.0
Contact, touch	1.5
NOTE 1 – Tabulated values are rms values NOTE 2 – Grasp and touch contact current limits apply to current flowing between the body and a grounded object that may be contacted by a person. NOTE 3 – The averaging time for determination of compliance for touch and grasp contact is 0.2s.	

[a] The grasping contact limit pertains to environments where personnel are trained to make rapid grasping contact and to avoid touch contacts with conductive objects that present the possibility of painful contact.

Table 6 Induced and contact current limits for continuous sinusoidal waveforms, f = 3 kHz to 100 kHz

Condition	**Exposure Reference Level Current (mA)**
Induced, each foot	1.00f
Contact, grasp[a]	1.00f
Contact, touch	0.50f
NOTE 1 – Tabulated values are rms values NOTE 2 – f is expressed in kHz NOTE 3 – Grasp and touch contact current limits apply to current flowing between the body and a grounded object that may be contacted by a person. NOTE 4 – The averaging time for determination of compliance for touch and grasp contact is 0.2s.	

[a] the grasping contact limit pertains to environments where personnel are trained to make rapid grasping contact and to avoid touch contacts with conductive objects that present the possibility of painful contact.

7. When the current waveform is non-sinusoidal, such as with pulsed or mixed frequency waveforms exposure shall conform to the rms ERLs in Table 5 and Table 6 and to either a restriction based on the peak field or a restriction based on the Fourier components of a waveform consisting of multiple frequencies. Details can be found in Section 4.1.4.2 of IEEE C95.1-2345™-2014.

Table 7 ERLs for induced and contact current (mA) for continuous sinusoidal waveforms – frequencies between 100 kHz and 110 MHz

	Exposure Reference Level		
Frequency	**100 kHz – 3 MHz**	**3 MHz – 30 MHz**	**30 MHz – 110 MHz**
Induced, each foot	100	100	100
Contact, grasp[a]	100	$100(f/3)^{0.3}$	200
Contact, touch	50	$50(f/3)^{0.3}$	100
NOTE 1 – Tabulated values are rms values; f= frequency in MHz NOTE 2 – Limits apply to current flowing between the body and a grounded object that may be contacted by the person. NOTE 3 – The averaging time for determination of compliance is 6 mins for induced currents, 1 s for touch contact current, and 6 mins for grasp contact current. NOTE 4 – Calculated values for personnel are capped at the 30 MHz values since there is insufficient data to extrapolate above 30 MHz. NOTE 5 – Light "brush" contact may result in arcs and shock and burn even at 50 mA and should be avoided, especially with long objects such as cranes and cables. NOTE 6 – The ceiling values (temporal peak values) for induced current are 500 mA for Zone 1 (for a maximum exposure duration of 14.4 s).			

[a] The grasping contact limit pertains to environments where personnel are trained to make rapid grasping contact and to avoid touch contacts with conductive objects that present the possibility of painful contact.

ERL for contact voltage to protect against RF burns

8. The ERL for the open circuit voltage that exists on objects exposed to electric and magnetic fields in the frequency range of 100 kHz to 110 MHz with which personnel could come into contact is 140 V (rms) as measured between any 2 points of contact with the body.

Thermal effects exposure reference level values

Table 8 ERLs for occupational exposure to time varying electric and magnetic fields between 100 kHz and 300 GHz

Frequency range (MHz)	**Electric field strength (*E*)[a] (V/m)**	**Magnetic field strength (*H*)[a] (A/m)**	**Power density (S) E Field, H Field (W/m^2)**	**Averaging Time $\|E\|^2$, $\|H\|^2$, S (minutes)**
0.1 -1	1842	$16.3/f_M$	$(9000,100,000/f_M^2)$[b]	6
1 – 30	$1842 / f_M$	$16.3/f_M$	$(9000/f_M^2, 100,000/f_M^2)$	6
30 – 100	61.4	$16.3/f_M$	$(10, 100,000/f_M^2)$	6
100 – 300	61.4	0.163	10	6
300 – 3000	-	-	$f_M/30$	6
3000 – 30,000	-	-	100	$19.63/f_G^{1.079}$
30,000 – 300,000	-	-	100	$2.524/f_G^{0.476}$
NOTE 1 – All values are rms values NOTE 2 – f_M is the frequency in MHz, f_G is the frequency in GHz				

[a] For exposures that are uniform over the dimensions of the body, such as certain far-field plane-wave exposures, the exposure field strengths and power densities are compared with the ERLs in the table. For non-uniform exposures, the mean value of the exposure fields, as obtained by spatially averaging the squares of the field strengths or averaging the power densities over an area equivalent to the vertical cross section of the human body (projected area) or a smaller area depending on the frequency, are compared with the ERLs in this table. [See item a) in 4.5.1, IEE C95.1-2345-2014]

[b] These plane-wave equivalent power density values are commonly used as a convenient comparison with ERLs at higher frequencies and are displayed on some instruments in use.

(i)The ERLs refer to exposure values obtained by spatially averaging the exposure time and the electric and magnetic field strengths, the squares of the electric and magnetic field strengths, or the plane wave

equivalent power densities, depending on the frequency along a line corresponding to the axis of the human body as follows:

Frequencies between 100 kHz and 3 GHz: The ERL for fields between 100 kHz and 3 GHz are derived on the basis of limiting the Whole Body Average SAR, which is proportional to the spatial average of the incident plane wave equivalent power density, or the RMS values of the squares of electric and magnetic field strengths ($|E|^2$, $|H|^2$), averaged over the projected area of the body or a line corresponding to the axis of the body. Therefore, the ERL corresponds to the spatially averaged plane wave equivalent power density or the spatially averaged values of the squares of the electric and magnetic field strengths.

Frequencies between 3 GHz and 30 GHz: For frequencies between 3 GHz and 30 GHz, the ERL is expressed in terms of the incident power density. However, to provide a transition in the frequency range 3 GHz to 6 GHz, compliance may be demonstrated by evaluation of either the incident power density or local SAR. From 3 GHz to 30 GHz, the power density is spatially averaged over any contiguous area corresponding to $100\lambda^2$, where λ is the free space wavelength of the RF field.

Frequencies between 30 GHz and 300 GHz: For frequencies between 30 GHz and 300 GHz, the power density is spatially averaged over any contiguous area of 0.01 m^2 (100 cm^2)

(ii) For near field exposures below 300 MHz, the applicable ERL is in terms of rms electric and magnetic field strength. For convenience the ERL may be expressed as equivalent plane wave power density. For frequencies below 30 MHz, both the rms electric and magnetic fields shall be determined; for frequencies between 30 MHz and 300 MHz, either field component will be sufficient provided that the point in question is in the far field of the source. For higher frequencies, either field component may be used when expressed as equivalent plane-wave power density for determining compliance with the ERLs.

(iii) For mixed or broadband fields at a number of frequencies for which there are different values of the ERL, the fraction of the ERL (in terms of E^2, H^2, or S) incurred within each frequency interval shall be determined and the sum of all such fractions should not exceed unity.

Pulsed fields

9. For exposures to pulsed RF fields in the range of 100 kHz to 300 GHz, the peak pulse power densities (S_{pk}) are limited by the use of normal time averaging, with one exception: The total incident energy density during any 100 ms period within the averaging time shall not exceed one fifth of the total energy density permitted during the entire averaging time (T_{avg}) for a continuous field, i.e,

$$\sum_{0}^{0.1s}(S_{pk} \times \tau) \leq \frac{ERL_{avg} \times T_{avg}}{5}$$

Where τ is the pulse width.

Spatial peak power densities for localised exposures

10. Compliance with the ERL is determined from spatial averages of the power density or the mean squared electric and magnetic field strengths over the area defined in footnote (i) of Table 8. The spatial peak value of the power density or mean squared field strength shall not exceed 20 times the square of the allowed spatially averaged values of the fields and 20 times the power density at frequencies below 100 MHz, and shall not exceed the equivalent power density of 200 W/m^2 at frequencies between 100 MHz and 300 MHz, $0.667f_M$ W/m^2 between 300 MHz and 3 GHz, and 2000 W/m^2 at frequencies above 3 GHz.

Multi-frequency exposures (exposure to multiple sources)

11. When multiple sources are introduced to an environment it is necessary to address the sources independently since each source will contribute some fraction of the ERL towards the total exposure at a fixed location. The sum of the ratios of the exposure (expressed as a plane wave equivalent power density) to the corresponding ERL for the frequency of each source is evaluated. The exposure is compliant with the ERL if:

$$\sum_{i=1}^{n} \frac{exposure}{ERL} < 1$$

Dosimetric Reference Limits

In-situ electric and magnetic field (0 Hz – 5 MHz)

1. Table 9 lists the DRLs for particular areas of the body in terms of the in-situ electric field. Two parameters are listed in the table: the rheobase in-situ field, E_0, and a strength-frequency parameter, f_e. Limits are determined from Table 9 as:

$$E_i = \begin{cases} E_0 & (f < f_e) \\ E_0\left(\frac{f}{f_e}\right) & (f \geq f_e) \end{cases}$$

where E_i is the maximum allowed in-situ electric field.

2. In Table 9, the in-situ electric field DRL applies to the rms E-field measured in the direction and location providing the maximum in-situ E-vector (vector magnitude) over a 5 mm linear distance. The averaging time for an rms measurement is 0.2s for frequencies above 25 Hz. For lower frequencies the averaging time is such that at least 5 cycles are included in the average, but for a maximum of 10s.

Table 9 Parameters E_0 and f_e for computing the DRLs[a] applying to various regions of the body; f = 0 Hz to 5 MHz

Exposed Tissue	Frequency parameter f_e (Hz)	E_0 (V/m)
Brain	20	1.77×10^{-2}
Heart	167	0.943
Extremities	3350	2.10
Other Tissues	3350	2.10
NOTE 1 – Tabulated values are given as rms quantities		

[a] Interpretation of the table is as follows: $E_i = E_0$ for $f<f_e$; $E_i = E_0\ (f/f_e)$ for $f \geq f_e$

Specific absorption rate (100 kHz – 3 GHz)

Table 10 DRLs for frequencies between 100 kHz and 3 GHz

Condition		SAR[a] (W/Kg)
Whole-body exposure	Whole-body average	0.4
Localised exposure	Localised (peak spatial average) [b]	10
Localised exposure	Extremities and pinnae	20

[a] SAR is averaged over the appropriate averaging times as shown in Table 8
[b] Averaged over any 10g of tissue (defined as a tissue volume in the shape of a cube)[10]
[c] The extremities are the arms and legs distal to the elbows and knees, respectively.

DRLs for frequencies between 3 GHz and 300 GHz

3. The DRLs for frequencies between 3 GHz and 300 GHz are the same as the corresponding ERLs shown in Table 8 and are considered appropriate for all human exposure.

[10] The averaging volume of 10g of tissue would be represented as a 10 cm^3 cube (approximately 2.15 cm per side).

General Public Reference Levels

Table 11 Reference levels for general public exposure to time varying electric and magnetic fields (unperturbed rms values)

Frequency range	**Electric field strength, *E* (Vm^{-1})**	**Magnetic field strength, *H* (Am^{-1})**	**Magnetic flux density, *B*(μT)**	**Equivalent plane wave power density. S_{eq} (Wm^{-2})**
Up to 1 Hz	-	32 000	40 000	-
1Hz-8Hz	10 000	32 000/f^2	40 000/f^2	-
8Hz-25Hz	10 000	4 000/f	5000/f	-
0.025 kHz - 0.8 kHz	250/f	4/f	5/f	-
0.8 kHz - 3 kHz	250/f	5	6.25	-
3kHz-150kHz	87	5	6.25	-
0.15 MHz - 1 MHz	87	0.73/f	0.92/f	-
1 MHz - 10 MHz	87/$f^{½}$	0.73/f	0.92/f	-
10 MHz - 400 MHz	28	0.073	0.092	2
400 MHz - 2000 MHz	1.375$f^{½}$	0.0037$f^{½}$	0.0046$f^{½}$	f/200
2 GHz - 300 GHz	61	0.16	0.20	10

NOTES
(a) *f* is the frequency as indicated in the frequency range column.
(b) Provided that basic restrictions are met and adverse indirect effects can be excluded, field strength values can be exceeded.
(c) For frequencies between 100 kHz and 10 GHz, S_{eq}, E^2, H^2 and B^2, are to be averaged over any 6-minute period.
(d) Between 100 kHz and 10 MHz, peak values for the field strengths are obtained by interpolation from the 1.5 fold peak at 100 kHz to the 32-fold peak at 10 MHz. For frequencies exceeding 10 MHz it is suggested that the peak equivalent plane wave power density, as averaged over the pulse width, does not exceed 1000 times the S_{eq} restrictions, or that the field strength does not exceed 32 times the field strength exposure levels given in the table.
(e) For frequencies exceeding 10 GHz, S_{eq}, E^2, H^2 and B^2, are to be averaged over any 68/$f^{1.05}$-minute period (where *f* is the frequency in gigahertz).
(f) No *E*-field value is provided for frequencies < 1 Hz. which are effectively static electric fields. Perception of surface electric charges will not occur at field strengths less than 25 kVm^{-1}. Spark discharges causing stress or annoyance should be avoided.

Table 12 Reference levels for time-varying contact currents from conductive objects

Exposure characteristics	**Frequency range**	**Maximum contact current (mA)**
General public	Up to 2.5 kHz	0.5
	2.5 kHz. - 100 kHz	0.2*f*
	100 kHz. - 110 MHz	20

NOTES
(a) *f* is the frequency in kilohertz.
(b) These values are set to avoid the possibility of indirect effects of exposure (shock and/or burn).

Table 13 Reference levels for current induced in any limb at frequencies between 10 and 110 MHz

Exposure characteristics	**Current (mA)**
General public	45

NOTES

(a) For compliance with the basic restriction on localised SAR, the square root of the time averaged value of the square of the induced current over any 6 minute period forms the basis of the reference levels.

Special Considerations for Radio Equipment including Mobile Communications Masts

1. All new / upgraded radio equipment, including mobile phone transmitters on the Defence Estate, shall be independently assessed by Defence Equipment & Support Air Defence and Electronic Warfare Systems PT (DES ADEWS) under the Radio Site Clearance (RSC) procedure. A radiation exposure hazard assessment for personnel is conducted as part of the RSC, in addition to weapon storage and processing areas, explosives, fuels and gases.

2. The RSC certificate shall be passed to the originator of the request to install radio equipment on the Defence Estate. The request originator shall provide a copy of the RSC certificate to the Head of Establishment / Commanding Officer of the site on which the radio system is to be installed, together with a statement of self-certification that the transmitter, when operational, complies with the legal limits for human exposure to electromagnetic fields.

3. It is the responsibility of the HoE / CO to consider the presence of the radio transmitter, along with any other non-ionising radiation sources, for inclusion the Site Risk Assessment. Where no significant risk is identified, it is the decision of the HoE / CO whether or not to include the mast/tower information on the Site Risk Assessment. However, the HoE / CO must retain the planning application / RSC certificate in case of enquiries concerning the potential exposure from the transmitters.

4. The strategy and policy for Radio Site Clearances is outside the scope of JSP 392 and may be found at JSP 604 Chapter 3032 (MOD Radio Site Clearance and Protection).