Introducing the EMF Directive 2013/35/EU

Tales From The Field: Assessing Compliance With The New EMF Regulations

Dr Richard Findlay
(richard.findlay@emfcomp.com)
Outline

1. Introduction
2. EMF Adverse Health Effects
3. Risk Assessment
4. Exposure Assessment
5. Applications
6. Case Studies
Introduction: Background

- New Control of EMF Regs
  - Control of EMF at Work (CEMFAW) Regs transposed into UK law in 2016
  - Often organisations confused by the apparent complexity of the EMF Regs
  - As a result, many have ignored the new legislation

- Aim Of This Presentation
  - A little knowledge can go a long way
  - Aim of this talk is to demystify the CEMFAW Regs through simple explanations and examples
The ‘Control of EMF at Work Regulations 2016’ (CEMFAW) ‘Action Levels’ aims to protect workers from adverse health effects arising from exposure to EMFs.

For members of the public, the EU Council Recommendation 1999/519/EC ‘Reference Levels’ apply.

The CEMFAW covers the frequency range 0 Hz to 300 GHz and is based on ICNIRP 1998 & 2010 guidelines.

Introduction: ‘At Risk’ Workers

- For ‘at risk workers’, again the EU Council Recommendation 1999/519/EC Reference Levels apply

‘At Risk’ Workers
- pacemakers
- defibrillators
- insulin pumps
- pregnant workers

Why?
- EMF interferes with implanted medical devices
- EMF resets pacemakers
- EMF effects on foetus still unclear
As these internal quantities within the body can only be determined through computer modelling using human models, there exist a second set of more restrictive values that can be measured.

They are presented as Exposure Limit Values (ELVs):
- Induced electric fields (ELF)
- SAR, power density (RF)

The CEMFAW limits are based on established biological effects and considerations within the body.

They are presented as Action Levels (ALs):
- Magnetic flux densities
- Electric field strengths
EMF Adverse Health Effects: Static Fields

Static:

- **Electric fields**
  Electrostatic discharge to grounded objects

- **Magnetic fields**
  Movement in a static field
  - Vertigo
  - Nausea
  - Metallic taste
  - Magneto-phosphenes (flashes before eyes)

- Problems with metallic implants, projectiles, medical devices
EMF Adverse Health Effects: Low Frequency Fields

Low Frequency (1 Hz – 100 kHz):

- **Electric fields**
  Surface charge: induction of current density and electric fields within body

- **Magnetic fields**
  Magnetic fields penetrate body: induction of current density and electric fields within body

- Adverse health effects include:
  Cognitive impairment, nerve stimulation
High Frequency (100 kHz – 300 GHz):

- Electromagnetic fields
  Tissue heating, indicated by the Specific energy Absorption Rate (SAR)

- 100 kHz-10 MHz: limb heating, induced E
- 10 MHz-400 MHz: whole-body heating
- 400 MHz-10 GHz: localised heating
- 10 GHz-300 GHz: surface heating

- Body temperature rise
  - 0 – 3 °C: increasing discomfort
  - above 3 °C: heat stroke, tissue damage
Recommendations
- Identify safety rep responsible for EMFs
- Carry out risk assessment
- Conclusions and actions should be clearly communicated to employees

Preparation
- Gather information of workplace activities
- Identify potential sources of high EMF
- Identify workers at particular risk (implanted devices, pregnant etc)
- Include repair and maintenance tasks
Risk Assessment: High Sources of EMF

Potentially High Sources of EMF:

- **Low Frequency**
  - Industrial electrolysis
  - Electric welding and melting
  - Electric crack detection
  - Electric transport
  - Induction heating
  - Industrial magnetisers/demagnetisers
  - Electric crack detection
  - High sources of current, voltage

- **High Frequency**
  - Communications antennas
  - Radar
  - Industrial heating and drying
  - RF plasma (CVD, sputtering)
  - RF welding
  - Medical devices (electrosurgery etc)
High Sources of EMF
Substations/Plant Rooms

Substations/Switch rooms/Plant rooms:
High Sources of EMF
New Builds

Planning of New Buildings:
High Sources of EMF Workshops

Workshop Equipment:
High Sources of EMF
Rooftops

Rooftops:
EMF Exposure Assessment: Procedure

- Identify EMF sources in the workplace
  1. Refer to manufacturer’s data, databases, guidelines, standards, practical guides
  2. If necessary, measure and compare with CEMFAW ALs
  3. If necessary, model and compare with CEMFAW ELVs
  4. If necessary, put into place EMF controls such as lines on floor, signs, interlocks etc.

- Record process
Step 1: Databases & EMF Literature

- Manufacturer’s data, manuals etc
- Standards
  - EN 50499 – procedure worker exposure to EMFs
  - EN 62110 – AC Power 50 Hz
  - EN 50445, 50444, 50505 - welding
  - EN 50519 – induction heating
  - EN 50400 – RF base stations
- Databases?
EMF Exposure Assessment
Measurement & ALs

Step 2: Measurement and Comparisons with Action Levels (ALs)

- Measurement Equipment
- Static Field Meters (e.g. MetroLab THM1176)
- ELF Magnetic Field Meters (e.g. Narda ELT-400)
- ELF Electric Field Meters (e.g. Narda EHP-50)
- RF Meters (e.g. Narda NBM-550)
- Spectrum analysers (e.g. Narda SRM-3006)

- Compare external electric field strengths, magnetic flux densities, power densities etc with ALs in EMF Regs Annex II and III
EMF Exposure Assessment
Modelling & ELVs

Step 3: Modelling and Comparisons with Exposure Limit Values (ELVs)

- Computational Modelling
  - Numerical methods
  - Human models

- Compare internal electric field strengths, SAR etc in the body with ELVs in EMF Regs Annex II and III

- Q: Why does the CEMFAW have two sets of ‘limits’, ALs and ELVs?
  - A: Because the modelling and ELV comparison can be more difficult, so ALs are a ‘first check’

  *However the modelling can be worthwhile!*
EMF Exposure Assessment
Modelling & ELVs

- A zone (EN 50499) or exclusion area, where ALs would be exceeded, can be mapped

- A similar exclusion area, where the ELVs would be exceeded, can also be produced

- The difference between the two areas will be dependent on the individual exposure situation, electromagnetic device, frequency, environment etc

- However, the exclusion area due to modelled ELVs is always smaller than the measured AL exclusion area

Views of human model and calculated exclusion areas due to (i) induced fields in the body and (ii) measured fields in the region of an antenna
Case Study
Facilities Management

Application – Facilities Management
Facilities Management

Measurements

- **Facilities**
  - Frequency of magnetic field was 50 Hz and associated harmonics, therefore EMF assessment required for low (ELF) frequencies
  - ‘Standard’ worker – in compliance with low Action Level (90%) at 20 cm from some cables within substations
  - ‘At risk’ worker – in compliance with Council Recommendation reference level (95%) at 120 cm from some cables in switchrooms
  - ‘At risk’ worker levels exceeded in some rooms adjacent to MRI unit
Case Study
Facilities Management

Recommendations

- **Facilities Management**
  - Advise ‘standard’ workers to maintain a head separation distance from identified cables within some substations
  - Prohibit ‘at risk’ workers from entering substations, MRI and switchrooms
  - Display appropriate warning magnetic field signage at the entrances to the identified switchrooms
  - Provide engineers with EMF awareness training, ensure that they are familiar with the findings of the risk assessment and the appropriate protection and prevention measures

(a) Warning: magnetic field
(b) Warning: non-ionising radiation.
(a) No access for people with active implanted cardiac devices
(b) No access for people with passive metallic implants
Present Situation
Where Are We Now?

Optical Radiation – Stewart Robertson, HSE, 2018

General advice

- Contingency plans – too little detail
- Safety dept documents advisory in nature rather than define reqts of law
- Risk assessments citing max outputs – not actual – no tie in with MPEs
- Procurement stage needs to be robust
Future work....

• Further proactive inspections of laser use at universities;
• Will provide further feedback on visits through AURPO and University LSO group
• Expect standards to improve
Thank you

For:

- Any questions related to EMF

Dr Richard Findlay

t: 07881 024124
e: richard.findlay@emfcomp.com