Introduction to new Physical Agents Directive for Electromagnetic Fields (EMF)

Presentation by Pete Dorey
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European Union EMF Directives

• **Workplace** - Physical Agents Directive (Electromagnetic Fields) 2013/35/EU

• **General Public** - EU Council Recommendation 1999/519/EC of 12 July 1999 on the limitation of exposure of the general public to electromagnetic fields (0Hz to 300GHz)

• **Products** - EU Directives include essential health and safety requirements for radiation control for electrical products leading to CE Marking
  – Low Voltage Directive 2006/95/EC
  – Machinery Directive 2006/42/EC
Physical Agents Directive (EMF) 2013/35/EU

- Applies to workers defined in 89/331/EEC as *any person employed by an employer, including trainees and apprentices but excluding domestic servants*
- Risk assessment required *proportional to the situation encountered* in accordance with defined Exposure Limit Values and Action Levels but technical detail to be given in *practical guides*
- Based on recommendations of the International Commission for Non-Ionizing Radiation Protection (ICNIRP)
- Does not cover suggested long term effects
- PAD(EMF) 2013/35/EU replaces the repealed PAD(EMF) Directive 2004/40/EC
Physical Agents Directive (EMF) Content

- Chapter I General Provisions
  - Scope, definitions, exposure limit values and action levels compliance
- Chapter II Obligations of Employers
  - Risk assessment process
- Chapter III Miscellaneous Provisions
  - Health surveillance, penalties, derogations
- Chapter IV Final Provisions
  - Practical guides, transposition date
- ANNEX I Physical quantities regarding the exposure to electromagnetic fields
  - Electric & magnetic field strength, magnetic flux density, power density, limb current, contact current, specific energy absorption & rate
- ANNEX II Non-thermal effects, Exposure limit values and action levels in the frequency range from 0Hz to 10MHz
  - Static and low frequency limits
- ANNEX III Thermal effects, Exposure limit values and action levels in the frequency range from 100kHz to 300GHz
  - High frequency limits
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EMF Direct Effects on the Human Body

Current density in body
\[ J \text{ mA/m}^2 \]

Internal Electric Field \( E_i \text{ V/m} \)

100kHz to 10MHz overlap

Electrostimulation

Specific Absorption Rate
\[ \text{W/kg} \]

>10GHz Power Flux Density \[ \text{W/m}^2 \]

Thermal

TÜV SÜD Product Service
Static Field Effects

**STATIC ELECTRIC FIELD**
- 20kV/m - perception of field on skin
- Electrostatic discharge (ESD) to grounded objects (painful but not dangerous)

**STATIC MAGNETIC FIELD**
- >2T during movement: vertigo, nausea, metallic taste, magnetic phosphenes in eye (annoyance)
- 5-8T effects on heart and nervous system
- >8T effects not fully established
- Metallic implants & projectiles in magnetic fields
- Indirect effects on medical devices & implants restriction typically 0.5mT
Coupling Below 100kHz

**E & H Effects Considered Separately**

Electric Field Inside Body $E_i \ll E$ Outside

Magnetic Field Inside Body same as Outside

Electric Field Lines $E$ V/m

Induced Current Density $J$ mA/m$^2$ and internal Electric Field $E_i$ V/m

Magnetic Field Lines $H$ A/m

$E_i$, $J$
Radio Frequency Hazards >100kHz

Exposure of Personnel - Heating

Ignition of flammable vapours and gases

Initiation of Electro-Explosive Devices (EED)

Interference with electronic systems – electromagnetic compatibility (EMC) – e.g. pacemakers
Thermal Effects Above 100kHz

Energy Absorption

100kHz – 10MHz
Neck & Limb Heating, Induced Currents (to 110MHz)

10MHz – 400MHz
Whole Body Heating

400MHz – 10GHz
Localised, Non-Uniform Heating, Aural effects

10GHz – 300GHz
Body Surface Heating

Basic restriction Specific Absorption Rate (SAR)

Basic Restriction Power Density

Tissue temperature 37-40° (increasing discomfort), > ~41° (tissue damage, heat stroke)
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Obligations for Employers

• Recommend Company Safety Policy addresses:
• Organisation – Safety Manager / Competent Services or Person
• Identify Sources of EMF and Workers at Particular Risk
• Risk Assessment Programme & Report
• Action Plan:
  – EMF Controls/PPE
  – Operational Procedures
• Information & Training
• Accident/Incident Procedure
• Health Surveillance, Medical Examination
• Consultation & Participation of Workers
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Risk Assessment

- Identify & assess EMF in workplace:
- Refer to Practical Guides, Standards, Guidelines, Databases, Manufacturers’ data
- Determine compliance by reference to above data or perform measurements and/or calculations
- Take account of:
  - EMF frequency, level, duration, type of exposure, distribution over body and over volume of workplace, uncertainties
  - Multiple sources and multiple frequencies of EMF
  - Direct & indirect effects (e.g. medical devices, projectiles, EED, flammable materials, shock/burn contact currents)
  - Effects on workers at particular risk (e.g. with body worn medical devices, pregnant)
- Compare results to Exposure Limits Values and Action Values
- Where exceeded - Write and implement an Action Plan
- Record assessment result
Exposure Limit Values and Action Levels

EXPOSURE LIMIT VALUES
Values to control thermal effects and electrical stimulation of tissue

SAR MEASUREMENT (>400MHz)
Typically for Product Compliance against Regulatory Requirements

ACTION LEVELS
Values to demonstrate compliance with ELV in the Workplace
EMF Measurement Equipment

- Hand Held RF Field Meter
- Spectrum Analyser
- Personal Monitor
- Area Monitor
- Contact / Limb Current Meter
Existing Standards

- EN 50499 Procedure for the assessment of the exposure of workers to electromagnetic fields
- EN 62110 AC Power Systems - 50Hz
- EN 50500 Railway - Magnetic field DC to 20kHz
- EN 50445 Welding – Magnetic inductive near-field up to 10MHz
  - EN 50444 Arc welding
  - EN 50505 Resistance welding
- EN 50519 Induction Heating - EMF fields up to 30MHz
- EN 50400 Fixed Equipment for Radio Transmission (110 MHz - 40 GHz)
  - Radio base stations including fixed terminal stations
  - Determination of domains and relevant sources, calculation specifications, measurement specifications, TER (total exposure ratio) assessment
Equipment Requiring Detailed Risk Assessment

- Electricity supply networks (G.P >100A, >125kV, Occ >500A, 200kV)
- Industrial electrolysis
- Electric welding & melting
- Electrically driven transport
- Dielectric welding
- Induction & dielectric heating
- Industrial magnetizer/demagnetizer
- Electric crack detector equipment
- Specialized RF energized lighting
- RF plasma devices (vacuum deposition & sputtering)
- Diathermy & Medical equipment with intentional radiation or current
- Industrial microwave heating & drying
- Communications antennas
- Radars
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### Action Plan – EMF Controls

#### Controls

- **Zoning; Barriers & Signs**
- **Antenna beam direction, radar sector blanking**
- **Lock off access (doors, roof access, towers)**
- **Select alternative equipment that emits less EMF**
- **Design and layout of workplace, e.g. move antenna location**

#### Occupational Only Controls

- **Alternative working methods to reduce exposure**
- **Use of interlocks, shielding on equipment**
- **Limit duration (transit area)**
- **Limit exposure level (reduce power or turn off)**
- **Personal Protection Equipment (Radiation meters, personal alarms, shielded clothing)**

![Warning signs](image)
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What Next?

• European Commission to issue Practical Guides by 1 January 2016
• UK Health & Safety Executive to issue UK Regulations implementing the PAD(EMF) 2013/35/EU by 1 July 2016
• In the interim, compliance with EMF exposure in the workplace is required now under the Management of the Health & Safety at Work Regulations therefore do not wait!
• Recommend that all new EMF risk assessments also ensure compliance with the new PAD(EMF) 2013/35/EU
• If workplaces are non-compliant to PAD(EMF) 2013/35/EU, an Action Plan will be required to bring them into compliance by 1 July 2016 as non-compliance after that date could lead to enforcement action
• The Action Plan may entail modifications to the workplace /equipment or new equipment that needs time to plan and costs to be allocated
• Avoid hitting the 1 July 2016 deadline unprepared!
Questions?

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