

Developing a strategy to evaluate and manage occupational exposures to RF-EMF

W. Gregory Lotz

Centers for Disease Control and Prevention,
National Institute for Occupational Safety and Health
Cincinnati, Ohio, U.S.A.

Disclaimer: "The findings and conclusions in this presentation have not been formally disseminated by the National Institute for Occupational Safety and Health and should not be construed to represent any agency determination or policy."



WORKPLACE SAFETY AND HEALTH



Background

- For RF exposures, formal risk assessment information is limited
- Occupational exposures may be high enough to present risk of established adverse effects
- Question of risk from long term, low-level exposures adds complexity
- Need for an overall plan to evaluate and manage workplace exposures to RF-EMF

Objectives

- It's more than measurement
- Outline a strategy for overall assessment of potential health risk of occupational RF exposure in a specific workplace
- Review components needed for a cost-effective program to prioritize and manage workplace risk from RF exposure

Introduction

- Occupational sources of interest for this presentation
 - ◆ RF welding, sealing, heating
 - ◆ Industrial microwave heating applications
 - ◆ Medical diathermy
 - ◆ Radar
 - ◆ RF broadcast antennas (radio, TV, communications)
- Potential for strong exposure with known effects (unique to occupational situations, and unlike environmental exposures)
- Need to communicate level of risk for workers from RF source related to strength of exposure

INTERPHONE data on occupational exposure to RF sources

- As part of INTERPHONE study, the CAPI gathers data on exposures to EMF besides mobile phone use
- These data are primarily intended to evaluate confounding exposures
- Data also represent a potential resource on prevalence and extent of occupational exposure to EMF sources

INTERPHONE Interview Data used for Occupational Exposure Assessment

- Occupational calendar
- Type of process
 - ◆ Screening questions for focusing interview
- EMF sources
 - ◆ Duration of exposure
 - ◆ Frequency of exposure
 - ◆ Automated process?
 - ◆ Proximity to source

Sources of Exposure Data for INTERPHONE use

- Detailed literature review
- Existing job-exposure matrices (JEMs) and source databases– more available for ELF
- Additional measurements of ELF sources
- Expert judgement
- More information needed - solicit contributions from EMF community

Example: Induction metal heater



Preliminary data.

Frequency	Means	Maximums
<u>ELF</u>	0.4–4150 μT	0.01-5160 μT
<u>VLF-LF:</u>		
-magnetic	0.06–0.29 μT	0.2–57 μT
-electric	30-96 V/m	300-2093 V/m
<u>MF-HF</u>		
-magnetic	0.1 – 7.1 μT	0.2 – 70 μT
-electric	0.15-14.9 V/m	3-3000 V/m

Average MF-HF Exposures from literature review

Primary metrics for this frequency band

Sources (from CAPI)	<i>E</i> -field (V/m)	H-field (A/m)	Induced current (mA)	Contact Current (mA)
Electrosurgical Devices	246.3	0.18	Leg 9.0, Arm 7.7	
AM Broadcast	209.4	5.05	Wrist 4.0, Ankle 4.0 (duty factor corrected)	30.3
HF Mobile Radios	77.7		53.6	
Induction Heaters	75.9	1.56	Leg 1.43, Arm 2.51	
Electronic Article Surveillance Equip.	44.4	4.85		0.07
Non-Directional Navigation Beacon	11			
Surgical diathermy	1.3	0.01	Leg 1.85, Arm 9.5	
Plasma Etchers & Plasma Assisted Chemical Vapor Deposition	0.05	10.5		1.37
RF Product ID & Personnel Access Control		2.9		

Develop a plan for each workplace

- prevention by design if possible
- evaluate exposure of workers in each job; not just measuring field strength
- Factor in work practices as a key role in exposure and potential health effects
- consider how to lower or minimize exposures
- plan modifications of operation when needed
- consider what to do in cases of overexposure or possible health complaints

Basic principles for the plan

- Build the strategy on basic occupational safety and health principles
 - ◆ prevent or contain hazard at their source (engineering controls)
 - ◆ control exposures by workplace practices and other administrative controls
 - ◆ control exposures with PPE when needed

Elements of the plan using this strategy

- define responsibilities, authorities and an administrative plan
- exposure assessment
- exposure controls
- medical surveillance
- training
- plan review

Define responsibilities

- management commitment and awareness
- who is responsible for assessment, review
- how will training be done
- what communication efforts will be undertaken
- if medical surveillance is needed, where will it be obtained
- develop a plan to decide at what level of exposure will control measures and training be instituted

Exposure assessment

- develop an inventory of RF sources
- identify sources by application, frequency, output power, worker locations and duty factors
- compare inventory to known information from references to estimate exposure risk
- conduct initial walk-through monitoring measurements focused on worker locations
- based on evidence gathered, conduct in-depth, comprehensive exposure measurements as needed

Exposure controls – when needed

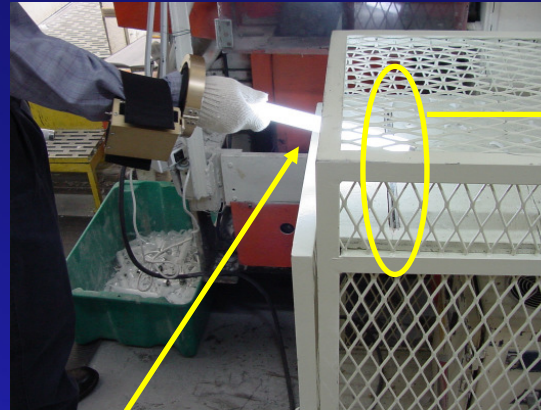
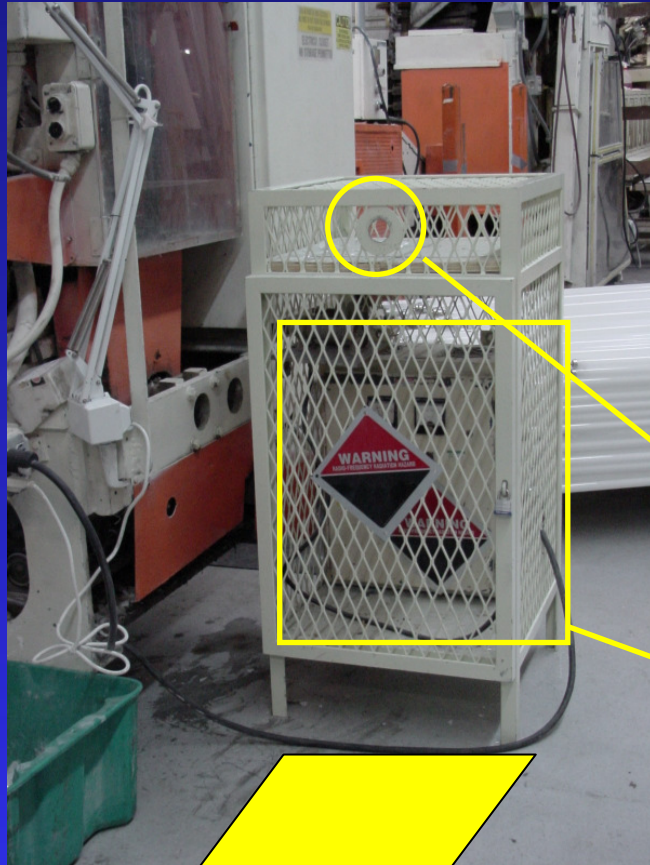
- engineering controls, e.g. shielding or redesign of equipment or work locations
- administrative controls that change work practices and worker locations to reduce exposure
- PPE if the source, work situation and available PPE are appropriate (last priority)
- At what exposure level will efforts be initiated to implement controls?

Lamp Testing Work Stations 27 MHz antenna



4 foot lamp tested by worker

Engineering Control



Antenna

Lamp entrance port

RF Transmitter

Working Station

Administrative controls and PPE – when engineering controls are not possible



©Viktor

Photo by Vincent Laforet / The New York Times

Medical surveillance

- initial medical history and physical examination
- identify any metallic or medical device implants
- consider periodic medical exams based on work situation and risk of exposure (little specific guidance exists for these decisions)
- in cases of potential or actual over-exposure, get the worker a medical examination
- except for skin RF burns, medical evidence is unlikely to be able to confirm or rule out over-exposure
- over-exposure incidents should be recorded

Training – risk communication

- Goals should be to help personnel to (a) recognize situations with potential for over-exposure to RF and (b) understand ways to avoid over-exposure
- RF safety awareness for workers with potential to be over-exposed and managers of such workers
- Consider setting up RF/EMF safety committee
- Management staff need additional training in RF-safety awareness and methods to estimate potential exposure, as well as risk communication

Plan review

- review annually
- revise when sources or work practices change
- evaluate how control methods could be improved to enhance both safety and productivity
- involve both workers and management
- evaluate assignments of responsibilities and authorities for the plan

Recap - Elements of the plan

- define responsibilities, authorities and an administrative plan
- exposure assessment
- exposure controls
- medical surveillance
- training
- plan review

Sources & Jobs without Published Data

Examples from interviews

- Auto electrician
- Laundry mangle
- Floor polisher/buffer
- Loom
- Milking machines on a dairy farm
- Amusement ride operator
- Rubber extruding machine
- RF milk pasteurization
- Metal etching machine
- Wire rope winding machine
- Military telecom antenna repair

Acknowledgements

Dr. Joseph Bowman

Dr. David Conover

Dr. Russell Savage, Jr.

