

The Electromagnetic Field Measurement Techniques

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OUTLINE FOR DAY 1 – INTRODUCTION

1. Brief overview on EMF sources
 - a. The most known EMF sources
 - b. EMF position in frequency spectrum
 - c. Non-ionizing radiation
 - d. EMF sources on interest (directed versus isotropic)
2. EMF measurements types
 - a. Health and safety compliance (focus of this course)
 - b. Electromagnetic compatibility
 - c. Equipment and product testing
 - d. Specific purpose
3. Instruments for EMF measurements
 - a. Broadband
 - b. Frequency selective
 - c. Isotropic
 - d. Directed
 - e. Example of available instruments
4. EMF measurement approaches
 - a. Short-term measurement
 - b. Long-term measurement (monitoring)
5. Human exposure to EMF (focus of this course)
 - a. Assessment of exposure by measurement
 - b. Assessment of exposure by calculation
 - c. Phantoms
6. EMF safety regulation
 - a. ICNIRP Guidelines
 - b. EN/IEC standards
 - c. IEEE standards
 - d. National legislative

OUTLINE FOR DAY 2 – THE HIGH-FREQUENCY EMF MEASUREMENT

1. Frequency range
2. The most known sources
3. EN Legislation
 - a. EN 50413 standard
 - b. EN 50492 standard
 - c. Some other standards
4. Quantities to measure
 - a. E or H (table 1 from EN 50413)
 - b. SAR
5. Instruments
6. In-situ measurement
 - a. Determination of domains (RD, SD and DI domains)
 - b. Determination of relevant sources
 - c. Multiple frequency fields and multiple sources

- d. Grid of measurement points
 - e. Spatial scanning
 - f. Measurement in one point
 - 7. ICNIRP reference levels
 - 8. Exposure evaluation by ICNIRP Guidelines
 - a. Comprehensive exposure assessment
 - b. Global exposure assessment
 - 9. Human exposure assessment in complex environment
 - a. Three point measurement
 - b. Five point measurement
 - 10. Assessment of the field strength at maximum traffic of a cellular network
 - a. GSM
 - b. WCDME
 - c. PMR Digital networks
 - d. Potential problem with maximum traffic
 - 11. Uncertainty
 - 12. Measurement report
- (EN 50492)

OUTLINE FOR DAY 3 – THE LOW-FREQUENCY EMF MEASUREMENT

- 1. Frequency range
- 2. The most known sources
- 3. EN Legislation
 - a. EN 62110
- 4. Instruments
- 5. Measurement principle for electric and magnetic fields
 - a. Harmonic content
 - b. Field orientation
 - c. Measurement locations
 - d. Perturbing effects of an operator in electric field measurement
- 6. Fundamental measurement procedures for electric and magnetic fields
 - a. Single-point measurement
 - b. Three-point measurement
 - c. Five-point measurement
- 7. Measurement procedures for finding the maximum exposure level to an electric field
 - a. Overhead lines
 - b. Underground cables
 - c. Substations and power system equipment
- 8. Measurement procedures for finding the maximum exposure level to a magnetic field
 - a. Overhead lines
 - b. Underground cables
 - c. Substations and power system equipment
- 9. Characteristics of electric fields generated by AC overhead lines
- 10. Characteristics of magnetic fields generated by AC power systems
- 11. Uncertainty
- 12. Measurement report

OUTLINE FOR DAY 4 – THE SEMONT SYSTEM FOR EMF MONITORING

- 1. Concept of the Serbian Electromagnetic Field Monitoring Network – SEMONT
- 2. Wireless EMF sensor

- a. Narda AMB 8057/3
- b. Wavecontrol MonitEM
3. Monitoring frequency bands
4. The SEMONT Internet portal
 - a. Communication with sensor nodes
 - b. Dissemination of the results
 - c. GIS feature
5. The SEMONT database
 - a. The monitoring campaign concept
 - b. Measurement results acquisition
6. The SEMONT measurement procedure
 - a. Spatial scanning over the grid
 - b. Hot-spot point
 - c. Monitoring in hot-spot
7. Legislation behind the SEMONT system
 - a. ITU.T K 83 standard
 - b. EN 50492 standard
8. The SEMONT exposure assessment approach
 - a. Boundary approach
 - b. Adaptive boundary approach
 - c. Database support for exposure assessment
9. Example of monitoring campaign
 - a. Monitoring in one point
 - b. Monitoring over the wide area
10. Open issues in the SEMONT system
 - a. Uncertainty
 - b. Uncertainty of the monitoring system
 - c. Precision of the exposure assessment

OUTLINE FOR DAY 5 – IEC/ISO 17025 REQUIREMENT

1. General requirements for the competence of testing and calibration laboratories
2. Management requirements
 - a. Organization
 - b. Document control
 - c. Subcontracting of tests and calibrations
 - d. Monitoring of corrective actions
 - e. Preventive action
3. Technical requirements
 - a. Personnel
 - b. Test and calibration methods and method validation
 - c. Validation of methods
 - d. Estimation of uncertainty of measurement
4. Assuring the quality of test and calibration results
5. Reporting the results
 - a. Test reports and calibration certificates
 - b. Calibration certificates
 - c. Opinions and interpretations