

ABSTRACT

This thesis presents a study of the relationship between field strength and the actual levels of SAR in the human body encountered in close proximity to high gain high power HF broadcast antennas. In order to assess the human exposure against ICNIRP guidelines, it has led to the development of a series of assessments of modelling techniques, mechanical configuration and environment of a transmission site. Due to the complex nature of this EM problem, each chapter of this thesis covers the key developments of particular sub-projects in different areas. The findings of each area correspond to the ICNIRP occupational and public exposure guidelines; they formed the reference parameters in the primary assessments which could apply to a range of similar EM scenarios. The chapters of this thesis do not necessarily follow a chronological order. Various potential influential aspects of assessing the human exposure levels were addressed during continuous problem solving processes, including several issues have not been covered in other research before.

There are three areas that have been covered in this thesis, firstly relating whole body SAR to incident plane-wave fields in correlation with ICNIRP basic restriction and reference levels. Second, near-zone incident fields characteristic were assessed by simulations and analyses the results, where some exposure assessment protocols for ICNIRP compliance was derived. Thirdly real-time field measurements were carried out to consolidate the findings from the theoretical modelling analysis.

Experimental results are shown to be in agreement with these predicted by theory and in general, the electromagnetic E-field strengths within the near-field of the antenna are found to be significantly below these recommended by ICNIRP.

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GLOSSARY

HF	3MHz-300MHz
MF	300kHz-3MHz
ERP	Effective Radiated Power
BBC World Service	British Broadcasting Company World Service
ICNIRP	International Commission on Non-Ionising Radiation Protection
SAR	Specific Absorption Rate
EMF	Electromagnetic Field
WHO	World Health Organisations
WBSAR	Whole-body Averaged SAR
UK HPA	United Kingdom Health Protection Agency
Norman	A Normalized Man
MoM	Method of Moments
FDTD	Finite Differential Time Domain
SPFD	Scalar Potential Finite Difference
EM	Electromagnetic
NEC4	Numerical Computational Code 4
MTHR	Mobile Telecommunications and Health Research
NCRP	National Council on Radiation Protection and Measurements
IEEE	Institute of Electrical and Electronics Engineers
MPE	Maximum Permissible Exposure

NUPB	United Kingdom National Radiation Protection Board
PWS	Plane Wave Spectrum
MRI	Magnetic Resonance Imaging
CT	Computed Tomography
CFL	Courant-Friedrichs-Levy
FIT	Finite Integration Technique
PBA	Perfect Boundary Approximation
TST	Thin Sheet Meshing Technique
PML	Perfectly Matched Layer
VF	Virtual Family
RF	Radio Frequency
PEC	Perfect Electric Conducting
AVG	Average Ground
PW	Plane Wave
HB	Huygen Box
HP	Homogeneous Phantom
IT'IS	Foundation for Research on Information Technologies in Society
ITU	International Telecommunication Union
EPM	Equivalence Principles Method
PDE	Partial Differential Equations
GPU	Graphics Processing Unit