General research activities related to EMF health

The research activity involves many university research groups, the National Research Council (CNR), and the Italian national agency for new technologies, energy and sustainable development (ENEA), and can be grouped in two main topics: the first one concerns mainly biological aspects and pertains the analysis of in vivo and in vitro effects of electromagnetic fields; the second one concerns engineering and biophysical aspects as interaction mechanisms, exposure, and dosimetry. Biological studies are addressed to investigate effects due to exposure to radiofrequency fields and to ELF fields. In this context, an important research topic is the study of possible effects of exposure to 900 MHz GSM RF fields on gene expression in human fibroblasts, and in particular the expression levels of the target genes, involved in cell stress response, neuronal differentiation and apoptosis processes. At the moment, a reduction in the expression levels of some genes has been evidenced, at different SAR levels and exposure times, failing to put in evidence a dose-response trend. Characterization of rat pheochromocytoma cells cultures is in progress, in terms of proliferation, response to apoptosis inductors, gene expression test; these parameters will be also utilized to investigate cells exposed to Wi-Fi frequencies.

Other studies are carried out to ascertain the cytotoxic and genotoxic potential of the recently developed Universal Mobile Telecommunication System (UMTS) standard, whose frequency band and modulation differ completely from those adopted by previous systems. In addition, attention has been also devoted to the possibility that combined exposures with RF radiation and chemical or physical agents could modify (by enhancing or inhibiting) the effect of such agents. The effects of UMTS signals on mammalian cells are under investigation by evaluating different cancer-related biological endpoints. Cell cultures were exposed or co-exposed to chemical (ferrous iron, Fe2+) or physical (X ray, α particles) agents and the effects were evaluated in terms of DNA damage, oxidative stress and cell viability.

The Adaptive Response (AR), considered as one of the defense mechanisms developed by cells and organisms to minimize DNA damage, is under investigation: in particular some studies have demonstrated that RF radiation induces adaptive response in human lymphocytes when cells are subsequently challenged with Mitomycin-C. Moreover, the RF-induced AR is induced when cells are RF exposed in S-phase but not in G1-phase of the cell cycle.

In the ELF range (2 mT, 50 Hz), recent studies showed that the processes of proliferation and migration of umbilical human vascular endothelial cells (HUVECs) exposed to ELF-EMF compared with control groups resulted significantly inhibited. Moreover, in endothelial cells a reduction of ability to make tubule like structures in vitro has been observed. In particular, the ability of ELF-EMF to produce a high reduction of the number of branch points respect to the control cells is under investigation.

As far as engineering aspects are concerned, dosimetric studies are carried out to show that current exposure limits and practically encountered exposure situations warrant human safety. However, some open points remain and are the subject of current investigations. Large efforts are being devoted to study the problems of child exposure and of exposure in non-uniform conditions. Furthermore, the development of new multi-
media wireless terminals is changing the scenario of personal exposure, pushing towards the evaluation of new exposure conditions where the user terminal is not held against the ear but placed in contact with different regions of the human body.

The National Institute for Environmental Research and Protection (ISPRA) has funded a project in the framework of the electromagnetic field monitoring due to base stations for mobile telecommunications and broadcasting systems. The main results of the study are 1) the proposal of a memorandum of understanding among all stakeholders (services providers, local administrations, local agencies for environmental protection, and citizens committees), for an agreed location of the antennas; 2) the proposal of an Environmental Electromagnetic Impact Factor: it is a number that, on a 1-100 scale, represents the impact of a radiating system in the surrounding environment on the base of the calculated or measured electromagnetic field values and distribution.

A new scenario under study is represented by the interaction between UHF fields from RFID and biological systems. Although some recent results showed that the computed average SAR is significantly under the limits, the electric fields are considerable, thus imposing a careful optimum positioning of the RFID sources in indoor environment. A further work is the application of a computational procedure based on theoretical quantum mechanics in order to represent interaction mechanisms of exogenous electromagnetic fields at molecular and protein level. The specific molecular system is a subgroup of hemoglobin. Attention is focused on the reaction trajectory of a specific molecule binding the metallic atom located at the center of the system, in order to give an insight on the dynamics of the binding reaction.

The evaluation of safety aspects is also the main concern of numerical estimation of coupling of environmental and occupational EMF with active and passive devices in the human body such as cochlear implants and neural stimulators. SAR distributions and temperature increments in pacemaker holders exposed inside an MRI apparatus, represent another research topic: the model consists of two anatomically based human body phantoms together with pacemaker models equipped with different kinds of catheters. An accurate thermal model is also considered in order to investigate the thermal parameter influence.

The National Institute for Occupational Safety and Prevention (ISPESL) has started a research program, in cooperation with CNR-IFAC and ENEA, addressed to assessment of occupational exposure during Magnetic Resonance Imaging clinical procedures. MRI uses EMF in three frequency ranges: the static field (0.5–3.0 T currently in Italy), the gradient fields (1–5 kHz) and radiofrequency fields (21–128 MHz). Measurement and calculation of dosimetric quantities procedures are being developed, including movement in the static field. A more general project on occupational safety for the use of EMF in health facilities has been recently funded by Ministry of Health, in the frame of a wider program on occupational safety inside health facilities, and it will be carried out by National Institute of Health (ISS), ISPESL, CNR-IFAC and ENEA.

**New policies and legislations regarding EMF exposure**

The Directive 2004/40/EC has been transposed inside the national framework law on safety at work: Legislative Decree n.81 of 2008, published on April the 30th 2008 and amended on August 2009. The provisions on the protection from all physical agents, including EMF, are placed in Section VIII. A specific
subsection is dedicated to EMF, but it will come into force in April 2012, according to the current deadline for transposition of Directive 2004/40/EC. At the moment only general provisions for risk assessment of physical agents fully apply, and no binding exposure limit values for EMF are in force. This implies however that employers have the obligation to carry out an EMF risk assessment, and adopt the proper protection measures when necessary.

Following the publication of the Legislative Decree, a non-binding guidance to EMF risk assessment and management (in the style of FAQs), has been issued by the coordination body of regional OSH authorities and ISPESL (the National Institute for Occupational Safety and Prevention), where it is recommended to try to apply at the maximum extent the limits of exposure from current ICNIRP guidelines and EMF Directive. The guidance adopts some basic concepts from CENELEC EN 50499 standard, and introduces two lists of equipment. The first one includes equipment for which the exposure levels are automatically compliant with the European Council Recommendation 1999/519/EC or the Directive 2004/40/EC; in this case the risk assessment procedure can be based on analysis of documentation and data sheet of the equipment present at the workplace. The second list includes equipment for which it is necessary to use a more accurate procedure to assess the exposure levels, with measurements and/or calculations.

**Areas of public concern and national responses**

The major concern of the public is on the question of base stations for mobile phones and installation of Wi-Fi network. Several citizen committees of “hypersensitive” subjects are also active, and their concern is mostly addressed to Wi-Fi new technologies. The national response is mostly based on a communication strategy, see the paragraph below.

**Public information activities**

A three-year communication project “Health and Electromagnetic Fields”, promoted by the Ministry of Health and carried out by the National Institute of Health (ISS) was completed at the end of 2009. A major objective was to make the most relevant International reports and information leaflets available to the general public, through Italian translations. Over 40 documents, including 20 issued from WHO, were translated (entirely or limited to relevant sections if too large) and posted on the website of the project (www.iss.it/elet). Within the same project, information meetings were organized in different areas of the Country, addressed to personnel of local health agencies or industrial hygienists and safety managers (for public and workers’ protection, respectively).

The Consortium Elettra 2000 also maintains a website for public information. It also regularly issues two series of Newsletters, one for general information of EMF and health, and the other focused on workers’ protection. Training courses on protection measures at workplaces are organized by ISPESL.