

Annex I: Project Progress Summary
Project Progress Summary

		NOT CONFIDENTIAL
Title of the project Combined effects of electromagnetic fields with environmental carcinogens		
Acronym of the project CEMFEC		
Type of contract RS		Total project cost €1 .438.448 €
Contract number: QLK4-CT-1999-01129	Duration 50 months	EU contribution €979.640
Commencement date 1 February, 2000		Period covered by the progress report 1 February 2000 – 31 March 2004
<u>PROJECT COORDINATOR</u>		
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List of participants Contractors: University of Kuopio (UKUO), Fraunhofer Gesellschaft zur Foerderung der angewandten Forschung e.V. (FHG), Vlaamse Instelling voor Technologisch Onderzoek (VITO), University of Genoa (UGOA) Assistant contractor to UKUO: STUK-Radiation and Nuclear Safety Authority (STUK)		

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Section 2: Project Progress Report

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Objectives: Human exposure to radio frequency (RF) electromagnetic fields (EMF) is rapidly increasing due to widespread use of mobile telephones. The study addressed concerns expressed about health hazards of weak EMFs. The RF fields were tested as possible co-carcinogens using both *in vivo* and *in vitro* approaches. The specific objectives were:

To study possible combined effects of RF exposure with known mutagenic/carcinogenic agents,

To investigate whether RF electromagnetic fields similar to those emitted by mobile phones enhance tumour development in a carefully selected animal model,

To study RF exposure as a possible enhancer of chemically induced DNA damage *in vivo*.

To use *in vitro* methods for investigating the effects of RF fields alone or in combination with environmental chemicals on selected cellular processes related to co-carcinogenesis or non-genotoxic carcinogenesis.

Results and Milestones:

(1) Development of an exposure system for exposing cells to radiofrequency radiation

An exposure system with the basic structure of a rectangular waveguide was developed for exposing cells to radiofrequency electromagnetic fields. The RF dosimetry was verified both by thermal measurement and numerical calculations.

(2) Validation of an exposure system for exposing freely moving rats to radiofrequency radiation

The exposure system - based on a radial transmission line (RTL), a waveguide formed by two parallel aluminium plates - was designed in a national research program, but it was constructed, tested and validated by thermal measurements and analytical calculations in this project. The RF dosimetry was further verified by modelling (FDTD calculations) granted by national funds.

(3) Assessment of cocarcinogenicity of RF fields in vivo

Cocarcinogenic effects of low-level GSM-type radiofrequency (900 MHz) radiation were evaluated in a 2-year animal study conducted in compliance with the OECD Principles of Good Laboratory Practice (GLP). The known carcinogen used to induce cancer was the drinking water mutagen (3-chloro-4-(dichloromethyl)-5-hydroxy-2(5H)-furanone, MX). Animals (female Wistar rats, 72 rats/group) were exposed to RF fields at two exposure levels (Specific Absorption Rates of 0.3 W/kg and 0.9 W/kg) for 2 h per day on 5 days per week. At the end of the 2-year study, tissue samples were collected for histopathology. Tissue samples were also frozen for the possible later use (for studies on mechanisms). The results of this study confirmed the carcinogenic effect of MX, but exposure to RF radiation was not found to affect cancer development.

(4) Assessment of co-genotoxicity of RF fields in vivo

After 3, 6 months and 2 years of exposure, blood samples were collected (20 animals/group) for genotoxicological assays. Brain and liver tissue samples were taken for the same purpose at the end of the study. The comet assay was used to detect DNA damage and the micronucleus test to detect chromosomal aberrations (structural chromosome damage) and genome mutations (aneuploidy induction). The results did not show any enhancement of genotoxic effects in the RF field exposed groups.

(5) Assessment of RF field effects on cellular responses relevant to non-genotoxic carcinogenesis

Two mammalian cell lines were used to test whether RF electromagnetic fields affect key cellular events that have been proposed as mechanisms for non-genotoxic carcinogenesis or cocarcinogenesis. The following endpoints were evaluated: Oxidative stress, Cell proliferation, Cell cycle analysis, Apoptosis, Mitochondrial membrane potential modifications and Gene expression (proto-oncogens: c-fos, c-jun and c-myc). The cells were exposed both to RF alone and in combination with environmental pollutants (MX and a herbicide vinclozolin). The dose-rates were similar to those of the animal study (0.3 W/kg and 1.0 W/kg). The exposure times were selected based on the end-point evaluated. The results did not show enhancement of the effects of the chemicals or any effects characteristic to non-genotoxic carcinogenesis.

6. Conclusions

Based on the results of the animal study, cocarcinogenic effects of RF fields are not likely in this experimental model and at the exposure levels chosen. This conclusion is supported by the fact that no enhancement of genotoxic effects were found *in vivo*, and by the cell culture studies showing lack of effects characteristic to non-genotoxic carcinogenesis.

7. Dissemination

The main channel of publication of the project results will be peer-reviewed scientific journals and reporting in scientific meetings.

Benefits and Beneficiaries:

Given the increasing use of mobile phones, improved understanding of the possible health risks of electromagnetic fields is important for decision-makers and all citizens. The results of this project will be utilizable for the health risk assessments of radiofrequency electromagnetic fields planned by international bodies such as the International Agency for Research on Cancer (IARC) and the World Health Organisation (WHO). These evaluations will form the scientific basis for decisions concerning possible revisions of RF exposure limits or other measures to reduce harmful effects.

The results of the project are also useful in risk communication. Because of the widespread exposure to electromagnetic fields from mobile communication systems, many citizens are concerned of possible adverse health effects resulting from such exposure. Results - such as those of this project - that reduce the uncertainties concerning health effects are essential for successful communication with concerned citizens.

Also the mobile telecommunications industry, including several European manufacturers and network operators, benefits from the results. Scientifically valid data on health risks (or lack of such risks) is important for the industry for the planning of their future activities and products

Future Actions (if applicable):