INTERNATIONAL EMF PROJECT
20th International Advisory Committee

World Health Organization
Avenue Appia, Geneva, Switzerland
Monday 4 – Tuesday 5 May 2015

Rapporteur – Martin Gledhill, representative of the Ministry of Health of New Zealand

Monday 4 May

Opening of the meeting

Maria Neira welcomed the participants and opened the meeting in Salle C of the World Health Organization's headquarters in Geneva.

Election of Chair and Vice-Chair

Tim Karabetsos (Greek Atomic Energy Commission - Greece) and Chiyoji Okhubo (Japan EMF Information Center - Japan) were elected Chair and Vice chair respectively. Tim Karabetsos took the Chair and delegates introduced themselves. Representatives who could not attend joined the meeting via video conferencing WebEx.

The proposed agenda was adopted. The draft minutes of the 2014 IAC meeting were adopted with editorial corrections noted by Simon Mann.

Update on the International EMF Project

Emilie van Deventer welcomed participants and provided an overview of WHO's roles and functions, and how the EMF Project fits into these. The function of the IAC is to provide a forum for a coordinated response on issues affecting the Project, to review Project outputs and provide feedback on its direction. The project is open to any WHO Member State government department or representatives of national institutions concerned with radiation protection. Over 60 countries are now involved in the EMF Project, and contacts have been made with 13 new countries over the past year. In addition the Project works with several UN agencies and relevant NGOs. There are also three collaborating centres, with designations of a further two under discussion.

WHO provides the Project Secretariat which facilitates and implements the programme agreed by the IAC. This includes the compilation of fact sheets, brochures and monographs, and ensuring compliance with WHO policies. The Project is entirely funded by voluntary contributions from Member States. Six countries have made financial contributions in the past year, and several national institutions have provided in-kind contributions. Additional funding and in-kind contributions are needed to continue the Project. IAC members are encouraged to provide financial or in-kind contributions to the EMF Project as these would help speed up the finalization of ongoing activities, by for example allowing the engagement of a professional editor.

The development of a first draft of the monograph on radiofrequency fields (RF Health Risk

Assessment) is continuing, with monthly conference calls and a meeting in Geneva in January 2015. An expert consultation on the draft chapters was held in late 2014. A steering group has been set up to review whether new research agendas for ELF and static fields are needed.

The first stage of the updated EMF Standards database is now available on the Global Health Observatory (GHO). A steering group to look further at the development of NIR Protection Standards met recently and will be discussed in detail later in this IAC meeting. The EMF Project website is being revamped in collaboration with the BfS. Three fact sheets have been reviewed, and will be forwarded to the IAC for their consideration when ready. An EMF list server is now running.

EMF Project staff have participated in a number of meetings around the world, and WHO were joint convenors, with ICNIRP, of a workshop on thresholds of thermal damage.

There was a question about the expansion to cover optical radiation. The intention is to work in a similar fashion to the EMF Project, and include, for example, work with collaborating centres. Some participants mentioned that they are attempting to start a European COST action on optical radiation.

Update on WHO activities

RF EHC monograph (*Eric van Rongen, Health Council of the Netherlands, the Netherlands*)
Preparation of the RF EHC monograph has taken longer than anticipated, due to the large volume of relevant research papers identified (1500 papers now in the database). A milestone was passed with the public consultation on technical chapter drafts in late 2014. 686 comments were received during the consultation. These have been listed and will be systematically considered and the response documented. 300 additional papers were suggested, but not all may be relevant. Some would need to be translated.

The monograph core group met in January 2015 to discuss the most important comments. Outcomes from this include:

- There will be a new chapter on biochemical and biophysical mechanisms.
- It is now proposed to have two Task Group meetings: one around September 2015 to determine inclusion and exclusion criteria, and a second in early 2016 to draw conclusions from the scientific evidence.
- "Grey zone" papers will now be listed as excluded, along with other excluded studies, and reasons given for their exclusion.
- Meta-analyses will not be included in the monograph – they may not have used the same quality criteria, and their conclusions may be based on studies excluded from the monograph.

A second draft is now in preparation for consideration by the Task Group. Publication of the monograph is not expected before late 2016. The cut-off date for papers to be considered was originally December 2013 but updating will continue until the Task Group meeting.

IAC participants commented that the monograph should be usable, and if it is too technical that may make it hard to read. Eric said this comment would be taken into consideration. The

European Commission representative noted parallels in the experience with the recent SCENIHR review, and stressed the need for transparency. The proposed listing of excluded papers and the reasons for this will help ensure such a situation.

EMF policy database (*S. Kandel, Israeli Society for Radiation Protection*)
The first set of data, showing status of EMF legislation for 31 countries, is now on the WHO Global Health Observatory(http://www.who.int/gho/phe/emf/en/). Data on numerical limits is now being prepared, and countries have been asked for confirmation of these, along with additional information on policy tools for devices and installations.

The intention is to update information every year. Volunteers were requested to help design a country profile template.

Local Authority handbook (*M. Gledhill, Ministry of Health of New Zealand*)
The handbook was further redrafted following a meeting with Emilie van Deventer and Rick Tinker in late 2014. Several countries have offered to field test the draft. All the original appendices have now been removed and the IAC was asked for suggestions on what to do with that material. The appendices will be placed in the IAC Dropbox for participants to review and provide feedback.

Fact sheets (*E. van Deventer, WHO*)
WHO rules for Fact Sheets include that they must start with a summary of key facts, be brief, and strictly factual (ie not include recommendations). Three EMF Fact Sheets are being reviewed, on base stations, ELF fields, and mobile phones. The base station Fact Sheet needs to be updated to include WiFi and the IARC conclusions, and will be sent to the IAC for review soon. The mobile phone Fact Sheet needs a more comprehensive update. IARC felt that some of the wording was not clear.

In response to a question, Emilie said that she would see whether fact Sheets could be published as a pdf.

EMF Project website (*E. van Deventer, WHO*)
The website is being revised to make it more compatible with the ionising and UV radiation websites. This will lead to much material being culled. WHO needs feedback on what IAC members need on the website to meet their needs. Participants commented that WHO is often more trusted than national governments.

Review of recent research on EMF

Laboratory studies (*B. Veyret, University of Bordeaux, France*)
Bernard Veyret commented that overall there have been no breakthroughs and not much had changed since his 2014 review, and referred participants to the recent SCENIHR report.

ELF: In the ELF region, cell experiments had investigated a large variety of endpoints, but very few studies were looking at effects related to leukemia. Experiments on a mouse model of Alzheimer's disease and ALS showed no effects of ELF fields. The Legros group in France has carried out further work to characterise the magnetophosphene response.

RF: At radiofrequencies, many low quality papers are being published. Most experiments on cell cultures have been negative. Experiments on animals have had a wide range of exposure conditions and biological models. Experiments on navigation and using short pulses appear to be progressing. The Lerchl data appearing to support a cancer promotion effect is weakened by the lack of a dose-response. In human subjects, the effects on EEG are still the most robust, and work by Kuster discounts any effect of electrode artefacts.

Epidemiology and IARC update (*J. Schüz, IARC, France*)
ELF: Recent epidemiology studies provide mixed results. Bunch et al found an association between power lines and childhood leukemia for cases before 1990 but not afterwards, suggesting the possibility of confounders. Pedersen et al saw no clear interaction between EMF and exposure to radon or air pollution and no evidence of confounding, but numbers in the study were small. The ARIMMORA project has started studies using a transgenic mouse which mimics the most common form of childhood leukemia, and studied other possible mechanisms.

RF: Hardell has questioned the completeness of the Swedish cancer registry and the effect that this might have on brain tumour incidence studies. In fact the main value of incidence studies is to provide a consistency check of risks observed in other studies, and under-reporting does not affect the conclusion that actual brain tumour rates contradict the moderate-to-strongly elevated risks reported in some studies. Prolonged follow-up of the UK million women cohort does not confirm an elevated neuroma increase in cellphone users.

The INTEROCC study, a collaboration between seven countries (Australia, Canada, France, Germany, Israel, New Zealand and the UK), found no association between cumulative EMF exposure and glioma or meningioma. There was an association with cumulative exposure in the 1-4 years before diagnosis (but not earlier time windows), which would suggest the possibility of a promotion effect. There is no known mechanism for this.

Projects in progress include the Mobi-Kids study, which should soon complete data collection and aims to publish results in 2016. A lot of effort has gone into characterisation of exposure. The GERoNiMO project is attempting to better characterise EMF exposures, and understand possible mechanisms for effects. A number of end points are being considered. The COSMOS mobile phone cohort study is progressing and well into its proposed 25 year time span.

Update on research in different countries

SCENIHR (*Theo Samaras, Aristotle University, Greece*)
SCENIHR has a standing mandate on EMF issues, and its most recent review (published earlier in 2015) updates the 2009 opinion. SCENIHR uses a weight-of-evidence approach in assessment, taking account all lines of evidence, and looking at the quality of evidence for each line. It focusses on research published since the previous Opinion, but in areas not covered by previous Opinions includes earlier research findings.

Theo Samaras provided an overview of the Opinion, which is available on the SCENIHR website. The Opinion includes recommendations for future research, and provides guidance on experimental design to improve the quality of data.

The IAC suggested that the RF monograph should also consider making recommendations on how to improve research methods. Eric van Rongen responded that this is already under consideration, and may form the basis of some papers.

Research projects on EMF and Health in Europe (*Paolo Ravazzani*)
Paolo Ravazzani provided an overview of research projects on EMF and Health in Europe (LEX NET, GERoNiMO, Mobi-Kids, ARIMMORA, COST Action BM1309 on EMF in medicine, EMSafety, Hemis and EMFWELD). Overall, there has been a large reduction in EMF research at the national level, and more of a focus on European projects.

The new Indian RF research programme (*R Sharma, Indian Council of Medical Research*)
Dr Sharma provided a very comprehensive overview of the EMF research being undertaken in India. This includes work on honey bees, reproduction, audiology and DNA. An Inter-Ministerial committee on EMF has recommended using an SAR limit of 1.6 W/kg for mobile phones, and 1/10 of the ICNIRP limits in the environment. There are many operators in India and large base station sites, and a general unease amongst the public.

In response to a question, Dr Sharma commented that transmitter powers used at base stations in India were frequently higher than elsewhere.

Review of national EMF risk management around the world

The new French law on siting RF installations ("loi Abeille") (*Olivier Merckel, ANSES*)
Olivier Merckel presented the background to the "loi Abeille", which is intended to respond to concerns about EMF exposure by balancing economic, environmental and social issues. The law does not impose new exposure limits, but makes a requirement for "sobriety" (the definition of which will be the subject of a subsequent decree, but appears to resemble "moderation"). Measures include consultation before installing antennas, provision of information to ensure user awareness of RF devices, and measures to reduce exposures from devices. A number of questions arose from the presentation:

Question	**Answer**
The law talks about the need to lower "atypical exposure". What counts as atypical?	The intention is to see what exposures exist already (for example, in a study on exposures in 16 communities) and use them as a guide. For example, 2-3 V/m appears acceptable, but 6 V/m is atypical. There is a desire to make a distinction between health-based exposure limits, and exposure values which are not related to health.
There is a requirement to provide information to communities – does this mean that a community can negotiate the location of base stations?	It is difficult to say at the moment, the intention is to facilitate the siting of base stations.
In 2003 Sweden tried to make hands-free kits compulsory, but learned that this conflicted with European Law as it could make it more difficult to sell	(From Mirjana Moser): France had to notify Brussels of the law and there was no opposition, so it is not considered to be a trade barrier.

Question	Answer
phones in Sweden compared with other countries. Will this not occur in France?	

Update on regulations and procedures in Brussels (*Charlotte de Grave, Bruxelles Environnement*)

In Brussels a permit is needed to operate an antenna. There are about 1500 antenna sites, with 9,700 antennas between them, and three main operators. The ordinance restricts exposures in public places to 6 V/m (an increase from the previous 3 V/m). This applies to all operators and antennas combined, but does not include private equipment or broadcast antennas. An expert committee will be constituted soon to assess evolution of technologies, research, etc.

An environmental permit is required if the EIRP >2 W. Each operator has the right to 33% of limit (with a dispensation if there is only one operator). Exposure assessments are handled by a software package, with measurements as ground check, or in case of complaints.

Questions arising from the presentation included:

Question	Answer
The law excludes balconies and terraces from the exposure evaluation, why is this?	They used to be included, but are now excluded to enable the implementation of 4G.
How long does it take to get a permit?	Maximum of 30 days.
How accurate is the software?	There is good agreement to the nearest V/m. It is recognised that the calculations are not exact (eg due to the effects of reflections), but this is the best way to do it.

Siting wireless base stations

There was a general discussion on siting wireless base stations, especially in and around residential areas. A key point brought up was that the emphasis should be on exposures, not the locations. Israel noted that they had produced a short movie explaining how more antennas gave rise to lower exposures.

Tuesday 5 May

Biomedical and medical applications

Innovative uses of EMFs in biomedical applications (*Mirjana Moser*)

The European COST (Cooperation in Science and Technology) Action BM-1309 is intended to build an interdisciplinary European network for innovative uses of electromagnetic fields (EMFs) in biomedical applications. The main objectives are to better understand biophysical

interactions, develop EMF-based devices and procedures, and make new discoveries in biomedical technologies. The Action runs until 2018. There are working groups on cancer-EMF interactions, non-cancer-EMF interactions and dosimetry.

The presentation covered some examples of work in these areas, including the use of low level EMF at very precise frequencies to treat cancer, EMF for hyperthermia as a sensitizer for radio- and chemo-therapies, and trans-cranial DC stimulation.

In response to a question about how the Action would cope with publication bias for cancer treatments, Miriana Moser said that the Action will not be making any kinds of review or assessments, but forming a network of researchers to bring people together to discuss strengths and weaknesses. A key objective is interdisciplinary interactions.

MRI in pregnant women & possible adverse health effects in the fetus (*Siegal Sadetzki)*
The high levels of EMFs at a range of different frequencies used in MRI gives rise to concerns about potential health effects. While MRI is generally considered to be a safe technology, the research database is not extensive, especially with regard to long term effects and the combinations of static, ELF and RF fields used.

Siegal Sadetzki presented an overview of the research and concluded that while it does not provide any clear evidence of adverse effects, the absence of evidence should not be taken as demonstrating evidence of absence. MRI should still be used cautiously, balancing the potential for risks and the diagnostic benefits. The use of volunteers in MRI studies should also be considered carefully. A recent Canadian study, for example, found that 30% of studies approved by ethics committees did not mention possible risks of MRI on the consent form, and overall suggested that both researchers and the ethics committees either did not know how to cope with unknown risks or did not take them into consideration. Therefore MRI should still be used with caution, until more definitive evidence of safety (or otherwise) is available.

The presentation generated a wide range of comments from participants, including:

- MRI risks to volunteers are never discussed, only occupational studies are carried out. Usually only risks from static fields are considered. There have been similar discussions with ultrasound.
- In Italy, fetal MRI is only undertaken if really necessary.
- In the UK, the HPA provided advice on protection of patients. There was interest in setting up a cohort study, but so far only a feasibility study has been carried out.
- There will be a side event on "Imaging for Saving Kids - the Inside Story about Patient Safety in Paediatric Radiology" at the forthcoming World Health Assembly. The discussion is very relevant to the possible revision of research agendas.

In response to a question on whether the scope of the EMF project covers medical imaging, Emilie van Deventer responded that it is concerned with all aspects of human health, and that radiation protection generally includes public, patient and occupational exposures.

Occupational management

Update on the European EMF Directive (*Zinta Podniece*)

Zinta Podniece provided an update on implementation of the European EMF Directive on EMFs, and the development of the Implementation Guide (IG). The shape of the IG is driven by the recognition that the majority of employers will have nothing new to do, that is important to avoid an unnecessary burden on businesses, especially SMEs, and that most employers which generate strong EMFs in the workplace are aware of this and already have measures in place. The IG is broken into four sections, within which main chapters are kept short and simple and detail is placed in appendices. There is also an appendix for MRI (for which a derogation is granted).

Transposition of the EMF Directive into national law (*Paolo Rossi*)
Paolo Rossi discussed the practicalities of transposing the requirements of the Directive into national law, to ensure that legal requirements are clear. For example, the Directive uses the term "where justified by practice or process", but the national law must be more specific about who can provide the justification, and how they should do so. Circumstances under which derogations are permitted also need to be specified. The use of exposure databases will be promoted, and there is potential for the expansion of existing databases such as www.portaleagentifisici.it.

Report on EMF activities from collaborating centres and international organizations

Reports from collaborating centres

Australian Radiation Protection and Nuclear Safety Agency (ARPANSA), Australia (*R Tinker)*
Update of the RPS3 RF Standard is awaiting revised ICNIRP Guidelines. The ELF Standard has been harmonised with ICNIRP 2010, and the RIS is now being considered.

Work has started on fundamentals of protection against NIR, to provide a unified approach. Guidance for the cosmetic use of lasers and IPL will be available soon. ARPANSA is participating in various sun protection Standards. A project on WiFi in schools is starting soon.

ARPANSA operates several communication forums, such as the EMERG group for stakeholder input, and an industry forum. The website has been updated, and a talk-to-a-scientist programme started. Most enquiries concern smart meters, power lines and WiFi. Key issues include confusion amongst the public about developments in other countries, and the social amplification of online views. There has been a large increase in the number of EHS entries in the EMR Health register.

Federal Office for Radiation Protection (BfS), Germany (*Dirk Geschwentner*)
Power lines are currently the main public concern, due to the need to expand the grid following a move away from nuclear power. BfS provides information to stakeholders, and has set up special webpages. There is a requirement for exposure minimisation.

A replication study by Lerchl on tumour promotion by RF fields found effects in the lungs, liver and lymphoma, but not in the brain, kidney or spleen. The results are not directly transferable to human exposures, but the underlying mechanisms have to be investigated.

BfS monitors UV in several locations and provides forecasts. In November 2014 BfS joined with other scientific bodies to publish advice on UV and Vitamin D. The main message is that

exposure of face, hands and arms to 0.5 MED, 2-3 times per week, ensures adequate Vitamin D synthesis. The UV index should be used to decide on protective measures, and Vitamin D deficiency should be treated by physician.

Federal Office of Public Health (FOPH), Switzerland (*D. Storch)*
Fact sheets on the FOPH website have been updated in 2014, and this work is continuing. The fact sheet on induction hobs has had one million hits. The FOPH is working on a draft law to protect the public from NIR and noise which should permit the control of sunbeds and laser pointers.

Public Health England (PHE), United Kingdom (*S. Mann*)
The Centre for Radiation, Chemical and Environment Hazards (CRCE) is still finding its feet in Public Health England (PHE). Most of the old HPA website material is now on a search (rather than structure) driven unified government website, or in a UK government website archive.

The CRCE is leading the exposure assessment for Mobi-kids, and involved in the GERoNiMO project. A national rollout of smart meters has just begun, and CRCE is acquiring samples of the equipment to make some exposure measurements (following an investigation model similar to that used previously for WiFi). Other projects include an exposure assessment in schools as part of the UK SCAMP work, development of the European EMF directive Implementation Guide, and work with ANSES on exposure to children from LTE.

Reports from NGOs and professional bodies

International Commission on Non-Ionizing Radiation Protection (ICNIRP) *(Rüdiger Matthes)*
ICNIRP's high priority projects include involvement with the WHO RF health risk assessment, and consequent revision of the RF exposure Guidelines, and discussion with ICRP, WHO and IRPA on general aspects of radiation protection, in order to harmonise principles. Protection in medicine and the cosmetic/"wellness" industry, health risk assessments for ultrasound and optical radiation, and determining knowledge gaps are given lower priority.

International Commission on Occupational Health (ICOH) (*Fabrizio Gobba*)
The International Commission on Occupational Health (ICOH) has 1,800 members, mostly physicians. It has 33 scientific committees, including one on radiation. In 2014 ICOH held a workshop on the implementation of the EMF Directive, and MRI and optical radiation will be discussed at the next World Congress.

International Electrotechnical Commission (IEC) TC 106 (*J. Keshvari*)
Jaraf Keshvari provided an overview of the IEC in developing exposure assessment Standards. Current work includes maintenance of Standards for mobile phone assessments (IEC 62209 series), LF assessment Standards, maintenance of the base station assessment Standard (IEC 6232) and work on vector probes for assessments. Numerical assessments (calculations) are important in situations where measurements are not possible, as in some medical applications and large scale devices such as aircraft.

There has been a formal objection to the use of current Standards for assessing mobile phone exposures, on the grounds that they are not conservative for assessing exposures to children. However, it has been demonstrated the objection has no good basis, as the Standards are, in

fact, conservative for all age groups.

International Committee on Electromagnetic Safety (ICES) (*Ralf Bodemann*)
IEEE/ICES has established a new SC-6 "Dosimetry Modelling with Application to Safety Standards for Human Exposure" to help fill gaps in knowledge on nerve activation by external fields. The most difficult and urgent task is LF dosimetry. The new sub-committee will assist other subcommittees, but not develop its own Standards.

A new Standard developed for NATO covers exposures in the frequency range 0 – 300 GHz. The Standard C95.7 on RF safety programmes has been revised, as has the Standard on measurement of SAR in the head.

Current projects include combining the ELF and RF exposure Standards, and the corresponding measurement Standards. The IEE/ICES website has been refreshed (http://www.ices-emfsafety.org/). IEEE and IEC liaise closely on many projects in this area.

Reports from international bodies

International Telecommunications Union (ITU), Switzerland *(T. Al Amri)*
Tariq Al Amri described the ITU structure and involvement in EMF Standards. Recent work concerning EMFs includes:

- Resolution 176 *Human exposure to and measurement of electromagnetic fields* – this includes formulating necessary measures and guidelines in order to help mitigate possible health effects of EMF radiation on human body, and participating in the WHO EMF Project.
- Question 7/5 *Human exposure to electromagnetic fields (EMFs) due to radio systems and mobile equipment* - study areas include measurement and modelling of sites with multiple transmitters, guidance on modelling exposures around telecommunications equipment and a handbook to answer frequently asked questions about human exposure to EMF.

ITU has a focus group on Smart cities which use a lot of RF technology. ITU recognises the importance of ensuring people are aware of what environmental EMF exposures really are, to provide confidence in the safety of the transmitters, but also recognises the need to balance costs and benefits of measurement programmes. An ITU "EMF Guide" app has been developed.

Reports from the European Commission

European Union EMF Activities DG SANTE, Luxembourg (*Donata Meroni*)
SCENIHR has published its updated opinion on EMF, and the European Commission has released a Fact Sheet and summary on its website. SCENIHR took care to address comments received during consultation on the draft, but has received some complaints since publication of the final opinion on the grounds of the scientific expertise of the WG members and conflicts of interest. In fact the EMF WG satisfied all SCENIHR criteria. SCENIHR maintains a website and published two newsletters per year.

International standards for Non-Ionizing Radiation (NIR) Protection

Summary of the Core Group (*Mirjana Moser*)

A core group was established to develop further the concept of international Standards for NIR. The Core Group includes Dr Jacques Abramowicz (World Federation of Ultrasound in Medicine and Biology), Dr Efthymios Karabetsos (Head of the Non-Ionizing Radiation Office, Greek Atomic Energy Commission), Dipl-Ing Rüdiger Matthes (ICNIRP chair), Dr Mirjana Moser (Independent expert in radiation protection), Dr John O'Hagan (International Commission on Illumination), Dr Rick Tinker (Director Radiation Health Services, Australian Radiation Protection and Nuclear Safety Agency). The group met on 27-28 April 2015.

The development of "Basic Safety Standards" for NIR (BSS-NIR) is within the core functions of WHO, and there is sufficient motivation and rationale for developing them. The BSS for Ionising Radiation (BSS-IR), which have 10 fundamental safety principles and 52 basic safety requirements, will be used as a starting point for NIR. However, there were many challenges, including the diversity of exposures and health effects, missing data, development of limits, precautionary philosophies, and the rapid technology development. While development was feasible, this would take time (estimated 42 months to develop a third draft) and money (estimated US$2M).

The overall vision for BSS-NIR is that they will provide a coherent set of fundamental principles and basic requirements which cover all NIR (including ultrasound and infrasound), all exposure situations and populations (with defined exceptions), be based on scientific evidence (but allowing for uncertainties and lack of knowledge), take into account an analysis of risks, costs and benefits, and be useful to Member States.

A simple questionnaire was distributed to the IAC to obtain feedback on the proposal.

One participant expressed some reservations about simply adapting an existing IR document, due to the much wider diversity in NIR effects and types of exposure. This would make basic principles very general indeed, and little different to general expectations of occupational public and environmental health management. It would be more useful at the moment to simply focus on limits.

Way forward

It is proposed that the next IAC meeting be held in Belgium, in the week before the BioEM conference in Ghent.