MINUTES: Second Meeting
WHO EMF Project Research Coordination Committee
WHO , Geneva, Switzerland
07 - 08 December 1998

Introduction

The WHO International EMF project was established to address possible concerns about possible health effects from exposure to EMFs. The work is being carried out with the participation of numerous collaborating organizations from around the world including the International Commission on Non-Ionizing Radiation Protection, The International Agency for Research on Cancer, the International Electrotechnical Commission, the International Labour Office, the International Telecommunications Union, the United Nations Environment Programme, the North Atlantic Treaty Organization, the European Commission, over 40 governmental agencies and institutions including the National Radiological Protection Board, UK; the Bundesamt für Strahlenschutz, Germany; the Karolinska Institute, Institute of Environmental Medicine, Sweden; the Food and Drug Administration, USA; the National Institute of Environmental Health Sciences, USA; the National Institute of Occupational Safety and Health, USA; and the National Institute for Environmental Studies, Japan.

Since its establishment in 1996, a literature review has been carried out and an agenda formulated for research needed to permit risk assessments for both cancer and health to be carried out during the first decade of the new millennium. The Research Agenda is one of the products of the First Meeting of the Research Coordination Committee held in Geneva, 4-5 December 1997. Information about the various the EMF Project, publications arising from it, its activities, minutes of this and other meetings and other details are available on its web site at: http://www.who.int/emf/.

Opening

The second meeting of the WHO EMF Project Research Coordination Committee commenced at 0900 h Monday 07 December 1998 in Meeting Room 'A' of the WHO Headquarters Building, Geneva, Switzerland. In his opening address (see Appendix "A" for full text), Dr Richard Helmer, Director, Protection of the Human Environment (PHE) Department, on behalf of Dr Gro Brundtland, Director-General, WHO, welcomed the delegates, including a special guest, Dr Kenneth Olden, Director, US National Institute of Environmental Health Sciences. The US NIEHS is one of a number of WHO collaborating centres.

Election of Officers

Dr Michael Repacholi proposed Dr Chris Portier as Chairman, Dr Jon Klauenberg as Vice-Chairman and Dr AM (Tony) Muc as Rapporteur. There being no objection from the assembled delegates, the Chairman continued with the second item of business.

Adoption of Agenda / Minutes of Previous Meeting

The draft agenda (see Appendix "B") was accepted by the delegates. The minutes of the previous meeting had been circulated prior to the present meeting. Since there were no comments or corrections, the minutes were accepted as circulated. Then, at the request of the Chairman, each delegate introduced himself or herself by giving their name and affiliation (see Appendix "E" for alphabetical list).

Update since previous meeting

> *The Chairman called upon Dr Repacholi to give an update on the activities of the WHO EMF Program since the previous meeting.*

Dr Repacholi added his personal words of welcome and appreciation to the delegates. He noted that numerous Fact Sheets had been produced and translations of the majority of them were available in several languages other than English, viz. French, German, Italian, Spanish, Russian and other languages would be included soon. All have been made available on the Project's web pages. The newest one, dealing with the ELF area, had been introduced at the recent meeting in Zagreb, Croatia

where the WHO EMF Project's initiative aimed at the development of a framework for the World Wide Harmonization of EMF Exposure Standards was launched.
The EMF Project presently involves numerous international organizations, the responsible health, safety or standards agencies of over 44 countries and a number of collaborating centres all over the world. The organization and operation of the Project were described with the aid of a chart (see Appendix "D") showing the principal areas of activity and the progress being made toward providing a sound basis for National EMF Protection Programmes.
For the information of new delegates and to refresh the memories of returning delegates, the Terms of Reference of the Research Coordination Committee (see Appendix "C") were reviewed.
Particular attention was drawn to future developments arising from implementation of new transportation systems involving magnetic levitation and the need to develop scientific data that could be used to respond to anticipated concerns that might be raised by users and operators of such systems. Furthermore, a scientific panel of international experts assembled by the US NIEHS using IARC criteria for evaluating the results of scientific research concluded that power frequency EMFs are a 'possible human carcinogen.' These developments alone clearly indicate the need for the review and update of the WHO Research Agenda that the present meeting was convened to address.

WHO/IARC/ICNIRP research requirements for Static and ELF and RF fields

The Chairman invited Dr. Repacholi to present an outline of the WHO/IARC/ICNIRP research requirements for Static and ELF and RF fields.

For the ELF area, issues related to transients and correspondingly better simulations of 'actual' exposure in animal and cellular studies, needs for better exposure assessments, clarification of issues surrounding memory loss, neurodegenerative processes and observed cardiovascular changes add further impetus to the meeting. For its part, the RF arena adds its own impetus inasmuch as the particularly rapid growth in cellular telephone use is threatening to give rise to a situation similar to what occurred with the advent of pregnancy screening using ultrasound. Namely, the identification of control and non-exposed groups will soon become very difficult or impossible because nearly everyone will have a mobile telephone.
In a comment from the floor it was noted that previously there had been substantial emphasis on development of a database of research papers and a good many had been submitted. However it was not clear that the database had been made available as yet. Dr Repacholi indicated that the earlier round had not elicited a great many useful references within the context of the Project. However, after the present meeting the submissions would be published to the web site.
The question was raised whether 2005 was a realistic deadline for conclusion of the Project. Was it going to be feasible to deal with all the issues and reach a final conclusion so soon? According to the proposed schedule, IARC will carry out a preliminary review to assess the literature and while the date for that is not final, all indications are that most of the research will be completed for the 2003 review.
An enquiry was raised about the status of a proposed Frequently Asked Questions (FAQs) section on the Project's web site. There was a hope and expectation that issues raised by the media would receive rapid review and response there. Dr Repacholi noted that there was every intention of including timely responses to such issues but before responses to results reported by specific studies could be posted there would have to be time for a detailed review by ICNIRP. It was stressed from the floor that it was essential that responses be QUICK. On this account Dr Repacholi noted that the Project is not in a position to mount a media watch in all countries. Industries and governments need to respond on their own behalf but an integral part of any such responses could be based on the position established by WHO through the Project in each specific area.

Before opening the floor to the roundtable discussion of ELF (and Static Field) issues, the Chairman invited Dr Kenneth Olden of the US National Institutes of Environmental Health Sciences (NIEHS) to address the delegates.

Dr Olden started by thanking the group for all the research work that had been provided to assist NIEHS in carrying out its duties under the US EMF RAPID Programme, including the extensive assistance provided through the carrying out of peer reviews of the numerous studies. Over a span of 5 years a total of US$ 45 M had been expended under the aegis of NIEHS with an additional US$ 33 M contributed to the effort by the US Department of Energy (DoE). Draft recommendations are due to go forward to Congress in the very near future. A number of areas such as memory loss, Alzheimer's, heart rate changes, alterations in cellular pathways and growth suppression of breast cancer cells by melatonin, to name a few, will be receiving particular attention. Brochures to keep the public informed on progress and developments will need to be under continuous review and update and while NIEHS may not remain directly involved they would continue to maintain close contact through collaboration with WHO.

Dr Chris Portier, NIEHS, continued with a more detailed description of the EMF RAPID Programme and the evaluation process it had just concluded. It started in 1992 and carried through a detailed process that was fully documented and discussed at each step which was carried out by small scientific working groups. Great care was taken to follow the IARC review process and on the strength of the evidence assembled the process led to the conclusion that ELF EMFs were a "possible human carcinogen." Of the 2,000 reports originally cited for review, only some 800 were included in the final process. All the documentation is included on the EMF RAPID web site. In the occupational area the review covered CLL, ALL, brain cancers, male and female breast cancers and 'all other' cancers and for the adults the findings were negative for cancer. In the end, it was the presence of limited epidemiological evidence for leukaemia in children that resulted in the "possible human carcinogen" rating.

Round table of current EMF research worldwide

After a short coffee break, the Chairman opened the ELF (and Static Field) roundtable discussion noting that RF issues should be held for later in the meeting.

Dr Leeka Kheifets, from the Electric Power Research Institute (EPRI), began the discussion with a description of three projects being evaluated to address static field issues. Two had to do with studies of mechanisms looking for increases in free radical lifetimes and the other at movement-induced currents both in animals and *in vitro*. These would be followed up with epidemiological studies in the railroad industry and/or among MRI technicians.

Dr Repacholi interjected with the comment that a static fields research package needs to be put in place as soon as possible to ensure that an adequate foundation exists for risk assessments before magnetic levitation rail systems are implemented. Dr McKinlay noted that volunteer patients undergoing MRI diagnostic procedures could be a useful group for epidemiological studies. It was also noted that DC transmission issues would have to be addressed.

Dr Kheifets continued, turning her attention to ELF issues and noting that research was under way in British Columbia on childhood cancer and ELF involving BC Hydro and Hydro-Québec. This was being supplemented by similar work in California. In the occupational area cardiovascular effects and brain cancers were being studied and in animal studies cancer promotion was being investigated. In the area of human studies consideration was being given as to why results cannot seem to be replicated reliably. At the cellular level, gap junctions in cancer cells were being studied. Finally, work was also being undertaken on the question of EMF hypersensitivity.

Dr Mathiessen advised that in Denmark an update on childhood cancer was to be proposed. They had not found any increases in male breast cancer or leukaemia. He also commented on a possible connection between electric shocks and ALS (Amyotrophic Lateral Sclerosis).

Dr Vlasta Mercier of Switzerland noted that non-specific symptoms were being explored among ELF hypersensitives in an attempt to discover whether there might be any objective parameters for assessing their condition.

Dr Axel Böttger noted that in Germany there were eight studies under way. One was epidemiological, two were human studies, two were *in vivo*, two were *in vitro* and one was on

dosimetry. The Chairman interjected that a US study incorporating personal monitor data for 1,000 individuals was available. Dr Böttger replied that there was a similar study covering 2,000 subjects in Germany.

Dr Alastair McKinlay advised that the childhood cancer study in the UK had reached the analysis stage and they were investigating other putative exposures. It is expected that the results will be forthcoming in the Spring of 1999.

Dr Wennberg of Sweden noted that in his country there were six or seven universities looking at the question of hypersensitives. There were also some cancer studies in engine drivers and pilots.

Dr Bartholome Ribas reporting on work in Spain indicated there was an EM dosimetry study in humans under way and seven other studies through the RF and ELF ranges.

Dr David Renew noted progress was under way on a study in the UK looking at leukaemia in utility company workers with special efforts to include exposure assessment.

The Chairman then called for the delegates to turn their attention to RF issues.

Ms Monique Kilkenney from the International Agency for Research on Cancer who was representing Dr. Elisabeth Cardis at the meeting presented an update on the proposed International Case-Control Study of Brain, Head and Neck Tumours. Preliminary work has been undertaken which showed that it is feasible to conduct a study among adult users of cellular telephones considering cancers in the brain, head and neck where effects might be detectable in view of the enhanced exposure. She noted that the greatest difficulty during the feasibility study was accurate exposure assessment. An exposure assessment committee has been set up to design and carry out a number of pilot studies - using information from "smart" phones and company records - to develop a meaningful index of past exposure (and related uncertainties). In response to a question from the floor about how many cases are expected she stated that for all brain cancers among 25 to 54 year olds the number would be about 1600 while for acoustic neurinomas it would be about 250. Questioned on the issue of cost she stated it was very difficult to estimate at this stage because it depends on how many countries will be involved and the type of interview that will be utilized (telephone or in-person). Responding to a request for information on what relative risk should be detectable she indicated that the study would have 80% power to detect a relative risk of 1.5 assuming a latency between exposure and disease of at least 5 years for several tumour types.

Dr RAF Cox reported that the UK was participating in the IARC study but would also carry through its portion as a stand alone study. They anticipate beginning in 1999 to conclude by 2002 to be in line with the scheduled IARC review in 2003. The study is to cover 2,000 cases and look at other end points as well. It will be the largest study ever in the UK and will be able to detect a RR of 1.5. When asked about the exposure assessment component, he stated that a pilot study is to look at 500 users asked to report their "perceived" use during a period when their "actual" use will be monitored. The point was pursued with an enquiry as to the comparability with the exposure assessment protocol IARC would use. He responded that there would be ongoing consultations between the UK study group and IARC. The UK component was intending to investigate "headaches" or, more generally, cerebral symptoms plus otology, on the hypothesis that there might be unilateral vestibular stimulation arising from heating. Dr McKinlay interjected that while the UK study might have some added features its cancer component would remain entirely consistent with IARC. One of the delegates asked whether only GSM phone use would be covered in the studies, or if others were, how could one tell? It was noted that the case-control design would look at whatever is used.

Dr Gugliemo D'Inzeo introduced a new foundation, ELETTRA 2000, established in Italy to foster, promote and monitor RF research. It would support research in Italy and ensure collaboration with Italy's partners in the European Community.

Dr Gerd Friedrich of FGF presented a list of current subjects under study. He noted that a database summarizing all their work was available on line.

Dr Jon Klauenberg reported on NATO activities. The NATO Advanced Workshop, held last October in Slovenia was very successful with 54 speakers and 84 countries represented. An EMF Dosimetry

Project has been established to advance EMF dosimetry along lines similar to those in place for the WHO's EMF Project. The ultimate objective is to produce an update of the EMF Dosimetry Handbook. There was also new work being done in ultra wide band exposures to help keep up with the advances in that technology. Dr Repacholi noted that Brooks AFB, in Texas, is probably the world's largest RF research facility.

Dr Mays Swicord discussed Motorola's involvement in RF research. Motorola is supporting work in some nine institutions. There was emphasis on *in vivo* research, some of which was due to be published shortly. Considerable work had been done in bioassays related to spontaneous tumours. None had shown any increases to date. Neither were there any positive indications from chemically induced or progression studies. Apart from some small stress responses, there were no positive findings to report. There were animal, cellular and human epidemiological studies still to be reported. While Motorola will be phasing out its own programmes, it will continue to play an active role in the mobile manufacturers' group activities.

Dr Bernard Veyret briefly stated that in France there was a comprehensive programme addressing non-cancer - headaches, hypersensitivity - issues incorporating eight projects being carried out by both academic and industrial groups. His response to a question about how one can tell a rat has a headache was, "You ask him!" noting, more seriously, that a model had been developed in Bordeaux that was reported in the literature.

Dr Veyret explained the operation and objectives of a Research Program Committee (RPC). He stated that target proposals were being developed for both animal and human studies to address provocation and memory effects. Dr Repacholi asked how the group is working with the EC in identifying priorities and how will it progress? Dr Swicord responded stating that the priorities had been derived from the WHO research agenda and other sources. The manufacturers and carriers would then select research organizations that would provide high quality research proposals to the EC 5th framework program for funding. 50% of the funds would be provided by industry and 50% by the EC.

Dr Vlasta Mercier noted that in Switzerland there was particular interest in mobile communications with basic work being done on near field dosimetry and exposure assessment. A concern was raised (referring to her earlier discussion about ELF studies) that taking the "susceptibility" issue seriously enough to study it might be sending confusing messages to the public, particularly since there is a dearth of information on mechanisms or end points. She noted that they are interested in testing the claimants with challenges and looking for what might appear in a variety of parameters.

Dr McKinlay recalled that at last year's meeting there had been a strong call for occupationally exposed cohorts where high exposures were well documented. In that context the UK is starting a study in Birmingham looking at subjects involved in the transmission activities related to broadcasting for which NRPB would be doing dosimetry. Considerable work had been done on exposure metrics and metrology for RF. The proceedings of a workshop hosted by NRPB would be published in the Journal of Radiation Protection and Dosimetry.

Dr Klauenberg noted a couple of other projects being studied at Brooks. First, a review and intercomparison of National and International Safety Standards was on course for publication in *Health Physics*. Second translations into English of Russian RF Standards and scientific papers had been done by Dr Pakimov and they would appear on their web site.

Dr Arne Wennberg stated briefly that in Sweden, Dr Kjell Hanson-Mild was involved in subjective studies plus there was work being carried out on malignant brain tumours.

Dr Dina Simunic reported that the COST 244 proceedings from the recent workshop in Zagreb were available.

Dr Veli Santomaa noted that in Finland there was a series of studies under way. He briefly described six of them. When asked whether the results would be posted to a web site he stated they would and the web site to consult was that of COST 244bis.

Ms Jo-Anne Basile discussed the US WTR projects stating that they were nearing completion and that the report on its findings would appear in February 1999. The group was involved in research

on mobile phones. There was a colloquium to be held, possibly in Washington, later in 1999. She also noted that the National Cancer Institute has a large scale cancer epidemiology study to appear in the late summer or early fall of 1999. There was an enquiry as to whether the litigation regarding privacy in the context of epidemiological studies had reached any conclusion. She noted that the lawsuit was still being heard in Chicago and a decision should be forthcoming by the spring. She noted that the litigation could have a dampening effect on future epidemiological studies.

Mr David Clarkson reported on activities in Australia being funded by the Australian National Health and Medical Research Council. A project, part of the IARC collaborative study, looking at brain and other tumours in adults was under way. Other funded projects were looking at memory and brain function, *in vivo* biology for genetic effects and a replication of the earlier transgenic mouse study by Dr Repacholi. A delegate asked whether there were any other studies likely. Mr Clarkson responded that the brain tumour and *in vivo* projects were pilot studies and may become full studies. About $1.1 M was earmarked for the rodent replication project plus some additional funds were earmarked for looking at other questions raised by it. Dr Olden commented that the exposure facilities previous to 1992 were not standardized. Dr Repacholi elaborated noting that emphasis has been placed on dosimetry and exposure assessment and work is proceeding toward having specific tests for such issues inasmuch as workshops have been held to try to ensure the best possible exposure protocols and dosimetry.

Two Working Groups (Static and ELF Fields; RF Fields) to review gaps in current WHO research agenda and make recommendations for completing it.

Just before lunch, the Chairman announced that the delegates would have the choice of participating in one of two working groups after the break - one would focus on low frequency issues and the other on high frequency issues. Drs Jack Sahl and Leeka Kheifets were nominated and confirmed by the delegates as Chair and Rapporteur, respectively for the low frequency group. Drs Jon Klauenberg and Russell Owen were nominated and confirmed to the corresponding positions for the high frequency group. The delegates were asked to re-assemble after the lunch break in the main meeting room for a short briefing and to confirm the venues for the two working groups.

Upon return from the lunch break, the question of intermediate frequencies was raised by one of the delegates. By way of clarification, Dr Repacholi noted that there was a meeting scheduled to be held on the subject in Maastricht, The Netherlands, this coming June. For the moment, intermediate frequencies are not on the agenda but, with the Maastricht meeting as a point of reference, they will become a part of the agenda for next year.

Dr Repacholi went on to define the task set for the working groups. Specifically they were to review research that was currently under way and identify where there are (still, or new) gaps in knowledge. The low frequency group should also address the implications of the "possible human carcinogen" rating assigned to ELFs by NIEHS. Dr Sahl enquired about how best to deal with the current agenda itself. Dr Repacholi stated that clearly there were new issues which needed to be addressed, e.g. memory loss, heart rate changes, and may give rise to new agenda items. Effectively, the task was to review the agenda and revise it as may be necessary in the light of current information.

The delegates spent the remainder of the afternoon working in one or the other of the two working groups. Each group was to report to the plenary session of the meeting, the next day.

Report of working groups and discussion

The meeting re-convened on Tuesday 08 December 1998 at 0900 h. The Chairman asked the Rapporteurs of the two working groups (Dr Owen for high frequencies, Dr Sahl for low frequencies) to step forward and present their reports.

*The **high frequency group** was invited to report on its deliberations.*

Dr Owen thanked the participants for their frank and lively contributions to the discussions. He observed that there were overarching concerns among the participants. First, there was a realization that new technologies gave rise to new exposure situations that were not necessarily well addressed by previous studies. Consequently it was crucial to remain responsive to new exposure situations. The issues associated with exposures arising from the use of mobile phones exemplify environmentally relevant exposure situations for which information is lacking. It was also noted that some of the content of the previous research Coordination meeting was not reflected in the documentation that was issued. There was particular mention of a database of new reports. Discussions also addressed questions regarding criteria for clearly specifying the quality and nature of exposures reported in the literature - dosimetry issues were seen as being very important. Real life exposures are decidedly inhomogeneous both spatially and temporally but it is recognized that there will be technological limitations to the degrees of detail that can be achieved.

It was recommended that research proposals be reviewed by a central board of experts in dosimetry.

Dr Owen then turned to each of the specific sections in the research agenda generated by the previous meeting. The following issues were discussed:

Animal studies

- Absolute levels of exposure and number of levels of exposure used in studies were deemed to be a critical issue but individual investigators should tailor the specific situation for the particular study.
- Whole body exposures are essential for carcinogenesis studies but target tissue studies are also appropriate on a tissue by tissue basis.
- The monitoring of exposure duration and intensity has not been addressed as yet.
- Dose should be held constant over whole life of subject animals.
- PIM-1 Transgenic Mice
- There remains a need for more research in this area.
- The overall relevance in toxicology is still the subject of much discussion.
- Cognitive function
- It was not clear what the recommendation from the last meeting was with regard to blood brain barrier studies.
- Memory loss studies are to be anticipated.
- Was there an animal model for memory loss?
- Epidemiology
- The needs identified in the previous research agenda were reaffirmed.
- The impact of the IARC study was noted although there were some questions about what might be learned from it.
- It was noted that there was a need for freedom in the design of studies.
- Human studies
- It is a problem that EMF hypersensitives are self-identified. There should be an explicit agreed list of symptoms by which they can be identified.
- *In vitro* studies
- Still need to address ODC activity and chromosomal aberrations.
- A survey for biomarkers of exposure should be undertaken.

Dr Owen then opened the floor for the participants in the working group to introduce additions or concerns that he might have missed in his summary.

It was noted that immunology was already included in the human studies section of the agenda and that it should added to the animal studies section as well. However, it was commented that there was not a consensus on such an addition. By way of compromise it was suggested that it be added as a secondary additional issue for testing in animal studies.

Dr Owen then opened the floor to all the attendees for their input.

Dr Repacholi commented that standardizing dosimetry and peer review might be problematic. Considering the fact that there was a relatively small number of knowledgeable researchers involved

such an added formality might be redundant. Support was expressed for the idea of having a group to specify criteria for evaluating appropriate dosimetry, e.g. dose distribution as well as average SAR. On the other hand it was suggested that it might be more effective simply to identify specific exposure information that must be presented in any acceptable study. The conclusion was that there be established a minimal set of requirements for information on dosimetry.

Dr Repacholi asked whether the question of maximizing exposures had been resolved by recommending that the highest levels used not exceed thermal levels. Dr Owen confirmed that their discussions had reaffirmed that recommendation.

A long discussion of the use of PIM-1 mice was initiated by Dr Repacholi's asking whether anything had developed regarding the relevance of using the strain in studies. Dr Portier noted that the whole area of transgenic models was being widely debated in an effort to establish the best possible approach to toxicological studies in general. The principal questions revolve around whether they give adequate and useful information or whether they might be able to provide additional information. There is a possibility that transgenics might end up being used for screening but not for more than 90-day preliminary studies. Dr Swicord stated that the transgenic model is simply not appropriate for RF studies. The value of transgenic mice for any testing is being seriously questioned. Dr Owen expressed hesitancy at totally excluding them at least for short term screening studies. Dr Repacholi noted that while there was still some effort necessary to characterize the applicability of transgenic mice more thoroughly there was a decided benefit in using them rather than continuing with the longer term standard 2 year bioassay studies.

Dr Repacholi enquired whether any conclusions had been reached regarding memory loss studies. Dr Klauenberg noted that there are a number of studies under way but, nonetheless, it was agreed that the issue should remain on the agenda. Dr Veyret supported the position. With many studies planned and ongoing, there still remained questions to be answered. Dr Repacholi dissented noting the particular relevance to cellular telephone use. Dr Klauenberg added that rather than encouraging more studies in the area, replication of existing animal memory loss studies might be more effective. It was ultimately agreed that encouraging completion of currently planned studies is sufficient.

Dr Repacholi asked whether ODC and chromosomal aberrations were the only outstanding issues identified in the area of cellular studies. Dr Owen reported that those had been specifically noted recognizing that there were many studies that address other aspects. With the exception of the ODC findings which still need to be addressed with laboratory studies, the situation was similar to that regarding memory loss. The recommendation is to encourage what is under way but that is enough for the time being.

Dr Portier raised the issue of chronic animal studies and whether they were adequate or should have added emphasis on dosimetry questions and restraint of animals. Dr Owen noted that it had been concluded that additional studies were needed in the area of dosimetry. Dr Swicord noted that the benefits of constraint are limited and impose trade-offs by adding complexities in interpreting animal responses. Dr Klauenberg stated it was quite possible to design exposure conditions where animals do not need to be restrained.

In response to a query about long exposure durations, Dr Owen noted that they were already incorporated in the current agenda.

*The **low frequency group** was invited to report on its deliberations.*

Dr Jack Sahl summarized the ELF Working Group's discussions. He started by thanking the members of the group for their active participation. He noted that he would be presenting general recommendations from the group rather than ranking current projects in terms of their priority.

The main issue that had been discussed was that of transients and how they might relate to the larger questions of electric and magnetic field effects. It was concluded that an expert body should be established to explore and decide on what the term transients should and should not include. There is a clear need to determine the characteristics of transients in the environment and evaluate them in terms of dB/dt. It is also necessary to assess the possible biological relevance in terms of the

quality and magnitudes of induced currents. Having established what the relevant parameters might be, it will then be necessary to determine which might be correlated with epidemiological study end points. Any that are left over would be candidates for new studies. Even with the assistance of such an expert body in focusing attention on the most relevant transient parameters, it is difficult to foresee that any conclusions could be reached in time for the IARC cancer risk assessment. In the end it was found not to be high priority in the face of limited resources.

In the previous agenda, breast cancer and neurodegenerative diseases appeared together. They should be separated. There is a need for a better animal model for breast cancer studies.

There is a need to separate Alzheimer's, Amyotrophic Lateral Sclerosis (ALS) and Parkinson's. Efforts should be made to encourage studies involving contact currents rather than focusing solely on induced currents.

In epidemiology, population based studies should be encouraged. The search for biomarkers in blood should be encouraged over the search for highly exposed human subjects and there should be an increased emphasis and focus on women. Cardiovascular diseases and particularly heart rate variability should receive greater emphasis.

Regarding *in vitro* studies the research is proceeding adequately but there is a need for more efforts in the area of cell differentiation.

In order to advance theoretical modelling efforts there is a need to improve the quality of biological data and the links between physics and biology. Better models need to be developed to allow for better extrapolations between different frequencies. The quality of data forming the basis of standards for exposures to high levels needs to be improved.

Immunological studies of host resistant animals and occupational leukaemia are two additional areas considered to be in need of further emphasis.

Dr Sahl then turned to the group's discussions on static fields. There were three points noted. First, consideration of the space/time gradients should be included in order to account for subjects moving in the field. Second, there should be a shift from electric and magnetic field exposures to a study of diseases where electric and magnetic fields are included as two among a number of other more general parameters. And, third, there should be a greater emphasis placed on bringing closure to the issue.

Dr Sahl then invited the ELF Working Group participants to express comments or raise points for discussion.

Dr Portier had a question with regard to biomarkers. Despite the fact that a fair number of clinical studies had been done there was a lack of information on females. Dr Sahl noted the group supported greater emphasis in both areas.

Dr Sahl then invited all the attendees to join in with comments and discussion.

Dr Owen asked whether the group, in dealing with *in vitro* issues, had discussed melatonin studies and cellular communications. Dr Sahl reported that this was discussed and they had concluded that progress was satisfactory and hence the subject did not warrant further emphasis at the present time.

Dr Repacholi noted that only the Anderson study is still outstanding. Three or four results were already in. Dr Sahl responded that the results are suggestive rather than definitive but also noted that greater emphasis had been recommended on female breast cancer studies.

Dr Owen asked whether better animal models should be sought and Dr Sahl agreed. The Working Group had concluded that there was a need for better new models or better use of existing ones. In response to Dr Repacholi's query as to whether any animal studies were ongoing at present, Dr Kheifets noted that there was only one, in Japan. Dr Kabuto stated that the study had started two years ago with tests of the exposure system and to establish baseline data. Then it had proceeded to the testing of DMBA doses and was now at the stage where exposures would be carried out this coming June through November. They will start with horizontal magnetic field exposures at five field strengths. That will take 2 to 3 months and be followed by circularly polarized magnetic field exposures. The results are due by the end of next year. Dr Kheifets added that there may also be some related work in progress in Germany.

In other areas, Dr Kheifets and her colleagues were investigating bias in reporting and how to control for it. They are also exploring ideas about enhancing animal models and looking at women using tamoxifen in the context of breast cancer.

Dr Repacholi drew attention to the need for dosimetry criteria. The question of how to define transients was also important but not felt to be a sufficient reason for the reviews of IARC and WHO to be delayed. He also asked whether any adequate biomarkers had been identified to which Dr Sahl responded that in the absence of any others there appeared to be at least melatonin. Dr Portier suggested blood ODC and estrogen might qualify but there should be an effort to move away from considering only hormones as possible biomarkers.

Dr Repacholi asked what should be highlighted in the area of cardiovascular effects in order to advance understanding. Dr Sahl noted that clarification of the clinical time variability was important for which there would likely be needed new epidemiological studies but he was doubtful whether they would be adequate. Dr Portier noted that existing epidemiological studies had not been designed for heart disease and may not incorporate adequate controls. Dr Sahl continued that they were of dubious value since they were using existing data sets and were neither ideal nor likely capable of resolving the cardiovascular disease issues. Dr Kheifets pointed out that the heart rate variability studies were not replicable. There was interest in investigating why the effect seems to come and go.

It was commented that methods to deal with other frequencies such as 16 2/3 Hz need to be developed. Dr Sahl responded that the issue of extrapolation had been flagged for emphasis by the ELF Working Group.

General discussion: Scheduling, Priorities

Dr McKinlay raised the issue of general priorities noting that the existing research agenda considered them and the new agenda should as well. It seemed that grouping static with ELF results is incorrectly increasing its priority. He suggested that RF be the top priority noting that the US EMF RAPID Program had made a great contribution in the ELF area and gave some prospects of "getting things together" there. Dr Repacholi agreed that greater emphasis on RF relative to ELF is appropriate but noted that there is a very different focus in different areas of industry. Considering that several countries were spending considerable sums of money on the development of magnetic levitation transportation systems, additional research will need to be done to address concerns that will arise there.

Dr Sahl noted that the Working Group specifically did not set any priorities but encouraged the EMF Project to do so and add such priorities to the report of the group's work. He felt that the current emphasis on ELF transients was particularly misplaced. Dr Repacholi disagreed noting that transients are the only parameter that relates directly to induced currents. In fact, there was an indication that wire codes relate to transients. It was clear from the report on the recent meeting in Bologna that since all "real" exposures have transient components there should be more rather than less emphasis on transients.

Returning to the question of priorities, Dr Owen noted that they were implied by numbering or the order in which the items in the list are presented. Dr Repacholi pointed out that the WHO relies on the working groups for the priorities. As new information comes forward, shifts in priorities arise from the discussions of the working groups and are reflected in their reports.

Dr Cox enquired whether the former agenda item calling for identification of a highly exposed occupational group to help explore the question of female breast cancer had been carried forward. Dr Sahl affirmed that it had.

A member of the ELF working group noted from his recollection of their discussions that transients were indeed a priority item and in that context there was an urgent need that they be defined before anything further is contemplated in that context.

Dr Sahl drew attention to what the group found to be an emerging issue and that is the growing interest in interference with medical implant devices of various sorts. Dr Repacholi underscored that such matters were not part of the EMF project. Dr Owen noted that there were indeed issues of that

nature arising but that they were being addressed by manufacturers' associations and other standards agencies.
Upon return from coffee break, Dr Portier noted that Dr McKinlay had had to leave but wanted to have it on record regarding his earlier comment that while he considered RF to be a matter of urgency, it was not necessarily of the highest priority.
Dr Kheifets commented and Drs Portier and Swicord confirmed that, according to their recollections, items on the former research agenda had not been prioritized. Dr Repacholi noted that a rank order is inherent in any agenda but, while there is no particular priority of one area over another, there were priorities within each area. Such priorities are established by the working group reports and may change as new information becomes available. However the basic agenda, where all the items have much the same priority, should not be changed in any fundamental way.
Dr Veyret noted that GSM cellular telephone use was growing extremely rapidly and that there is, consequently, an urgent need for more research in the mobile phones area. Dr Repacholi underscored that the relative priorities of RF vs. ELF vs. Static were not really a problem since the areas are quite separate and should be considered as such in the agenda. Problems might arise only if an agency were to cover more than one of the areas. Dr Olden commented that this was the case in the US. A portion of budgets is allocated to "interest" or purely exploratory research, but for targeted research there was an urgent need for WHO-like priorities to guide funding decisions. The greatest benefit would be realized from an overall risk assessment to prioritize the separate areas. Dr Repacholi responded that RF likely ranks first because of the gaps in knowledge that remain. Second would be ELF because of the recent assessment that it ranked as a "possible" human carcinogen. That leaves static in third place but still not to be dismissed because available data is largely on patients and its application outside such a context would be problematic. Dr Sahl noted his agreement with those priorities from a societal point of view but added that specific groups might have radically different interests. It was questioned whether the working groups could take any specific items off the agenda for either area. It was also commented that priorities should be assigned within areas (e.g. within ELF) although it would appear to be inappropriate to assign them between areas (e.g. between RF and ELF). Dr Repacholi agreed that adding or changing priorities within areas was appropriate and even eliminating items was possible but only to a limited degree in the interests of achieving closure on a given area.
It was commented that, with risk assessment as a goal, was it not then essential to develop new dosimetric quantities and, in a similar vein, some sort of standardized or otherwise agreed set of symptoms arrived at by which variability in susceptibility could be evaluated. Dr Portier agreed and noted that both issues had been addressed and were included in the working group reports. Dr Repacholi noted that in the previous meeting the starting point was the goal of carrying out a health risk assessment to be carried out. It was then possible to identify the gaps in knowledge that needed to be filled and these formed the basis for the research agenda. Dosimetry is definitely at the top of the list and is an essential first step. Individual susceptibility was indeed important since most studies tended to focus attention on healthy workers. Attention was drawn to the example of asthmatics who were much more sensitive to the effects of smog. It was questioned whether it was realistic to expect risk assessment to be able to proceed in the absence of a dose unit. Dr Portier responded that the IARC and WHO actions are only aimed at determining whether there is evidence for effects in the first place. This was not dependent on having knowledge of dosimetry or mechanisms.

Funding agencies

Dr Repacholi noted the arrival of Dr Kirste Haarvisto and the Chairman invited her to give an update of the European Communities' DG 12 5th framework program.

EC's DG 12 incorporates biomedicine and health. The current round will be completed by the end of 1998 and then the new 5th framework will commence. It will run to 2002. A new structure and approach have been implemented and some programs have been dropped. Three different levels define the basic areas within which programs will be supported under the framework. Acceptance

of any proposal requires a co-decision by both the Council and Parliament of the EC. It is expected that the framework program will be adopted. It is only very general with regard to topics. In the past there were 20 or so programs. In the new framework there are only four "thematic" programs. The third level document is of the most use for applicants since it gives application details and an application evaluation manual. At least two countries must be involved. A proposal preparation time of three months is allowed after application for funding has been submitted. Evaluation will be carried out, in the first instance, by individual experts and at the final stage by an expert panel. Specific individuals may apply to be experts for the purposes of these evaluations. By way of example, Quality of Life was cited as one of the Thematic Programs. Under it there were five or six sub groups called "Key Actions" which were selected using specific criteria. They represent topics where some basic knowledge is available but a more integrated, multidisciplinary approach demonstrating collaboration between authorities, manufacturers and users is needed. The relevant Key Action is Environmental Factors and Health which covers air pollution, chemical exposures, noise and electromagnetic radiation and includes occupational situations. Individual susceptibility or specific subgroups such as females or children can also be included. Another subsection covers risk assessment, communications, etc. Specific work programs will be developed and adopted by delegations from each EU country.

Dr Repacholi said that the WHO welcomes the EU initiative. He enquired whether it was limited to EU countries. The answer was that evaluations were being carried out of proposals that had participants from various eastern European countries. It was possible that they would be approved. Participation by other countries such as the US, Canada or Japan, for example, would be conditional on their operating on their own budgets.

In response to a question about how calls for proposals will be made, it was stated that appropriate publicity would take place. A campaign was to be launched in February, there was a conference scheduled in Essen, Germany and there would a posting on the EC web site and in each country.

In response to a query about what types of proposals would be accepted in the areas of risk assessment/communications, Dr Haarvisto noted that the subject was still being debated.

Dr Swicord asked why the term launched was used. Does it mean "call?" What is the list of "participants?" How can users be involved in research? The answers were as follows. "Launch" does not mean "call." The launch was to establish the first two levels of the framework. Then the work programs could be set up. Participants can be public or private, industries, decision makers, users, etc. As for users being involved in research, the list of participants was recommended, not absolute. They might be involved where applicable on a case by case basis and possibly as a consumers' group.

When asked how experts would be established Dr Haarvisto noted that formerly they were simply appointed while now individuals could apply. The selections would be made by staff after review of the applications received.

It was noted that with a February launch, assuming a three month deadline for submissions means that proposals would be due in May. Was there any suggestion that there would be more than one call? Dr Haarvisto stated that there would indeed be more than one call, and information would be published indicating when calls would be made for specific topics.

The question of amount and allocation of funding was raised. Would it be allocated a priori or based on subjects? Dr Haarvisto responded that it would be basically a priori. The overall allocation will be established (it is too soon to estimate how much it might be) and divided among the various levels of programs with allowances for generic and fundamental work.

When the prospect of long term projects was raised it was stated that there was nothing to prevent commitments being made beyond the 5^{th} framework termination date of 2002.

The Chairman invited Dr Arne Wennberg to describe the work of COST 244bis.

COST 244bis was one of many groups working within the European Co-operation on Science and Technology framework. It had been established to promote the study of electromagnetic bioeffects.

Under DG 13 (Communications) COST had been asked to look at possible effects of mobile telephones for which they have a contract from the EC. They will be holding a conference on "Future European Research on Mobile Communications Health Effects" in April 1999 in Bordeaux.

The Chairman adjourned the meeting for lunch at 1220 h.

Working Group summaries

*The meeting was reconvened at 1400 h. The Chairman invited Dr Sahl to summarize the work of the **low frequency group**.*

Dr Sahl opened the closing session with the ELF Working Group's priorities for new research in that area. The first priority was dosimetry in support of risk assessment and the second was further work on neurodegenerative diseases. The latter because there was a high potential for public health impact. There was a particular need to elucidate the issue of fields vs. currents as the significant agent of effect. Dr Kheifets pointed out that the two items cited would have to be seen as in addition to and subordinate to the priorities in the original research agenda. Dr Portier advocated switching the two new items. Dr Cox noted that in the absence of an identified highly exposed occupational group there is little progress to be expected in any case. Dr Sahl also re-introduced the issues of breast cancer and cardiovascular effects.

Dr Repacholi underscored the fact that heart rate variability had been reported demanded that its possible impact on health be evaluated. It would appear to warrant priority status and its resolution had some prospect of success over the short term. Dr Kheifets noted that breast cancer and cardiovascular effects were clearly of higher priority than neurodegenerative effects but and there was a good amount of work in progress addressing these questions. Dr Repacholi noted that definition of exposure and issues surrounding transients were clear priorities but wondered whether there should be more emphasis on additional animal studies. In that regard, Dr Sahl noted that it would be most desirable to recognize the importance of Alzheimer's, ALS and Parkinson's and look for suitable animal models to study them. Dr Veyret noted that Novartis had developed a genetically altered strain of mice applicable to the study of Alzheimer's. Dr Portier cautioned that the suitability of such a model for establishing causal links to EMF exposures would have to be established i.e. the animal must be susceptible to the disease but not manifest it in the absence of exposure to the agent under study. Dr Swicord added a further note of caution stating that care needed to be taken not to apply models without giving considerable thought to what objectives might be served by using them.

*The Chairman invited Dr Klauenberg to summarize the **high frequency group**'s work.*

After thanking the RF Working Group for its hard work and lively discussions, Dr Klauenberg presented a summary of its deliberations. He went through the list of items in the former agenda noting how the order should be changed to reflect current priorities.

Drs Owen, Portier and Swicord made suggestions for other arrangements of the items. There was considerable discussion about whether epidemiological studies should be advanced compared to their former placement but the issue was not resolved. It was also noted that although it does not appear explicitly, dosimetry was an integral component of most items.

Dr Klauenberg wondered how and when the database of studies under way would appear. Dr Repacholi reported that up to now sufficient details had not been provided to allow it to be assembled. He encouraged the funding agencies to send details of approved proposals on an ongoing basis. Internally funded studies would be treated on an equal basis with externally funded studies. Typical information would include principal investigator, an abstract giving the hypothesis and end points to be studied, sensitivity of the study. It was suggested that the information should also include the name of the funding agency and start and end dates. Items would be deleted upon peer-reviewed publication of the results. Candidate studies for inclusion could be submitted by email but only after approved for funding. It was noted that COST is in the process of carrying out the development of a similar database.

Research Funding

Dr Repacholi enquired whether any of the new work arising from the research agenda was of interest to the funding agencies in attendance.

Dr Portier noted that NIEHS was interested in hypothesis driven ELF research but had yet to come to a decision about RF. It was unlikely that there would be any internally funded studies. For EPRI's part, Dr Kheifets noted that except for a workshop on dosimetry it is not likely there would be funding beyond the several commitments made on the basis of the previous agenda. Dr Harrison stated that the mobile phone manufacturers intend to work toward the 5th Framework program. Dr Repacholi underscored the importance of the industry's sponsoring appropriate research. Dr Mathiessen noted that Denmark was sponsoring a project to investigate the connection between ALS and contact currents. Dr Santomaa said in Finland, initiatives were being taken to develop EMF educational materials to inform the public, including materials for schools to educate children. Dr Sahl enquired about the status of NIEHS's so-called "Blue Book" of research and was informed by Dr Portier that NIEHS was not able to carry on with it on their own but was open to suggestions of partnerships to maintain it in some form or other. Dr D'Inzeo noted the establishment of Elettra 2000 in Italy to support Italian components of the COST and EU initiatives. Dr Klauenberg drew attention to NATO's long term support in the RF area but added it did not have any particular interest in the cell phone issue. Dosimetry remains a major concern. NATO's "Science for Peace" program outlined on its web site could be an avenue for obtaining support through its Scientific Research Division. In addition, a great deal of work was funded internally by the US Department of Defence. Mr Friedrich from Forschungsgemeinschaft Funk (FGF) noted they have a databese comprising over 2,000 abstracts in 39 different areas. It has linkages with IEEE. Dr Clarkson stated that the Australian government has spent $4 - 5 M, raised in the form of a levy on spectrum users, to fund an extension of the PM1 mouse study.

Other Business and Next Meeting

A call was made for any other issues to be addressed. There being none, attention turned to the date and venue for the next meeting in approximately one year's time.

Among the locations left for consideration and later action were: San Antonio, Texas where the labs at Brooks AFB would be available for tours; Geneva, Switzerland to more easily accommodate the large number of European attendees; Erice, Italy where the meeting could be held before or after the planned NATO/ASI meeting on Pulsed RF Exposures in late November. No specific decision was made as to the location or date of the next meeting.

Dr Repacholi thanked the attendees for their active participation, Dr Muc for serving as rapporteur and Mrs Peter for her able adiminstrative assistance that allowed the meeting to run smoothly.

The Chairman adjourned the meeting at 1730 h.

APPENDIX "A": Welcoming Address

For almost a year WHO's programmes have been reviewed and new directions and priorities set. With this there has been a major reorganization of the structure to better align staff and projects with these priorities. This process is almost complete. On behalf of the new Executive Director of the Cluster on Sustainable Development and Healthy Environment (SDE), Mrs Poonham Singh, I would like to welcome you to WHO headquarters in Geneva and hope that your time spent here will be both enjoyable and scientifically stimulating.

I am Dr Richard Helmer the new Director for the Department of Protection of the Human Environment (PHE). This covers a broad range of risk assessment and normative work on issues such as food and water, sanitation and chemical safety, radiation and occupational health. Its activities are in four major directions: chemical safety, food safety; water supply and sanitation; and occupational health. In addition, the Department co-ordinates research on environmental health issues of global significance such as climate, ionizing and non-ionizing radiation.

It is my sincere pleasure to introduce to you a special guest, Dr Kenneth Olden, who is Director of the US National Institute of Environmental Health Sciences, a collaborating centre for WHO. As most of you will know, the NIEHS has been heavily involved in assessing biological and health

effects from exposure to EMF, particularly from electric power lines. A major NIEHS report has been compiled on this subject and will provide very useful information to WHO's EMF Project.
One of the major objectives of this meeting will be to identify what extra research is needed to complete WHO's EMF Research Agenda. However, most of you will know that an international working group convened under the NIEHS RAPID Program concluded that exposure to power frequency fields is a "possible human carcinogen". Following this conclusion, focused research is now needed that will provide more information about whether exposure to power frequency fields leads to an increased incidence of leukaemia in children. Through this committee of WHO's EMF Project, this research must be encouraged.
The International Electromagnetic Fields (EMF) Project is a major activity within our Department. Everyone in the world is now exposed to EMF from sources such as electric power generators, distribution systems and electrical appliances, transportation systems, telecommunications facilities and associated devices such as mobile telephones, medical and industrial equipment, radars and radio and television broadcast antennas. Even a small consequence of EMF exposure from these multiple sources could have a major public health impact.
As developing countries become industrialized and develop infrastructure for electricity generation, and use, or telecommunication systems, it is hoped that the lessons learned from this Project will assist their sustainable development within a healthy environment.
The International EMF Project assesses both health and environmental effects of exposure to EMF in the frequency range 0 - 300 GHz. Dr Michael Repacholi manages this Project and will give a short presentation on this Project.
The EMF Project commenced at WHO in 1996 and is scheduled to end in 2005. It has been designed in a logical progression of activities and outputs to allow improved health risk assessments to be made, and any environmental impacts, of EMF exposure. Project objectives are to:

1. provide a co-ordinated international response to concerns about possible health effects of exposure to EMF
2. assess the scientific literature and makes status reports on health effects
3. identify gaps in knowledge needing further research to make better health risk assessments
4. encourage focused, high quality research programmes to fill these gaps
5. incorporate research results into WHO's Environmental Health Criteria monographs where formal health risk assessments will be made of EMF exposure
6. facilitate the development of a framework for internationally acceptable guidelines limiting EMF exposure
7. provide information on the management of EMF protection programmes for national and other authorities, including monographs on EMF risk perception, communication and management, and
8. provide advice to national authorities and others on EMF health and environmental effects and any protective measures or actions needed.

This committee meeting will be a very busy one, but will substantially progress the major objective of the EMF Project; to determine if EMF exposure causes adverse health effects at levels encountered in our working and living environment.
My very best wishes to you for a fruitful and successful meeting.
Dr Richard Helmer
Director, Protection of the Human Environment (PHE)
World Health Organization, Geneva
7 December 1998

APPENDIX "B"

INTERNATIONAL EMF PROJECT

EMF RESEARCH COMMITTEE

AGENDA

Location: WHO, Geneva, Salle A (Level 1, Main Building) **Dates:** 7-8 December 1998

Monday 7 December

9.00 Welcome

1. Election of Chair, Vice Chair, Rapporteur, Committee Terms of Reference
2. Adoption of agenda/minutes of previous meeting
3. Update since previous meeting
4. WHO/IARC/ICNIRP research requirements for static and ELF and RF fields.

10.30-11.00 Coffee

Round table of current EMF research worldwide

Interaction between WHO and key research programmes

12.30-14.00 Lunch

Two working groups (Static and ELF fields; and RF fields) to review gaps in current WHO research agenda and make recommendations for completing it.

Coffee available at 15.30

17.30 Close for the day

18.00-20.00 Cocktail party

Tuesday 8 December: resume at 9.00

9.00 Report of working groups and discussion

10.30-11.00 Coffee

Scheduling of research

12.30-14.00 Lunch

Compiling and maintaining research database

15.30 Coffee

Research funding

Any other business and next meeting

Close approximately at 17.00

APPENDIX "C"

Research Coordination Committee

Terms of Reference

WHO/ICNIRP reviews (meetings in Munich, November 1996 on RF, and in Bologna, June 1997 on static and low frequency fields) of the scientific literature on biological effects of exposure to EMF have been completed and major gaps in knowledge have been identified needing more research in order to make better health risk assessments. The primary aim of this Committee is to share information related to research activities and to assist with the Coordination of EMF research world-wide.

Research Coordination Committee terms of reference:

- Ensure that all the research needed by WHO is completed in a reasonable time.
- Avoid duplication of research, ensuring that scarce resources for research are used wisely and effectively.
- Encourage high quality research.
- Encourage the use of standardized protocols so that results can be easily compared or studies combined, where possible, to allow meta-analyses to be performed.
- Maintain an updated world-wide inventory of EMF research, researchers and results.

To facilitate the goals of this Committee, all funding agencies are asked to share details of research they currently sponsor. These details should include:

- type of study (epidemiological, in vivo, in vitro);
- hypothesis being tested;
- relevant details about the study;

- name of the principal researcher;
- research institution where the study is being conducted; and
- contact address, telephone, fax and e-mail of the principal researcher.

This information should be made available to WHO on disk and updated on a continuing basis, as it is one of the objectives to create a research database from this information. The whole research database will be available to everyone through the home page of the International EMF Project: http://www.who.ch/programmes/peh/emf/emf_home.htm

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APPENDIX "D"

Chart showing the Organization and Operation of the WHO EMF Project

APPENDIX "E"

Alphabetical Listing of Delegates in Attendance
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WHO Building, Geneva, Switzerland
07 - 08 December 1998

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