INTERNATIONAL
COMMITTEE *on*
ELECTROMAGNETIC
SAFETY

Approved Meeting Minutes

SCC28 Subcommittee 4 Meeting

June 29, 2002
8:00 am – 5:00 pm
Hotel Loews Le Concorde
Québec City, Québec Canada

1. Call to Order

The meeting was called to order by Cochairman D'Andrea at 0800h.

2. Introduction of those Present

Each of the attendees introduced him/herself. See Attachment 1 for the list of attendees.

3. Approval of Agenda

The cochairmen reviewed the agenda – following a motion by M. Meltz that was seconded by M. Ziskin, the agenda was approved unanimously. (See Attachment 2 for agenda.)

4. Approval of the Minutes of January 19, 2002 Meeting

Following a motion by J. Leonowich that was seconded by M. Ziskin, the minutes of the January 19, 2002 meeting were unanimously approved without change.

5. Chairman's Report

Cochairman Chou briefly reviewed the recent history of SC-4 activities. He noted that the 4th meeting of the Revision Working Group (RWG), schedules for September 13-14, 2001 was canceled because of the attacks on the World Trade Center. He reviewed the twelve items agreed to at the January 4th Revision Working Group meeting (see Attachment 3) and pointed out that progress is close to being on schedule. The 4th draft of the revision, which will be discussed for the first time in SC4 at this meeting, will be revised after the meeting and that revision will be discussed at the September 9-10, 2002 6th RWG meeting. The Goal is to complete a subcommittee balloting draft before the end of this year. Chou noted that since it has been difficult to obtain consensus on one or two tiers (the subcommittee is split on this issue almost equally), the two-tier approach would be retained. SC-4 will also follow the approach of SC-3 (safety levels – 0-3 kHz) and develop a revision with MPEs that are safe for all.

The Air Force Workshop held the previous Sunday and sponsored by the Air Force Research Labs at Brooks AFB was discussed next. (See Attachment 4 for program.) Chou explained that the workshop program consisted of a series of presentations, each of which was a summary of a white paper commissioned by SC-4 and mostly prepared by members of the RWG. He pointed out that the white paper process was a means for moving forward while the literature evaluation was still ongoing. Each white paper covered a specific topic, e.g., ocular effects, behavioral and cognitive effects, epidemiological studies of RF exposure, etc. The white papers are posted on the private part of the SC-4 website but will be moved to the public section for comments after this meeting. The comments are due by July 31st. The authors will consider all comments, make changes as necessary before submitting the papers for publication in a special issue of *Bioelectromagnetics*. The papers, which must be submitted to the Chief Editor by September 1st, will be independently peer-reviewed before publication.

6. SCC-28 EXCOM Report

ICES Chairman E. Adair explained that the ICES Executive Committee (EXCOM) would be meeting this evening and a full report will be given at the ICES main committee meeting the following day. She noted that the EXCOM meets frequently, either face-to-face or by teleconference. The last teleconference was in March. Some members of the EXCOM also met with members of the IEEE Standards Department in March to discuss a number of issues including fund-raising and the development of a mechanism for providing rapid response to the public and media about important issues. Issues regarding electronic balloting were discussed, specifically balloting by individuals who are not members of ICES. Fees for balloting by ICES members who are not IEEE-SA members was also discussed. Both issues were resolved to the satisfaction of the EXCOM.

Adair also discussed the program for attaining greater recognition internationally and acknowledged the work of the membership chairman, Tom McManus, who has recruited a number of key scientists from outside the US. The membership of ICES currently stands at 113 with approximately 30% from outside the US. Adair also recognized the chairman of the International Liaison Committee, Michael Murphy, for his work as a roving ambassador. Murphy has helped ensure that ICES is on the programs of the important international meetings, e.g., WHO EMF Project meetings, where standards development and harmonization are discussed.

The IEEE USA letter to the Honorable John Graham, Administrator, Office of Information and Regulatory Affairs, Office of Management and Budget (OMB) was also discussed. This letter asks for his support in encouraging federal agency participation in voluntary standards developed through an open consensus process, i.e., follow OMB Circular A-119; *Federal Participation in the Development and Use of Voluntary Consensus Standards and in Conformity Assessment Activities*. A follow-up letter will go out shortly to targeted agencies.

Adair also reviewed the status of the planned joint ICNIRP/ICES Thermal Physiology Workshop. The intent is to try to schedule the meeting in Dublin Ireland in May 2003 in conjunction with the COST 281 meeting. She briefly reviewed the recent WHO workshop and said that she had hoped new information on cells, tissue and organs would have been discussed. No firm conclusions were reached –the papers prepared by the participants are scheduled to be published.

Adair concluded by noting that she was invited to speak at the American Industrial Hygiene Association meeting in San Diego in May. J. Leonowich organized the session and she presented Leonowich's paper on the PAVE PAWS radar controversy plus her paper on ICES.

7. Literature Evaluation Working Group Reports

a) Literature Surveillance. Chou noted that L. Heynick, Chairman of the Literature Surveillance Working Group, would not be attending this meeting but had sent a report (see Attachment 5). Chou summarized the report noting that that there are now 1612 papers in the database – the latest citation list (List #27) is posted on the private and public parts of the SC-4 website. He said that L. Heynick asked whether he should stop now or continue adding papers. Sheppard recommended continuing adding papers because of the possible need for new papers during the BEMS review of the white papers. Meltz said that including new papers should be the white paper author's responsibility – he recommended that the authors not include papers in their summaries after List #27. He also asked for a cutoff on any obligations for reviewing papers after List #27 – but would allow chairs of the evaluation working groups to initiate review of any paper of seminal importance. Blick agreed but pointed out that the paper must be in the database in order to conduct a review. Meltz then suggested that papers should continue to be added but only papers on List #27 should be used unless of seminal importance.

MOTION

D. Blick moved that additional papers would not be added to database as of List 27 unless requested by working group chairs or white paper authors.

The motion was seconded by J. Cohen.

Swicord said that he was troubled that relevant papers may be overlooked if the motion passes. Scanlon said that he views the white papers as being independent. He recommended establishing a cutoff and including new papers, after list #27, as part of the review for the next revision. Sheppard suggested establishing a date after which papers would not be added. The question was called and the motion defeated with 4 in favor and the majority against.

Sheppard suggested closing the literature database to new submissions after the white papers have been submitted to BEMS – August 31, 2002 – with a second indeterminate cutoff date to include papers published before August 31st.

MOTION

C. K. Chou moved to establish December 31, 2002 as the cutoff date for adding new papers to the literature database.

The motion, which was seconded by J. Bushberg, carried with 26 in favor, 4 opposed and 3 abstentions. Cohen expressed concern that allowing papers in until December 31st would conflict with the goal of completing a subcommittee balloting draft by the same date.

b) ***In Vivo*****.** Blick reviewed the status of the *in vivo* evaluations and presented the following summary:

	4/5/2002	**6/28/2002**
Reviews requested	1040	~1060
Evaluations received	951	1001
Articles with completed reviews	419	449

Blick also provided a list of the reviewers and the number of papers reviewed by each (see Attachment 6) and expressed his appreciation to the reviewers.

c) Engineering. Blick reported (on W. Hurt's behalf) that 1717 requests for engineering evaluations have been sent out, 1563 have been completed, and 685 papers have been completely reviewed, i.e., 2 or more evaluations of each paper. A list of the reviewers and the number of papers reviewed by each is shown in Attachment 7.

d) *In vitro*. Meltz reported that he was behind in the *in vitro* reviews – 283 papers were out and 163 were returned. He said that the next few months would be devoted to white paper reviews but he would try to get back to the evaluations to catch up.

8. White Paper Reports

a) Thermoregulatory Responses to RF Energy Absorption (see Thermoregulatory Responses**).** Adair reported that the white paper "Thermoregulatory Responses," which was reviewed and cleaned up by D. Black, is about 50 pages in length. She summarized the presentation that she gave at the AF Workshop. She discussed some of the data, mentioned positive uses of RF energy, e.g., for treating hypothermia, and discussed computer models of the human thermoregulatory system. She also spent time discussing her research on humans, from which she concluded that at the SAR threshold of 4 W/kg, and sometimes higher, humans thermoregulate very efficiently – core temperature remains constant. She also discussed the thermoregulation profile for a number of species and presented sample data noting that she finds the data for non-human primates useful – they can thermoregulate at whole-body-average (WBA) SARs up to 5 W/kg. Her basic conclusion is that the present 4 W/kg threshold is adequate; 0.4 W/kg for humans is very conservative and should afford protection to all.

b) Behavioral and Cognitive Effects of Microwave Exposure (see Behavior**).** D'Andrea pointed out that a new rationale has been drafted that concludes that the basic restriction of 0.4 W/kg WBA SAR is supported by the data. He noted that the few chronic studies in the literature are not useful for setting standards because of the wide range in the data and inconsistent results.

c) Epidemiological studies of Radiofrequency Exposure. On behalf of Mark Elwood, Black discussed the limitations of epidemiology. He pointed out the limited power of ecological studies, noting that many times the follow-up studies do not support the initial findings, e.g., the Dolk study in the UK. Recent occupational studies of good design and statistical power have usually shown no effect. Meta analysis has not been applied to the RF studies but has been applied to those at ELF where the risk appears to be greater than 1. Ecological studies reporting sleep disturbances, etc., do not demonstrate risk. He said his conclusion is that the RF studies usually do not indicate a risk greater than 1 and that the data does not provide evidence of a problem or evidence of a threshold.

d) **Effects of Radiofrequency Exposure on Homeostasis and Metabolism.** Black reviewed the white paper on homeostasis. He noted that some hormones can be altered by thermal mechanisms but there seems to be no evidence of effects on hormones in humans or animals at SARs less than 4 W/kg. He said that some effects that are observed at 8 W/kg merely demonstrate that the system is functioning properly and are not important effects useful for standard setting. Some effects have been observed in humans at partial body exposures of 8 W/kg – it is not clear if these effects would persist after heat is conducted away from the exposed area. He concluded by noting that a no adverse effect level of 1 W/kg is well supported and probably conservative by a factor of 3-4 times.

e) **Radiofrequency Electromagnetic Fields and Cancer, Mutagenesis, and Genotoxicity (see** Cancer-Mutagenesis**).** Mason reviewed the report, which he said was primarily produced by L. Heynick with support from Polson, Johnston and himself. The report is 28 pages in length and includes *in vivo*, *in vitro* and epidemiological studies. Mason said that when he presented a summary of the report at the AF Workshop, he concentrated on mammalian studies. Included are the classical studies from about as far back as 1962 up to 1998+. He concluded by pointing out that numerous mammalian *in vivo* cancer studies, or cancer related studies, have been conducted over a wide frequency range but this substantial body of scientific evidence indicates no definitive effect of microwave exposure on cancer.

f) **Lifespan and Cancer (see** Lifespan**).** Elder reported that 16 studies fit the literature selection criteria. In general, the literature supports an association between lifespan and cancer, including cancer induced by ionizing radiation and chemicals. The RF studies do not support an association. He said that the most recent studies support the conclusions of the Chou/Guy Air Force study. The only paper showing an association was a paper by Little of the EPA that showed an effect at 6.8 W/kg but not at 2 W/kg. He concluded by stating that the weight of evidence in the RF studies describing lifespan data and cancer in the same animal populations showed that exposure to RF energy did not adversely affect lifespan at SARs equal or less than 2 W/kg or cancer development at WBA SARs equal to or less than 1.5 W/kg.

Sheppard noted that based on Little's data a 1°C temperature increase associated with a 6.8 W/kg exposure affects lifespan, but exposure at 2 W/kg does not. He noted that we now have two data points and asked if we could define a threshold temperature rise from these data.

g) **Ocular Effects (see** Occular Effects**).** Elder also presented the paper on Ocular effects. He noted that exposure of the eye to more than 150 W/kg for more than one half-hour will produce opacities in the eyes of rabbits and dogs but not in primates. This may be attributed to coupling associated with the facial features of the animals, e.g., the rabbit eyes protrude somewhat – monkey eyes are recessed. Exposure at levels that could cause opacities in the eyes of primates would first produce other effects, e.g., serious facial skin burns. He noted that the data reported by Kues, i.e., effects on the cornea and retina, is inconsistent and have not been replicated. The conclusion is that clinically significant ocular effects associated with exposure to RF energy have not been confirmed in human populations.

h) **Evoked Auditory Effect (see** Auditory Effect**).** Chou summarized the white paper on the evoked auditory response. He pointed out that the mechanism is similar to that of hearing acoustic sounds. The threshold is based on the energy density per pulse – the average and peak SAR are not relevant. The mechanism is thermoelastic in nature, i.e., the absorbed pulses create a pressure wave within the skull that couples into the hearing mechanism. He said that the auditory effect, which is usually only experienced under controlled conditions and in very quiet environments, is not considered adverse with respect to human health.

i) **Central Nervous System (see** CNS**).** D'Andrea presented an update on the progress of the CNS white paper – which is not yet complete. He said that it has been difficult to draw specific conclusions from the literature because of the varied experimental parameters, exposure protocols, subjects, endpoints and inconsistency of the results and, therefore, difficult to answer the question "will this represent an adverse health effect in

humans?" He pointed out that most of the papers have no clear relevance with regard to human health.

j) Calcium Efflux (see Calcium Efflux). Merritt acknowledged Heynick pointing out that his presentation at the AF Workshop was based mainly on Heynick's white paper **"**Radiofrequency Electromagnetic Fields and Calcium Efflux." He pointed out that because of the inconsistencies in the experimental results and the failures in the attempts to replicate many of the studies, the experimental results can not be used for standard setting. He concluded by reading the following statement from Greengard –"The effect of electromagnetic radiation on calcium efflux is potentially interesting, but further progress should be along more imaginative lines where the functional significance, if any, of this observation can be studied."

k) Teratogenesis and Developmental Studies (see Teratology). Merritt briefly summarized the presentation given at the AF Workshop. He pointed out that the experimental evidence indicates that exposure of pregnant mammals to RF radiation at levels that do not induce significant temperature increases are not teratogenic to the fetus. He also noted that modest maternal temperature increases may be associated with slight growth retardation *in utero,* an effect also seen with conventional heating. He concluded by stating that teratogenic activity associated with of RF exposure is clearly a thermal phenomenon.

l) *In Vitro* Studies of Possible Biological Effects of Radio Frequency Exposures, with *In Vivo* Correlation. Meltz reported that the white paper is about 46 pages in length at this time. He noted that it includes a tutorial on the meaning of individual reported biological effects, if they truly occur, with respect to other biological responses that are expected to happen. Cell kinetics and the relevance of single and double strand breaks are also discussed. He noted that an early draft of the paper has been posted to the private section of the SC-4 website. He explained that at low to moderate SARs, i.e., 2-5 W/kg, the weight of evidence of those *in vitro* studies that could most directly serve as indicators of possible *in vivo* adverse effects indicates an absence of effects, including cell killing, SCE, DNA damage, chromosome aberrations, phenotypic mutations, and cell transformation. His conclusion is that RF is not toxic to cells at low to moderate SARs. He noted that the white paper also looks at the literature relating to effects of chemicals and reviewed the distinction between bioeffect and health effect, and between *in vitro* and *in vivo* experiments. He concluded by pointing out that one should be careful when interpreting experimental results – an effect that may be necessary for something to happen may not be sufficient.

Adair noted the controversy over the use of cellular telephones and adverse health effects and asked whether the issue is sufficiently important to produce a white paper on that issue, e.g., by pulling together relevant sections of key white papers. Black said that he thought such a white paper would be important because of the unique exposure that is not normally considered in standards development. Chou agreed that this would be important and suggested that Black pursue the issue with D'Andrea, who is writing the CNS effect paper.

m) **One versus Two Tiers in RF Standards: Science, Policy and Myth (see One vs Two Tiers).** Tell presented the report on the paper which Erdreich and he had prepared. He pointed out that the presentation at the Air Force Workshop discussed two myths regarding the issue of one versus two tiers including 1) a scientifically based standard should have only one tier, and 2) two tiers are unnecessary and merely political. He noted that other topics discussed were whether the standards should be based on

temperature increase or behavioral disruption in laboratory animals, whether behavioral disruption is considered adverse, and the role of chronic exposure. He said that the real issue is that there appears to be no consensus within the committee on one versus two tiers and if 0.4 W/kg is safe for all.

9. Mechanism Working Group Report

Sheppard explained that he had been contacted by Adair, Tell and others to look into the issue of "Brillouin precursors." He presented the following statements and asked whether or not either should be included in the informative section of the revision because of the attention the topic is being given in reference to the PAVE PAWS radar controversy:

> 1) The hypothesized influence of Brillouin precursors was not considered because this minor feature of field propagation by pulses with exceptionally fast risetimes is unlikely to occur for realistic exposures and has much too small a fraction of total pulse energy to cause a biological effect.
>
> **OR**
>
> 2) Calculations predict that propagation of a microwave pulse with very rapid onset leads to separation of the low-frequency Fourier components, a "Brilliouin precursor", from the main pulse, which carries almost all the pulse energy. Because these low-frequency components are attenuated less than the high frequencies, after passing through a thick piece of tissue, the attenuated electric field amplitude at low frequencies exceeds the attenuated high frequency amplitude, although there is very much less energy in the low-frequency pulse. Brillouin precursors, and a corresponding effect when a pulse is rapidly switched off, have not been observed in biological tissue. Calculations show they do not occur for actual devices, such as radar, that do not meet the requirement for a field transition within a small fraction of the period of oscillation (for example, $<10^{-10}$ s for a 1 GHz field). If Brillouin precursors were to occur, the attenuated low-frequency components would have only a small fraction of the total pulse energy and any hypothetical low-energy effects attributable to these components would be dwarfed by effects of low frequency components in superficial tissues exposed to the unattenuated field. On the basis of their implausibility with practical exposures, their low energy content, and the absence of a mechanism for unique effects, further consideration would not advance risk assessment for RF exposures.

Sheppard noted that the phenomenon has not been observed in biological tissues. Osepchuk pointed out that the issue has been raised by one person and has not been brought forward to the committee by that person. He recommended that the issue not be addressed. Merritt agreed pointing out that since the phenomenon has not been observed in tissue, why bring it up at all? Osepchuk pointed out that the only support for the phenomenon being biologically important, other than from the person who raised the issue, is from a physicist who has done some work at optical wavelengths, who has no experience at microwave frequencies but who has been speaking with the press about microwaves. He said the issue is completely confused regarding biological implications and supporting evidence has never been presented in the peer-reviewed literature.

Tell thanked Sheppard on behalf of the Risk Assessment Working Group (RAWG) pointing out that he thought as a minimum the RAWG should get feedback on the issue – which Sheppard has done. Varanelli said that he supports Osepchuk – this is a non-issue that should not be part of

ICES deliberations. Gandhi also supported Varanelli and Osepchuk pointing out that extreme bandwidths are needed in order for the effect to occur. Chadwick agreed, adding that strong anomalous dispersion is also necessary for the effect to occur – the issue is irrelevant with respect to RF. In response to a question from McManus regarding who is espousing the issue, Sheppard replied that it was postulated by Dr. Albanese of the Air Force and has received recent notoriety when he related it to the transmissions from the PAVE PAWS radar on Cape Cod.

Sheppard asked the group to consider whether or not we would be in a stronger position if the issue were included in the informative section of the standard and dismissed or if we should not even dignify the issue and not include it. Chou noted that because of the controversy, a NAS/NRC committee is addressing the issue – he felt that we should address the issue but not include it in the standard. Osepchuk said that the issue is political – 99% politics and 1% science. In response to a question from Elder, Osepchuk replied that the NRC report is due in one year.

MOTION

Varanelli moved that in light of any evidence in the peer-reviewed scientific literature supporting Brillioun precursors as being biologically important at RF frequencies, this issue should not be included in deliberations regarding the revision of C95.1.

The motion was seconded by Adair.

Sheppard explained that the phenomenon exists in highly dispersive media and is reported in the literature – it is a real physical phenomenon – but there is no literature relating it to health effects. Johnston said that she supports all of the comments and added that since this is of public concern it should be addressed – but independent of the standard.

The question was called and the motion was approved with the majority in favor, 3 opposed and 3 abstentions.

10. Harmonization with ICNIRP

Murphy reported that ICES is being regularly represented at meetings along with ICNIRP and the amount of time given to ICES on the agenda has been steadily increasing. He also noted that plans for the joint ICES/ICNIRP thermophysiology workshop are progressing.

11. Risk Assessment Working Group

Tell provided background information about the RAWG by describing its history and purpose, e.g., provide a review of the literature evaluations as to the "riskiness" of RF exposure. He pointed out that the decision was made at the April 5th meeting of the Revision Working Group (RWG) that the revision would contain two tiers and that the RAWG should decide on a suitable SAR protective of all people. In lieu of a face-to-face meeting, extensive e-mail deliberations followed the April meeting regarding this issue and several meetings of the RAWG met a number of times during the BEMS meeting. He then reviewed a statement developed by RAWG members during the BEMS meeting. The draft is considered a best compromise statement resulting from the meetings at BEMS (see Attachment 8). Tell pointed out that some of the decisions were based on harmonizing with ICNIRP. Bassen said that he was concerned that the peak spatial average value selected in harmonization with ICNIRP was related to a specific organ – the eye – and asked whether other organs should be included. Swicord pointed out that in this case the eye is considered the most sensitive organ. He said that biological effects associated with other organs, e.g., a possible correlation with cancer is speculative at best. Elder agreed and pointed out that the conclusions reached by the expert panel at the WHO thermophysiology workshop is that the eye is the most sensitive organ to temperature rise.

Varanelli said that until the RAWG presents SC-4 with the weight of evidence supporting the position of the abbreviated rationale, voting on this document would be premature. Meltz argued that it is inappropriate to make broad challenges and asked Varanelli to be specific. Osepchuk thanked Tell. He said that it is difficult reaching consensus and the single page document is not too bad but needs some work. Tofani, referring to the ICNIRP peak spatial-average SAR being considered for adoption, said that it was not based on the threshold for cataracts but on limiting the temperature rise in the eye to < 1°C. Kuster asked why the defining volume was a cube – Tell replied that it was chosen for reasons of practicality and is consistent with current practices. Kuster thought that a sphere or hemisphere would be more appropriate.

Adair pointed out that the current debate over what to call the two tiers centers on the bases for the corresponding thresholds, e.g., sensitivity, temperature rise, etc. She said that the debate was resolved for the 1991 standard by defining the exposure environments, i.e., controlled and uncontrolled and asked why we are now going to occupational and public. Tell replied that it was consistent with ICNIRP and probably more meaningful to most people. Reilly recommended that SC-4 harmonize with SC-3 and use "general public" for the lower tier, which should be safe for all and which can be relaxed for controlled environments. He read the following two definitions from SC-3's'draft C95.6 standard:

> **general public:** All individuals who may experience exposure, excepting those in controlled environments.
>
> **controlled environment:** An area that is accessible to those who are aware of the potential for exposure as a concomitant of employment, to individuals cognizant of exposure and potential adverse effects, or where exposure is the incidental result of passage through areas posted with warnings, or where the environment is not accessible to the general public.

Weller said that he has a practical concern about the language associated with the use of two tiers, e.g., one based on 0.08 W/kg and the other on 0.4 W/kg. The concern is that while 0.08 W/kg may be considered safe for all, some may interpret 0.4 W/kg as being hazardous to some people and he recommended a single tier standard set at 0.08 W/kg. Tell said that there is really nothing going on at 0.4 W/kg except under certain environmental conditions where some people may be able to sense the exposure – but that is not considered a hazard. Meltz asked Adair if a person could sense exposure under some environmental conditions – Adair responded that they could not.

Osepchuk said that he is not in complete disagreement with the abbreviated rationale and pointed out an important difference between it an ICNIRP – specifically, the words in the ICES draft "additional safety margin," which implies that both levels are safe.

Varanelli said that he supports Reilly – the group should reflect carefully on the use of "occupational." Elder asked Cleveland about the terms used by the FCC – Cleveland replied that the FCC uses "occupational/controlled exposure" and "general public/uncontrolled exposure." Mason suggested deleting reason number 1 (Attachment 8) and changing number 3 to number 1 – which would be consistent with the procedures/philosophy of IEEE and other standards developing organizations. Varanelli again spoke against using the term "occupational" because it could be tied to 8 hr/day exposures. He pointed out that deliberations in the late 1980's resolved the issue of who was occupational and who was general public – RF worker versus office worker – by defining the exposure environments, i.e., controlled and uncontrolled. He recommended retaining the terminology used in the 1991 standard. Black pointed out that New Zealand and Australia retained "occupational" and "general public" but "controlled area" is being considered. He said that it is defined in the new Australian standard and tied to supervision.

Adair referred to page 18 of the 1999 edition of C.95.1 and read the following passage:

> "No verified reports exist of injury to human beings or of adverse effects on the health of human beings who have been exposed to electromagnetic fields within the limits of frequency and SAR specified by previous ANSI standards, including ANSI C95.1-1982. In the promulgation of revised guidelines, the responsibility of the current Subcommittee IV is adherence to the scientific base of data in the determination of exposure levels that will be safe not only for personnel in the working environment, but also for the public at large. The important distinction is not the population type, but the nature of the exposure environment. When exposure is in a controlled environment, the scientifically derived exposure limits apply. When exposure is in an uncontrolled environment, however, an extra safety factor is applied under certain conditions; these include, but are not limited to, the following:
>
> - Exposure in the resonant frequency range, and
> - Low-frequency exposure to electric fields where exposure is penetrating or complicated by associated hazards like RF shocks or burns induced by metal contacts.
>
> As defined earlier, uncontrolled environments include the domicile and most places where the infirm, the aged, and children are likely to be. It also includes the work environment where employees are not specifically involved in the operation or use of equipment that does or may radiate significant electromagnetic energy and where there are no expectations that the exposure levels may exceed those shown in Table 2. On the other hand, controlled environments may involve exposure of the general public as well as occupational personnel, e.g., in passing through areas such as an observation platform near a transmitting tower where analyses show the exposure may be above that shown in Table 2 but is below that in Table 1. Other exposure conditions include that of the radio amateur who voluntarily and knowledgeably operates in a controlled RF environment."

Tell noted that even those words are somewhat soft in that no hard evidence is included to back them up. Gettman said that he is concerned over the use of the word "chronic" since it is usually tied to the word "cancer." Tell pointed out that the tie would be incorrect since most chronic studies report negative results. Osepchuk agreed with both Gettman and Tell – the word "chronic" raises issues and the lack of positive chronic studies supports the conclusion.

During the lunch break the abbreviated rationale was revised (see Attachment 9). Elder suggested inserting the words "for most people" into the third sentence of the 1st paragraph and deleting the word "virtually," i.e.

"…margin of of safety, for chronic exposures in humans and is reconfirmed as safe **for most people** under ~~virtually~~ all environmental conditions."

Weller asked about the meaning of "reconfirmed" in the sentence since it conveys the concept of proven. Adair reviewed the rationale for the 1991 standard – after which Weller suggested changing the word to "reaffirmed."

Considerable discussion about the document followed. Swicord explained that the word "suggested" in the last sentence of the 2nd paragraph is inappropriate if regulatory agencies are expected to read the document. He called for a straw vote on its removal – the consensus was to leave it in. Bodemann said he was concerned about use of the word "chronic" in the first

paragraph unless the context in which it is used is supported by the science. Sheppard responded by noting that repeated exposure of animals where a slight temperature increase occurs suggests an absence of effects. Cohen suggested leaving in the word "chronic" because the standard is based on the interpretation of animal data. Bodemann said that his concern is that it may be misinterpreted by some as meaning there are effects down to WBA SARs of 0.08 W/kg under chronic exposure conditions.

Rogers brought up the issue of a cubical averaging volume for the peak spatial-average SAR. He pointed out that what may be a convenient shape for FDTD modelers may not necessarily be convenient to others, e.g., those that study the brain.

The issue of extremities was reviewed next, i.e., the arms and legs. Chou said that he spoke with Bill Guy who recalled that the original intent was to include the arms and the legs as extremities in the partial body relaxation – not just the hands, wrists, feet and ankles. Bassen asked whether the pinna would be included as an extremity. He pointed out that the issue is important for the SCC-34 standard on wireless handset SAR assessment. Adair said that it would be a mistake to include the arms and legs because of their large mass. Tofani again pointed out that the peak spatial-average SAR value in the ICNIRP guidelines is not based on the threshold for cataractogenesis but on limiting the temperature increase in the eye to less than 1°C.

Tell summarized by listing some of the topics that have to be addressed including, the rationale for the ICNIRP peak spatial-average SAR, the definition of extremeties and the 20 W/kg SAR values. Tofani suggested appropriate wording regarding the ICNIRP rationale (See Attachment 10, which also contains a number of other revisions that were agreed to – the changes are hi-lighted.) Tofani noted that the defining document for the ICNIRP biological basis for the peak spatial-average SAR is the 1998 Bernardi paper (IEEE MTT).

The discussion then went to defining the extremities. It was agreed that an appropriate definition would be the arms from the elbows down and the legs from the knees down – including the elbows and knees. Tell noted that Adair's concern about including the arms and legs seems to be associated with heating large masses of tissue. He pointed out that the basic restriction is still 0.4 W/kg – which limits the SAR anyway. Chou recalled his experience with RF hyperthermia applications and how difficult is was to heat tissue- even at high SARs. He said that Dr. Lehmann of the Universtiy of Washington showed a local SAR of at least 130 W/kg is needed to achieve a beneficial effect related to heating. For a 70 kg man, the allowed total of 28 W cannot produce much heating.

A number of straw votes were taken and consensus was reached on the following:

- Reaffirmed 4 W/kg as the adverse effect level.
- The WBA SAR for controlled exposure is 0.4 W/kg and 0.08 W/kg for exposure in uncontrolled environments.
- The peak spatial-average SAR limit will be the same as ICNIRP, i.e., 10 W/kg averaged over 10 g of tissue in the shape of a cube for exposure in controlled environments and 2 W/kg averaged over 10 g of tissue in the shape of a cube for exposures in uncontrolled environments.
- The partial-body relaxation values for the extremities, i.e., arms from the elbows down and legs from the knees down, are twice the above values, i.e., 20 W/kg and 4 W/kg averaged over 10 g of extremity tissues.

A straw poll on the following statement by Tofani was taken:

ICNIRP set as the partial body limit 10 W/kg averaged over 10 g of tissue to limit any possible temperature rise which may occur in the eye to 1°C or less. The eye is considered to be the most sensitive organ to temperature rise.

The majority were in favor (25), 8 opposed and 5 abstained.

A straw poll on the following was also taken:

Subcommittee 4 should proceed with the general concepts as proposed in the one-page abbreviated rationale, as amended in this session, with the understanding that the 0.4 W/kg level proposed must be supported with summary statements relative to this level from the various topic areas covered in the White Papers.

The majority were in favor, 3 opposed and 2 abstentions.

Bassen pointed out that while SC-4 may have accepted the revised abbreviated rationale as amended, except for FDA, none of the other regulatory agencies are here to vote.

The final abbreviated rationale statement is shown in Attachment 11.

12. Informative Section Discussions

a) **Annex A (approach to standard revision).** Swicord reported that no new material has been added to Annex A.

b) **Annex B (selecting an adverse effect - summary of the literature evaluation results).** Sheppard reported that an outline of what to do with the 1or 10 g averaging mass has been prepared.

c) **Annex C (explanation of maximum permissible exposure limits).** Tell noted that the material for Annex C has already been covered at this meeting.

d) **Annex D (technical similarities and differences in this standard and other protection guides).** Chou noted that today's decisions regarding comparisons with ICNIRP will be included in this Annex.

e) **Annex H. (practical example applications of standard).** DeFrank reported that there has been little progress since the last meeting and solicited assistance for drafting the sections on induced and contact currents, i.e., providing examples.

13. Interpretations Working Group

Adair reported that she has reviewed the recent induced current interpretation by Hatfield's Interpretations Working Group because of a request for a reinterpretation. This is a work in progress.

14. Other Old Business

a) **Biography of subcommittee members on the website.** Chou encouraged members to submit a photograph of themselves, similar to a passport photo, and a short – less than bout 300 words, for posting on the SC-4 website.

15. New Business

D'Andrea explained that the process is to flesh out the normative and informative sections of the revision in time for discussion at the September Revision Working Group meeting.

16. Date and Place of Next Meeting

a) 6th Revision Working Group meeting. The 6th Revision Working Group meeting will be held on September 9-10, 2002 in Washington DC.

b) **SCC28-SC4 meeting.** The next ICES series of meetings will be held in Houston TX in conjunction with the EMBS meeting. Tentative dates are Saturday, October 26, 2002 through noon, Tuesday, October 29th.

Chou asked for ideas on the venue for the spring 2003 meetings. He pointed out that one option would be to meet with BEMS in Maui Hawaii the 3rd week of June 2003. Another option would be to piggyback with the ICES/ICNIRP workshop, scheduled to be held in Dublin, Ireland in conjunction with the COST 281 meeting, in May 2003.

Chou asked for a show of hands of those in favor of Maui - > 50%

He then asked for a show of hands for Dublin - > 50%

He said that more than likely there will be an ICES presence at both meetings – the venue for the SC-4 meeting will be determined during the next few days.

18. Adjournment

There being no further business, upon a motion by M. Ziskin that was seconded by M. Swicord, the meeting was adjourned at 1545 h.

Summary of Motions

	Motion	Moved/Second	Results (Yay/Nay/Abstain)
1.	Additional papers will not be added to database as of List 27 unless requested by working group chairs or white paper authors.	Blick/Cohen	4/majority/0 (Failed)
2.	Establish December 31, 2002 as the cutoff date for adding new papers to the literature database.	Chou/Bushberg	26/4/3 (Passed)
3.	In light of any evidence in the peer-reviewed scientific literature supporting Brillioun precursors as being biologically important at RF frequencies, this issue should not be included in deliberations regarding the revision of C95.1.	Varanelli/Adair	Majority/3/3 (Passed)

ATTACHMENT 1

Attendance List

[M]

ICES SC4 Meeting

Quebec City, Quebec, Canada
June 29, 2002

	Last Name	First Name	Affiliation	Country	Status	E-mail
1.	Adair	Eleanor	Independent Consultant	US	M	eleanoradair@aol.com
2.	Adlkofer	Franz	Verun Foundation	DE	O	prof.adlkofer@verun-foundation.de
3.	Aslan	Edward	Narda Microwave Corp	US	M	Edward.aslan@L-3COM.com
4.	Baron	David	Holaday Industries, Inc.	US	M	baron006@tc.umn.edu
5.	Bassen	Howard	FDA/CDRH	US	O	hib@cdrh.fda.gov
6.	Black	David	IT Medicine Assoc Ltd	NZ	M	drblack@itmedical.com
7.	Blick	Dennis	AFRL/HEDR (Veridian)	US	M	dennis.blick@brooks.af.mil
8.	Bodemann	Ralf	Siemens AG	DE	M	ralf.bodemann@siemens.com
9.	Bushberg	Jerrold	U of C Davis	US	M	Jbushberg@ucdavis.edu
10.	Chadwick	Phillip	MCL	UK	M	phil.chadwick@mcluk.org
11.	Chikamoto	Kazuhiko	JANUS	JP	O	chika@janus.co.jp
12.	Chou	C.K.	Motorola, Inc.	US	M	ck.chou@motorola.com
13.	Cleveland	Robert	FCC	US	M	rclevela@fcc.gov
14.	Cohen	Jules	Independent Consultant	US	M	jcohen@denny.com
15.	Cyr	Howard	USFDA/CDRH	US	O	hwc@cdrh.fda.gov
16.	D'Andrea	John	Naval Health Research Ctr.	US	M	john.dandrea@navy.brooks.af.mil
17.	de Jager	Linda	Technikon Free State	ZA	M	ldejager@tofs.ac.za
18.	DeFrank	John	USACHPPM	US	M	john.defrank@amedd.army.mil
19.	Durrenberger	Gregor	ETH/IFH	CH	M	gregor@ifh.ee.ethz.ch
20.	Elder	Joe	Motorola	US	M	joe.elder@motorola.com
21.	Gajda	Greg	Health Canada	CA	O	greg_gajda@hc-sc.gc.ca
22.	Gettman	Ken	Nat Electrical Manuf Assoc.	US	M	ken_gettman@nema.org
23.	Haes	Donald	Independent Consultant	US	M	haes@mit.edu
24.	Hammer	Wayne	SPAWAR Systems Ctr.	US	M	hammerw@spawar.navy.mil
25.	Hubbard	Roy	Tech Serv Int	ZA	M	roy.hubbard@eskom.co.za
26.	Hurt	William	USAF Res Lab	US	O	william.hurt@brooks.af.mil
27.	Ivans	Veronica	Medtronic Inc	US	M	veronica.ivans@medtronic.com
28.	Jaffa	Kent	Pacificorp	US	O	kent.jaffa@pacificorp.com
29.	Johnston	Sheila	Independent Consultant	US	M	sajohnston@btclick.com
30.	King	James	Department of the Navy	US	O	jjking@us.med.navy.mil
31.	Kuster	Niels	IT'IS	CH	O	kuster@it is.ethz.ch
32.	Lathrop	Janet	Resource Strategies Inc	US	O	jclathrop@fcgnetworks.net
33.	Leonowich	John	Battelle Pacific NW Nat Lab	US	M	john.leonowich@pnl.gov
34.	Mason	Patrick	USAF/AFRL/HEDR	US	M	patrick.mason@brooks.af.mil
35.	McKenzie	Roy	Telstra Res Lab	AU	O	roy.mckenzie@team.telstra.com
36.	McManus	Tom	Dept. Public Enterprise	IE	M	tommcmanus@dpe.ie
37.	Meltz	Martin	Ctr. for Env. Rad. Tox.	US	M	meltz@uthscsa.edu
38.	Merritt	James	USAF Research Lab	US	O	james.merritt@brooks.af.mil
39.	Murphy	Michael	AFRL/HEDR	US	M	michael.murphy@brooks.af.mil
40.	Nappert	Hughes	Industry Canada	CA	O	nappert.hughes@ic.gc.ca
41.	Needy	Robert	Naval Surface Warfare Ctr.	US	M	needyri@nswc.navy.mil
42.	Osepchuk	John	Full Spectrum Consulting	US	M	j.m.osepchuk@ieee.org
43.	Pakhomov	Andrei	McKesson Bio Services	US	M	andrei.pakhomov@brooks.af.mil
44.	Petersen	Ronald	Independent Consultant	US	M	r.c.petersen@ieee.org

ATTACHMENT 1

	Last Name	First Name	Affiliation	Country	Status	E-mail
45.	Reilly	J. Patrick	Metatec Associates	US	M	jpatrickreilly@erols.com
46.	Rogers	Walter	Veridian	US	O	walter.rogers@brooks.af.mil
47.	Scanlon	William	Queens University, Belfast	IE	M	w.scanlon@ee.qub.ac.uk
48.	Sekijima	Masaru	Mistubishi Safety Inst	JP	O	m-sekijima@ankaken.co.jp
49.	Sheppard	Asher	Asher Sheppard Consulting	US	M	ashersheppard@compuserve.com
50.	Sutton	Carl	Independent Consultant	US	M	doctorchs@aol.com
51.	Swicord	Mays	Motorola	US	M	mays.swicord@motorola.com
52.	Tattersall	John	DSTL	UK	M	jtattersall@dstl.gov.uk
53.	Tell	Richard	Richard Tell Assoc. Inc.	US	M	rtell@radhaz.com
54.	Thansandote	Art	Health Canada	CA	M	art_thansandote@hc-sc.gc.ca
55.	Tofani	Santi	Servizio Di Fisica Sanitaria	IT	M	fisicasan@asl.ivrea.to.it
56.	van Rongen	Eric	H Council of the Netherlands	NL	M	e.van.rongen@gr.nl
57.	Varanelli	Arthur	Raytheon Company	US	M	a.g.varanelli@ieee.org
58.	Vebayashi	Shinji	NTT Do Co Mo Inc	JP	O	vebayasi@mlab.yrp.nttdocomo.co.jp
59.	Wagenaar	Femme-Michelle	KPN Netherlands	NL	M	mailher@heroffice.org
60.	Wake	Kanako	Comm Res Lab	JP	O	kana@crl.go.jp
61.	Weller	Robert	Hammett&Edison	US	M	rweller@h-e.com
62.	Ziriax	John	USN NHRC-Det	US	O	john.ziriax@brooks.af.mil
63.	Ziskin, MD	Marvin	Temple Univ. Med School	US	M	ziskin@temple.edu
64.	Zollman	Peter	Vodafone Group R&D	UK	O	peter.zollman@vodafone.com

M =Member
O =Observer

INTERNATIONAL COMMITTEE *on* ELECTROMAGNETIC SAFETY

ATTACHMENT 2

IEEE/ICES SCC-28 Subcommittee 4

Safety Levels with Respect to Human Exposure to Radio Frequency Electromagnetic Fields, 3 kHz to 300 GHz

June 29, 2002
8:00 am – 5:00 pm
Hotel Loews Le Concorde
1225 cours du General De Montcalm
Québec City, Québec G1R 4W6 Canada

Agenda

1.	Call to Order	*D'Andrea/Chou*
2.	Introduction of those Present	*All*
3.	Approval of Agenda	*D'Andrea/Chou*
4.	Approval of the Minutes of January 19, 2002 Meeting	*D'Andrea/Chou*
5.	Secretary's Report	*Petersen*
6.	Chairman's Report	*D'Andrea/Chou*
	a) SC4 approved guidelines and time schedule	
	b) AF Workshop	
	c) BEMS special issue	
7.	SCC28 EXCOM Report	*Adair*
8.	Risk Assessment Working Group Report	*Tell*
9.	Mechanism Working Group Report	*Sheppard*
10.	Harmonization with ICNIRP	*Petersen*
11.	Literature Evaluation Working Group Reports	
	a) Literature Surveillance and Database Software	*Heynick/Morrissey*
	b) Engineering	*Hurt*
	c) In Vitro	*Meltz*
	d) In Vivo	*Blick*
	e) Epidemiology	*Ruscio*
	f) Literature review results dissemination	*Petersen*

12. Normative Section Discussions *Tell*

13. Informative Section discussions

    a) Annex A (approach to standard revision) (Swicord/Erdreich)

    b) Annex B (selecting an adverse effect - summary of the literature evaluation results (Sheppard)

    c) Annex C (explanation of maximum permissible exposure limits) (Tell)

    d) Annex D (Elder)

    e) Annex H (DeFrank)

14. Editorial Committee Reports

    a) Sixth Revision Working Group meeting and time schedule *Chou*

    b) White paper reports

        1) Thermoregulatory Responses to RF Energy Absorption (*Adair)*

        2) Behavioral and Cognitive Effects of Microwave Exposure (*D'Andrea*)

        3) Epidemiological studies of Radiofrequency Exposure (*Black*)

        4) Radiofrequency Electromagnetic Fields and Cancer, Mutagenesis, and Genotoxicity (*Mason*)

        5) Lifespan and Cancer in Laboratory Mammals Exposed to Radiofrequency Fields (*Elder)*

        6) Microwave Effects on the Nervous System (*D'Andrea*)

        7) Ocular Effects of Radiofrequency Exposure (*Elder*)

        8) Human Perception of Pulsed Radiofrequency Exposure (*Chou*)

        9) Radiofrequency Electromagnetic Fields as Related to Teratogenesis and Developmental Abnormalities (*Merritt*)

        10) Effects of Radiofrequency Exposure on Homeostasis and Metabolism (*Black*)

        11) Radiofrequency Electromagnetic Fields and Calcium Efflux (*Merritt*)

        12) In Vitro Studies of Possible Biological Effects of Radio Frequency Exposures, with In Vivo Correlation (*Meltz*)

        13) One vs. Two Tiers in RF Standards: Science, Policy and Myth (*Erdreich*)

15. Interpretations Working Group *Hatfield*

16. Other Old Business

    a) Biography of subcommittee members on the website *Chou*

17. New Business

18. Date and Place of Next Meeting *D'Andrea/Chou*

    a) 6th Revision Working Group meeting September 9-10, 2002 in Washington DC

    b) SCC28-SC4 meeting, October/November 2002

19. Adjournment

ATTACHMENT 3

IEEE/ICES SCC-28 Subcommittee 4

4th Revision Working Group Meeting Summary

Fort Lauderdale, Florida

Participants:

Adair, Blick, Chou (Chair), Cleveland, Curtis (1st day only), D'Andrea, Elder, Heynick, Hurt, Kantner, Kuster, Lang, Leonowich, Lotz, Morrissey, Owen, Petersen, Roberts, Sheppard, Swicord, Tell, Ziskin.

Based on our current understanding and pending the conclusion of the review and white paper process, the consensus of the Revision Working Group is as follows:

1. The RF safety standard should be based on science.
2. RF safety standard revision should be derived from peer-reviewed publications and documents that are reviewed by the SC4.
3. The adverse effect level remains at 4 W/kg subject to revision following completion of the literature evaluation and white papers.
4. The maximum exposure limits should be based on established adverse effects after inclusion of an appropriate safety factor(s).
5. Safety factor(s) should consider uncertainties in the biological database (e.g., measurements, environmental conditions, exposure duration, individual variability, and other factors.)
6. Non-thermal RF biological effects have not been established and none of the reported non-thermal effects are proven adverse to health (does not apply to electro-stimulation). Thermal effect is the only established adverse effect.
7. The microwave hearing effect is not adverse and should not be used for setting the peak power limit.
8. The shape and size of the averaging volume and the peak SAR are still to be determined. The important end point is the temperature change.
9. RF standard should be harmonized with other international standards to the extent where scientifically defensible.
10. Rationales must be documented for all changes relative to the current standard.
11. The editorial committee will add in the informative section a paragraph dealing with potentially sensitive subpopulations, such as children.
12. Reconsider the two-tier approach (whole body average SAR 0.4 and 0.08 W/kg) the peak SAR value and the averaging volume.

ATTACHMENT 4

Setting a Science-Based Standard for Safe Human Exposure to RF Electromagnetic Fields: A Tribute to Dr. Eleanor R. Adair

U.S. AIR FORCE LABORATORY WORKSHOP

24th Bioelectromagnetics Meeting in Quebec, Canada
Loews le Concorde Hotel, Room: Borduas Ballroom (3rd Floor),
June 23, 2002

Time	Topic	Presenter
9:00	Introduction	Michael Murphy
9:10	The IEEE Standards Process & the Creation of ICES	John Osepchuk
9:30	Thermoregulatory Responses to RF Energy Absorption	Eleanor Adair
10:00	Behavioral and Cognitive Effects of Microwave Exposure	John D'Andrea
10:30	Break	
10:45	RF EMF and Calcium Efflux	Jim Merritt
11:15	RF EMF and Cancer, Mutagenesis, and Genotoxicity	Patrick Mason
11:45	Lifespan & Cancer in Laboratory Mammals Exposed to RF	Joe Elder
12:15	Lunch Break	
13:15	Microwave Effects on the Nervous System	John D'Andrea
13:45	Ocular Effects of RF Exposure	Joe Elder
14:15	Human Perception of Pulsed RF Exposure	C.K. Chou
14:45	Epidemiological studies of RF Exposure	David Black
15:15	Break	
15:30	Effects of RF Exposure on Homeostasis and Metabolism	David Black
16:00	RF EMF as Related to Teratogenesis and Developmental Abnormalities	Jim Merritt
16:30	RFR Biological Effects - *In Vitro* Studies with *in Vivo* Correlation	Marty Meltz
17:00	One vs. Two Tiers in RF Standards: Science, Policy and Myth	Linda Erdreich
17:30	SC4 Concluding remarks	John D'Andrea C.K. Chou
17:35	Adjourn	

(This is an open meeting; all are invited.)

Lou Heynick Literature surveillance report:

The Edition-27 citation lists were emailed to the members of the RAWG a few weeks ago. The accession number of the last citation is 1612. The LSWG part of the database was correspondingly updated, and the "articles" and "diskid" files were emailed to the WG Chairs.

ACTION ITEM:

A formal decision is needed about whether to set a cutoff date, i.e., whether this is to be the final edition.

ATTACHMENT 6

Activity of In Vivo Reviewers by Year
(Sorted by number of completed reviews)

NAME	PRE 1998	1998	1999	2000	2001	2002	TOTAL	OUT
Adair, E.	27	16	32	25	29	14	143	0
Blick, D.			53	24	25	22	124	0
Morrissey, J.		4	15	19	27	16	81	2
DeLorge, J.			48	18			66	*
Lu, S.-T.		5	12	20	8	6	51	10
Miller, S.			28	5		10	43	2
Murphy, M.	9	2	16	2		7	36	4
Seaman, R.			9	13	7	6	35	0
Jauchem, J.		8	16	5		5	34	0
Utteridge, T.				15	11	8	34	6
Lapin, G.			25	7			32	*
Ziskin, M.			12	10	4	6	32	3
Cobb, B.	1	12	13	2		2	30	2
Merritt, J.			8			19	27	0
Tattersall, J.				11	8	7	26	0
Vijay			8	6	9	3	26	0
Spiers, D.			8	16			24	*
Ryan, K.			22	1			23	*
Marmaro, G.		7	13				20	*
Babij, T.		9			8		17	*
Bellier, P.					15		15	7
Lai, H.	11	1					12	*
Johnston, S.						11	11	0
Black, D.					1	7	8	0
Elson, E.		8					8	*
Bushberg, J.				7			7	5
McNamee, J.					2	5	7	6
#63, anonymous				5			5	1
Orr, J.			5				5	*
Walters, T.		2	3				5	*
Frei, M.	4						4	*
Mason, P.		4					4	*
Lotz, G			2				2	*
Wenger, C. B.			1				1	*
TOTAL	52	78	349	211	154	154	998	48

*Indicates reviewer not currently active

NOTE: Totals mat not correspond exactly to numbers in RAWG database as a few papers may not have been properly credited to reviewers prior to 1998.

ATTACHMENT 7

IEEE/ICES –SCC 28, SC4, RFR Lit. Rev, Eng. WG Membership

	# of Evaluations	DoE		# of Evaluations	DoE
E. Aslan*	105	8/93	C. Hicks, Jr.	60	9/94
T. Babij	27	8/93	W. Hurt*	104	8/93
Q. Balzano	25	7/93	M. Israel*	29	1/01
H. Bassen*	87	8/93	N. Kuster	27	8/93
P. Chadwick*	20	1/01	J. Leonowich*	39	8/94
C.K. Chou*	86	7/97	J. Lin	26	9/94
J. Cohen*	104	7/93	E. Mantiply	66	8/93
J. DeFrank*	69	12/96	S. Maurer	24	8/93
C. DiNallo*	10	1/01	M. Moore*	106	12/95
A. Faraone*	40	4/99	R. Olsen	86	7/93
K. Foster*	92	8/93	J. Osepchuk*	82	8/93
G. Gajda*	26	3/01	R. Peterson*	58	7/93
D. Hadlock	6	8/93	A. Varanelli	15	10/96
J. Hatfield*	107	7/93	L. Williams, Jr.	67	8/94

-- active

DRAFT Abbreviated Rationale for Revised C95.1-200X Standard

Prepared by the

Risk Assessment Working Group

(1) Whole-body average SAR in the frequency range where SAR is appropriate

In the twelve years since the publication of C95.1 standard, substantial additional human and laboratory data, including studies of chronic exposure, have been developed regarding the potential health effects of RF exposure. The weight of the evidence continues to support the determinations made in the previous standard in regard to the threshold for potentially adverse health effects for short term exposures at about 4 W/kg. Consistent with the philosophy of the prior standard, a ten-fold safety factor has been applied to this threshold to account for chronic exposures (0.4 W/kg) and is reconfirmed as safe under virtually all environmental conditions. This level is also consistent with a no observed adverse effects level (NOAEL) in the biological database for chronic exposures. To be conservative, it is recommended for occupational or other settings for which an RF safety program exists.

A reasonable scientific argument could be made for a single tier standard at the 0.4 W/kg exposure level based on the biological effects database for potentially adverse health effects. However, similar to the previous standard, a lower tier, incorporating an additional five-fold margin of safety, is suggested for the general public for the following reasons:

1. Under all environmental conditions, the additional level of RF energy absorption at 0.08 W/kg is expected to be innocuous;
2. This approach is consistent with other well established health and safety standards for RF exposure;
3. It is traditional to afford the general public a greater margin of safety than for occupationally exposed individuals.

(2) Partial-body SAR in the frequency range where SAR is appropriate

Occupational exposure: SAR $\leq$ 10 W/kg in any 10 grams of tissue in the shape of a cube.

General public exposure: SAR $\leq$ 2 W/kg in any 10 grams of tissue in the shape of a cube.

The peak SAR limits are harmonized to the ICNIRP guidelines, based on one-tenth of the cataractogenic threshold of 100 W/kg within any 10 grams for occupational exposures and one-fiftieth of the cataractogenic threshold within any 10 grams for general public exposures. This reflects the biologically based rationale offered by ICNIRP and departs from a dosimetry based approach used by IEEE.

The averaging times for SARs remain the same as in the current draft of C95.1-200X.

DRAFT Abbreviated Rationale for Revised C95.1-200X Standard

Prepared by the
Risk Assessment Working Group
June 28, 2002

(1) Whole-body average SAR in the frequency range where SAR is appropriate

In the twelve years since the publication of C95.1 standard, substantial additional human and laboratory data, including studies of chronic exposure, have been developed regarding the potential health effects of RF exposure. The weight of the evidence continues to support the determinations made in the previous standard in regard to the threshold for potentially adverse health effects for short term exposures at about 4 W/kg. Consistent with the philosophy of the prior standard, a ten-fold safety factor (0.4 W/kg) has been applied to this threshold to provide an additional margin of safety for chronic exposures in humans and is reaffirmed as safe for most people under (virtually?) all environmental conditions. This level is also consistent with a no observed adverse effects level (NOAEL) in the biological database for chronic exposures in animals. To be conservative, 0.4 W/kg is recommended as the limit for controlled exposures such as may occur in occupational settings for which an RF safety program exists.

A reasonable scientific argument could be made for a single tier standard at the 0.4 W/kg exposure level based on the biological effects database for potentially adverse health effects. However, similar to the previous standard, a lower tier, incorporating an additional five-fold margin of safety, is included for uncontrolled environments for the following reasons:

1. It is traditional to afford the general public a greater margin of safety than for occupationally exposed individuals.
2. This approach is consistent with the previous IEEE standard and most other health and safety standards for RF exposure.

(2) Partial-body SAR in the frequency range where SAR is appropriate

Controlled exposure: SAR ≤ 10 W/kg in any 10 grams of tissue in the shape of a cube.

Uncontrolled exposure: SAR ≤ 2 W/kg in any 10 grams of tissue in the shape of a cube.

The peak SAR limits are harmonized to the ICNIRP guidelines, based on one-tenth of the cataractogenic threshold of 100 W/kg within any 10 grams for occupational exposures and one-fiftieth of the cataractogenic threshold within any 10 grams for general public exposures. This reflects the biologically-based rationale offered by ICNIRP and departs from a dosimetry-based approach used previously by IEEE. For limbs (arms and legs), the peak SAR limits are twice the above values, i.e., 20 W/kg and 4 W/kg averaged over 10 g limb tissues. This change reflects a correction for the extremities in the current C95.1, which only include hands, wrists, feet and ankles, and also harmonizes with the ICNIRP guidelines.

The averaging times for SARs remain the same as in the current draft of C95.1-200X.

DRAFT Abbreviated Rationale for Revised C95.1-200X Standard

Prepared by the
Risk Assessment Working Group
June 28, 2002

(1) Whole-body average SAR in the frequency range where SAR is appropriate

In the twelve years since the publication of C95.1 standard, substantial additional human and laboratory data, including studies of chronic exposure, have been developed regarding the potential health effects of RF exposure. The weight of the evidence continues to support the determinations made in the previous standard in regard to the threshold for potentially adverse health effects for short term exposures at about 4 W/kg. Consistent with the philosophy of the prior standard, a ten-fold safety factor (0.4 W/kg) has been applied to this **threshold yielding an SAR of 0.4 W/kg which is reaffirmed safe under all environmental conditions**. ~~to provide an additional margin of safety for chronic exposures in humans and is reaffirmed as safe for most people under (virtually?) all environmental conditions.~~ This level is also consistent with a no observed adverse effects level (NOAEL) in the biological database for chronic exposures in animals. To be conservative, 0.4 W/kg is recommended as the limit for controlled exposures such as may occur in occupational settings for which an RF safety program exists.

A reasonable scientific argument could be made for a single tier standard at the 0.4 W/kg exposure level based on the biological effects database for potentially adverse health effects. However, similar to the previous standard, a lower tier, incorporating an additional five-fold margin of safety **yielding an SAR of 0.8 W/kg**, is included for uncontrolled ~~environments~~ **exposures** for the following reasons:

1. It is traditional to afford the general public a greater margin of safety than for occupationally exposed individuals.
2. This approach is consistent with the previous IEEE standard and most other health and safety standards for RF exposure.

(2) Partial-body SAR in the frequency range where SAR is appropriate

Controlled exposure: SAR ≤ 10 W/kg in any 10 grams of tissue in the shape of a cube.

Uncontrolled exposure: SAR ≤ 2 W/kg in any 10 grams of tissue in the shape of a cube.

ICNIRP set as the partial body limit 10 W/kg averaged over 10 g of tissue to limit any possible temperature rise which may occur in the eye to 1°C or less. The eye is considered to be the most sensitive organ to temperature rise. ~~The peak SAR limits are harmonized to the ICNIRP guidelines based on on tenth of the cataractogenic threshold of 100 W/kg within any 10 grams for occupational exposures and one-fiftieth of the cataractogenic threshold within any 10 grams for general public exposures.~~ This **IEEE recommendation** reflects the biologically-based rationale offered by ICNIRP and departs from a dosimetry-based approach used previously by IEEE. For **extremeties (from elbows down and knees down)**, ~~limbs (arms and legs),~~ the peak

SAR limits are twice the above values, i.e., 20 W/kg and 4 W/kg averaged over 10 g of **extremity** ~~limb~~ tissues. This change reflects a correction for the extremities in the current C95.1, which only include hands**.** ~~, wrists, feet and ankles, and also harmonizes with the ICNIRP guidelines.~~

The averaging times for SARs remain the same as in the current draft of C95.1-200X.

DRAFT Abbreviated Rationale for Revised C95.1-200X Standard

Prepared by the
Risk Assessment Working Group
June 28, 2002

(1) Whole-body average SAR in the frequency range where SAR is appropriate

In the twelve years since the publication of C95.1 standard, substantial additional human and laboratory data, including studies of chronic exposure, have been developed regarding the potential health effects of RF exposure. The weight of the evidence continues to support the determinations made in the previous standard in regard to the threshold for potentially adverse health effects for short term exposures at about 4 W/kg. Consistent with the philosophy of the prior standard, a ten-fold safety factor) has been applied to this threshold yielding an SAR of 0.4 W/kg which is reaffirmed safe under all environmental conditions. This level is also consistent with a no observed adverse effects level (NOAEL) in the biological database for chronic exposures in animals. To be conservative, 0.4 W/kg is recommended as the limit for controlled exposures such as may occur in occupational settings for which an RF safety program exists.

A reasonable scientific argument could be made for a single tier standard at the 0.4 W/kg exposure level based on the biological effects database for potentially adverse health effects. However, similar to the previous standard, a lower tier, incorporating an additional five-fold margin of safety yielding an SAR of 0.08 W/kg, is included for uncontrolled exposures for the following reasons:

1. It is traditional to afford the general public a greater margin of safety than for occupationally exposed individuals.
2. This approach is consistent with the previous IEEE standard and most other health and safety standards for RF exposure.

(2) Partial-body SAR in the frequency range where SAR is appropriate

- Controlled exposure: SAR ≤ 10 W/kg in any 10 grams of tissue in the shape of a cube.
- Uncontrolled exposure: SAR ≤ 2 W/kg in any 10 grams of tissue in the shape of a cube.

ICNIRP set as the partial body limit 10 W/kg averaged over 10 gr of tissue to limit any possible temperature rise which may occur in the eye to 1 °C or less. The eye is considered to be the most sensitive organ to temperature rise. This IEEE recommendation reflects the biologically-based rationale offered by ICNIRP and departs from a dosimetry-based approach used previously by IEEE. For extremities (from elbows

down and knees down), the peak SAR limits are twice the above values, i.e., 20 W/kg and 4 W/kg averaged over 10 g of extremity tissues. This change reflects a correction for the extremities in the current C95.1, which only includes hands, wrists, feet and ankles. .

The averaging times for SARs remain the same as in the current draft of C95.1-200X.