



# **ICES**

## *International Committee on Electromagnetic Safety*

### *Approved Minutes*

#### **IEEE/ICES TC95 Subcommittee 4**

#### **Safety Levels with Respect to Human Exposure to Radio Frequency**

#### **Electromagnetic Fields, 3 kHz to 300 GHz**

#### **Nokia House**

#### **6000 Connection Drive, Irving TX**

#### **Building NH1, Room 150**

**29 November 2007 (Thursday)**

**1300 – 1700 h**

**1. Call to Order**

Co-chairman Ziskin called the meeting to order at 1305 h.

**2. Introduction of those Present**

Those in attendance introduced themselves (see Attachment 1 for list of attendees).

**3. Approval of Agenda**

Following a motion by Hatfield that was seconded by Cohen, the agenda was approved without modification. (See Attachment 2 for agenda.)

**4. Approval of the Minutes of 1 March 2007 Meeting**

Following a motion by Meltz that was seconded by Murphy, the minutes of the 1 March 2007 London meeting were approved without modification.

**5. Secretary's Report**

Petersen reported that the following four TC95 standards require action before 31 December 2007: C95.3-2002: (RF measurements and computation, 100 kHz to 300 GHz); C95.4-2002: (Safe distance from antennas during blasting operations); C95.6-2002: (Safety levels, 0 to 3 kHz); and 1460-1996: (Guide for measurement of quasi-static electric and magnetic fields). He noted that all four are undergoing reaffirmation balloting. The reaffirmation of C95.6 (for five years) has been approved by the balloting group and is on the IEEE SA Standards Board's

(SASB) Review Committee (RevCom) agenda for the December meeting (see Attachment 3.) The reaffirmation of C95.4 has also been approved and will be on the RevCom agenda for the March SASB meeting. Petersen also pointed out that action will be required by 31 December 2010 on C95.1-2005 (Safety levels, 3 kHz – 300 GHz), C95.2-1999 (R 2005) (RF energy and current flow symbols), and C95.7-2005 (RF safety programs). He suggested that SC4 and SC3 think about combining C95.1 and C95.6 into a new standard that would cover the frequency range of 0 to 300 GHz. A good time to begin the process might be immediately after approval of C95.1a-200X (Amendment to clarify localized exposure and peak power density issues and include ceiling values for induced and contact current).

## **6. Chairman's Report**

Chairman Ziskin said that the Chairman's report would mainly be a review of the open action items from previous meetings, which would be covered under "Old Business" – Item 7a.

## **7. Old Business**

### **a. Matters arising from the minutes**

Ziskin referred to the list of open action items from the March meeting (see Attachment 4). He noted that several of these will be addressed at this meeting. Item 1 is still open, Item 2 is still open – awaiting IEEE approval for publication of a short version of a paper on IEEE C95.1-2005 in *The Institute*, perhaps in January, and a longer more detailed version, perhaps in *Health Physics*. Item 3 is open, Item 4 will be discussed at this meeting, Item 5 – the short courses scheduled for this meeting were cancelled and will be reconsidered for the San Diego meeting, Item 6 will be addressed later at this meeting, Item 7 will be addressed later at this meeting and a proposed amendment will be discussed at the San Diego meeting, Item 8 is also open and will be discussed at this meeting, Item 9 has been completed (see Attachment 5), Item 10 is ongoing, and Item 11 is ongoing – Meltz is in the process of collecting relevant data.

### **b. Literature surveillance**

Morrissey provided an update on the literature surveillance process (see Attachment 6). He pointed out that the number of publications seems to be increasing, especially papers having to do with mobile telephones – not only papers reporting bioeffects, but papers describing social issues as well, e.g., rudeness, use of mobile phones while driving. He encouraged starting early with the review process while the number of papers is relatively small and manageable. In response to a question from Ziskin, Morrissey explained that about 160 new relevant papers have been published within the past year with the great majority pertaining to mobile telephone studies. He also noted that there are now more than 3000 citations in the IEEE/WHO database.

### **c. Literature review/evaluation**

Morrissey briefly discussed some of the epidemiology data from the Interphone Study. He noted that while many of the studies show low odds ratios, one should not place too much weight on these studies and neglect many important *in vivo* studies that have been published recently, e.g., studies reporting gene expression changes – including stress response genes. He also noted that the results of some *in vitro* studies that report athermal effects might be artifactual, e.g., associated with unexpected hot spots in the sample. He briefly discussed some of the "sleep" studies and said that it is not clear if there is a connection with human health. Each study is a piece of the puzzle and it's still not clear how they all fit together.

Lang pointed out that questions remain regarding the effectiveness of the cooling systems used in many of the in vitro studies and whether they preclude the possibility of thermal gradients. Cleveland noted that this would be a topic of a roundtable discussion at BEMS 2008. Elder noted that he hasn't seen any reports published since the literature cutoff date for the C95.1-2005 standard that would change the weight of evidence.

Johnston reported on the Sleep Workshop held recently in Stuttgart. She said it was a significant workshop with a good mix of scientists and the bottom line is that effects of RF on sleep are small and not biologically significant. She pointed out that the focus on  $\alpha$ -rhythms may be meaningless since approximately 20% of the population may not even exhibit significant  $\alpha$ -rhythms. Bailey noted that there is  $\alpha$ -rhythm feedback to the ocular system, i.e., an ocular-motor feedback system that may be relevant. Swicord noted that there are large differences in the studies and their results. Effects are often small in magnitude and not consistent in direction and repeatability, the definition of "alpha" EEG spectrum is inconsistent, recordings may have been taken before, during, or after sleep, there are differences in spectral content of the signals, and there is significant inter- and intra-individual variation. This makes the practice of averaging  $\alpha$ -rhythm data probably the least reliable method for examining data, which he said is an important take-home message. Morrissey asked if we can make a clear connection with EEG data and health, e.g., similar to the evoked auditory response, a repeatable effect that is not considered adverse to human health. If we can't, should the data even be reviewed? Swicord explained that we must first determine if the effect is established and then make a decision. Johnston agreed pointing out it is too early to make a decision.

**d. Health Physics article**

Ziskin reported that he contacted Susan Hassler, an *IEEE Spectrum* editor, several months ago regarding publishing a press release on C95.1-2005. Hassler informed Ziskin that *IEEE Spectrum* does not publish press releases and referred him to Kathy Kowalenko, Editor, *The Institute*. Kowalenko was interested in publishing a short article sometime during the beginning of next year. In the meantime, there is still interest in publishing a longer article elsewhere, perhaps in *Health Physics*.

**e. Temperature vs. peak spatial-average SAR**

As a follow-up to AI 6 of the March 2007 SC4 meeting, the following motion was introduced by Meltz and seconded by Chou:

**Motion: Move that ICES TC95/SC4 pursue the investigation of relationships between localized tissue temperature increase and peak spatial-average SAR (100 kHz to 3 GHz) or power density (3 GHz to 300 GHz) as a basis for revising the localized exposure limits at frequencies from 100 kHz to 300 GHz.**

**Discussion:** Chou reviewed discussions by an ad hoc that led to the motion (which was also made by Meltz at the March London meeting but withdrawn at that time because of a lack of clarity regarding the implications (see Attachment 7). Chou said that the ad hoc deliberated and exchanged ideas and opinions a number of times following the March meeting and prepared the motion and overview shown in Attachment 8. By way of introduction, he briefly reviewed the history of the 20:1 ratio of peak-to-average SAR that led to the peak spatial-average SAR values in the 1982 standard and subsequent C95.1 standards. He noted that corresponding ratios reported in the literature at the time ranged from 5 to 50, and higher. Investigating the relationship between T or  $\Delta T$  and effect under localized exposure conditions might lead to more defensible basic restrictions for localized exposure. He noted

that addressing T or  $\Delta T$  was an action item still open from the revision process that led to the 2005 standard. In response to a question from Meltz, Chou explained that while the threshold for behavioral disruption is the basis for contemporary science-based standards; it is not clear what the threshold is for an actual injury. He noted that injuries would be expected to result from non-stochastic processes, which raises the question of a need for the lower tier. Also, penetration depth and the organs that are located at that depth are factors that must be considered, which suggests the need for additional dosimetry tools. The issue is that it is important to know the value of  $\Delta T$  that would result in an injury to an organ or part of an organ under whole-body-averaged and partial body exposure conditions. Swicord explained that the problem with the current standard is the lack of a clear link between partial-body exposure and injury, i.e., is there a T or  $\Delta T$  threshold that results in injury that can be related to exposure?

Following review of the motion and the overview (Attachment 8), Varanelli suggested removing the final paragraph of the overview because it does not add information and it is written in a negative tone—everyone agreed. Cohen asked to amend the motion by changing “...as a basis for revising the localized exposure limits...” to “...as a basis for a decision on the need to revise the localized exposure limits...” Meltz and Chou agreed to amend the motion.

**Amended Motion: Move that ICES TC95/SC4 pursue the investigation of relationships between localized tissue temperature increase and peak spatial-average SAR (100 kHz to 3 GHz) or power density (3 GHz to 300 GHz) as a basis for **revising a decision on the need to revise** the localized exposure limits at frequencies from 100 kHz to 300 GHz.**

The question was called and the motion was approved unanimously.

#### **ACTION ITEM 1:**

**Meltz will establish/staff an ad hoc to pursue the investigation of relationships between localized tissue temperature increases and peak spatial-averaged SAR (100 kHz to 3 GHz) or power density (3 GHz to 300 GHz). In addition to Meltz, the ad hoc will include Morrissey, Ziskin plus additional outside experts.**

Meltz agreed to report on the results of the ad hoc’s work by 2009.

#### **f. Amendment--status**

Petersen showed a series of slides that explained in IEEE terms the differences between an amendment, corrigendum and a revision (see Attachment 9). It was agreed that a document clarifying the peak power density/localized exposure issues and ceiling limits for induced and contact current would be an amendment. He suggested submitting a PAR (Project Authorization Request) for an amendment and as soon as the amendment is approved, a submitting a PAR for the revision of C95.1-2005. The revision should incorporate C95.6, i.e., SC3 and SC4 should work jointly on the revision. Petersen reported that Amendment 1 is being prepared to address clarification of the localized exposure/non-uniform exposure/peak power density issues. He said that he will obtain the Word file for the published standard and insert the suggested changes in IEEE amendment format, including technical changes suggested by Harrington that are deemed appropriate for the amendment. Also included will be the ceiling values for induced and contact current that appeared in the 1991 standard but were inadvertently omitted from the 2005 standard.

**ACTION ITEM 2:**

**Petersen will obtain the Word file for the published C95.1-2005 standard and prepare an amendment in IEEE format that addresses the localized exposure/peak power density issue, induced and contact current ceiling values, and other technical changes deemed appropriate.**

There was general agreement that would be desirable but some felt that SC3 and SC4 should begin working on the revision immediately and incorporate the changes that would appear in the amendment into a revision, i.e., skip the amendment.

**MOTION: Chou moved that SC4 and SC3 begin work on the revision immediately rather than first drafting and going through the approval process for an amendment.**

Tell seconded the motion, which passed unanimously.

**ACTION ITEM 3:**

**The co-chairs of SC4 will contact the co-chairs of SC3 to establish an Editorial Working Group to begin drafting the revision of C95.1-2005 to include C95.6-2002.**

Tell asked for ideas on how to move forward quickly. He said that the original literature review took quite a long time but now we only need to review relevant papers that were that were not included in the literature review for the 2005 standard. He also suggested that we carry out the reviews in the same manner as we did toward the end of the 2005 literature review, e.g., eliminate the need for several reviewers and individual scoring for each paper. In response to a question from Murphy, Tell said that he favored the approach of updating the white papers used for the 2005 standard and after the new literature cut-off date, publish these white papers in a special issue of the BEMS journal. Swicord said that he agrees in principle but the white papers would have the names of the individual authors—the literature review should be a committee effort.

Discussion followed regarding the consequences of ignoring induced current ceiling values by waiting for approval of a revision, which may take several years. Klauenberg pointed out that the lack of ceiling values for induced and contact current is having a significant impact in some instances and he urged the subcommittee to reconsider the motion that was just approved and, perhaps, begin work on the revision and an amendment simultaneously. Even though a prior motion was approved to begin the revision process without first seeking approval of an amendment to address ceiling values for induced and contact current and clarify the localized exposure/peak power density issue, the following motion was made:

**MOTION: Needy moved that in addition to establishing an Editorial Working Group to begin drafting the revision of C95.1-2005, an amendment to include induced and contact current ceiling values and clarify peak power density/localized exposure should be completed as quickly as possible.**

The motion was seconded by Meltz and approved unanimously.

**Action Item 4:**

**Thansandote or Ziskin will submit a PAR for an amendment to C95.1-2005.**

The goal is to complete balloting on the amendment in time for approval by the SASB no later than the end of 2008. In the meantime, work can begin on gathering information for the

revision and as soon as the amendment is approved, a PAR will be submitted for the revision of the 2005 standard.

**g. THz Ad Hoc**

(The THz Ad Hoc met the afternoon of the previous day.) Petersen briefly summarized the results of the meeting where in-depth presentations were given by Pat Roach, Bob Thomas and Jill McQuade (see Attachments 10, 11 and 12 for the slides presented at the ad hoc meeting). He pointed out how important the work being carried out by members of the AFRL at Brooks City Base is to both ICES and ANSI ASC Z136 (laser safety) for providing data necessary for confirming or revising the MPEs at frequencies on both sides of 300 GHz. These data would also provide important information on averaging time, effects of exposure area, skin depth, etc. This effort is a continuation of an initiative that began almost 10 years ago at a meeting at Brooks that was attended by a number of members of ICES (SCC-28 at the time) and the Z136 committee. It's only recently that hard data is being obtained. Pat Roach agreed to provide, or have someone in his organization provide, a summary presentation similar to yesterday's keynote presentation (Attachment 10) at the Z136 committee's Annual Meeting in February. The goal would be to enlighten to laser community and recruit more members of Z136 for the ad hoc.

**8. New Business**

**a. AT&T court ruling and the adequacy of safety margin**

Ziskin reviewed a suspected microwave injury suffered by an AT&T Alascom employee while working at their Eagle River, AK, SatCom earth station (see Attachment 13 for presentation). A Worker's Compensation claim was filed that was appealed up to the Superior Court of AK, which ruled in favor of the claimant (Mr. Ochitt). The accident occurred when Ochitt was in the process of removing a 4 ft section of waveguide connected to a high-power amplifier that he thought had been shut down. The waveguide dimensions were about 2" by 4", the frequency about 6 GHz, and the calculated average power density in the waveguide about 11 W/cm<sup>2</sup>. Mr Ochitt had been exposed when he separated the flanges to remove the waveguide section. His exposure lasted about 5 to 7 min with the flanges separated less than 1" and his head located approximately 12" from the waveguide. Measurements indicated that the exposure could have been greater than 200 μW/cm<sup>2</sup>.

Ziskin, who represented the claimant, reviewed the history of the case. He pointed out that calculations by an AT&T safety representative indicated far lower exposure than what was measured but the calculation assumed a point source, rather than a directional source with gain like an open-ended waveguide. Immediate symptoms included redness on the left side of the face; numerous delayed symptoms were generally related a traumatic event, e.g., numbness in 3 fingers on left hand, stumbling on left side but no loss of balance, left sided headaches, loss of mental alertness, clinical depression, etc. In response to a question from Bailey, Ziskin noted that the employee was given a neurological exam and an ophthalmological exam, the results of which were negative. Ziskin noted that Bill Guy had carried out an analysis of the potential exposure and determined that the exposure could have been only about 9.5% over the MPEs. He said that there were a number of questions regarding Guy's analysis, e.g., whether or not specular reflections were considered. Petersen said that he had read the decisions and he found it impossible to determine exactly where Mr. Ochitt's head was relative to the separated waveguide, e.g., 12" from the flange along the axis of the waveguide, in line with the flanges but 12" off axis of the waveguide, or

something else. Bailey asked what Ziskin thought the mechanism for the reported symptoms might be. Ziskin said that the redness could have been associated with heating but the symptoms exhibited later on seemed to be associated with depression. He felt that the symptoms could be related to an increase in temperature of part of the brain during the exposure. In response to a question from Bushberg, Ziskin said that there was no evidence of permanent skin damage.

Curtis said that he was involved with this case while he was at OSHA. He said that OSHA cited AT&T for violating lockout/tagout requirements. He also said that while dueling experts on some of the hearing panels seemed to be an issue, the major outcome is that the panel defined the MPE as a bright line between safety and hazard, i.e., exposures even slightly in excess of the MPEs implies hazard. Evidently they did not recognize the margin of safety built into contemporary standards. Bailey reminded the committee that in this case we have to separate scientific causation from legal causation. He said that if the case was decided in favor of the claimant because the exposure simply exceeded the limit—that is a legal decision. The OSHA citation probably helped the court reach this decision. He said that the bottom line may be related to the lack of proper treatment of the employee initially.

#### **b. Biological consequences of hyperthermia**

Ziskin gave a presentation on the biological consequences of hyperthermia (see Attachment 14). He described a study that he is involved with using pregnant guinea pigs as the subject animals. He pointed out that sensitive and important irreversible effects occur in rapidly dividing cells that include fetal developmental abnormalities. The pups were exposed in-utero at different times during gestation and the effects were dependent on when the exposures occurred. He noted that the relationship between exposure duration and temperature is useful, i.e.,

$$t_{43} = t \times R^{(43-T)}$$

where  $T$  is the temperature,  $t$  is the time in minutes and  $t_{43}$  is the time to produce the same effect at 43 degrees. He pointed out that exposure resulting in a temperature of 41.5° C whole-body caused birth abnormalities, including effects similar to clubfoot, distorted bone structure and wasting of muscle tissue and lack of muscle cell innervation. A whole-body temperature of 39° C is safe. Based on this, C95.1 is a conservative standard but no level is low enough for people who claim that they are electro-sensitive. There was considerable discussion following the penultimate slide regarding the need for a lower tier when the interaction mechanism is thermal but no specific action followed.

#### **9. Date and Place of Next Meeting**

The next meeting will be held in conjunction with BEMS 2008 in San Diego, CA in June 2008. The date and time will be announced as soon as arrangements are made with the conference center.

#### **10. Adjourn**

There being no further business, following a motion by Needy and a second by Thansandote, the meeting was adjourned at 1625 h.

**Actions Arising from 29 November 2007 SC4 Meeting  
Nokia House, Irving, TX**

	<b>Action</b>	<b>Assigned to</b>	<b>Due</b>	<b>Status</b>
1.	Meltz will establish/staff ad hoc to pursue the investigation of relationships between localized tissue temperature increase and peak spatial-averaged SAR (100 kHz to 3 GHz), or power density (3 GHz to 300 GHz). In addition to Meltz, the ad hoc will include Morrissey, Ziskin and additional outside experts.	Meltz	15 November 2007	
2.	Obtain the Word file for the published C95.1-2005 standard and prepare an amendment in IEEE format that addresses the localized exposure/peak power density issue, induced and contact current ceiling values, and other technical changes deemed appropriate.	Petersen	1 March 2008	
3.	The co-chairs of SC4 will contact the co-chairs of SC3 to establish an Editorial Working Group to begin drafting the revision of C95.1-2005 to include C95.6-2002.	Thansandote/Ziskin	1 March 2008	
4.	Submit PAR for an amendment to C95.1-2005.	Thansandote/Ziskin	1 March 2008	

**Motions Arising from 29 November 2007 SC4 Meeting**  
**Nokia House, Irving, TX**

	<b>MOTION</b>	<b>MOVED/SECONDED</b>	<b>Y/N/A</b>
1.	Move that ICES TC95/SC4 pursue the investigation of relationships between localized tissue temperature increase and peak spatial-average SAR (100 kHz to 3 GHz) or power density (3 GHz to 300 GHz) as a basis for a decision on the need to revise the localized exposure limits at frequencies from 100 kHz to 300 GHz.	Meltz/Chou	Y: (Unanimous)
2.	Move that SC4 and SC3 begin work on the revision immediately rather than first drafting and going through the approval process for an amendment.	Chou/Tell	(Y): Unanimous
3.	Move that in addition to establishing an Editorial Working Group to begin drafting the revision of C95.1-2005, an amendment to address induced and contact current ceiling values and clarify peak power density/localized exposure should be completed as quickly as possible.	Needy/Meltz	(Y): Unanimous

**Attendees – TC95/SC4 Meeting  
Nokia House, Irving TX  
29 November 2007**

	<b>Last Name</b>	<b>First Name</b>	<b>Affiliation</b>	<b>E-Mail Address</b>
1.	Bailey	Bill	Exponent Inc	wbailey@exponent.com
2.	Baron	David	dB-emf	d.baron@ieee.org
3.	Bodemann	Ralf	Siemens AG	ralf.bodemann@siemens.com
4.	Bushberg	Jerry	University of California, Davis	jtbushberg@ucdavis.edu
5.	Chou	C-K	Motorola Labs	ck.chou@motorola.com
6.	Cleveland	Bob	EMF Consulting	rfejr23@yahoo.com
7.	Cohen	Jules	Independent Consultant	jcohen@denny.com
8.	Curtis	Bob	RF Check, Inc	bob@rfcheck.com
9.	DeFrank	John	CHPPM	john.defrank@us.army.mil
10.	Elder	Joe	Motorola Labs	joe.elder@motorola.com
11.	Gettman	Ken	Nat'l Elect Manufacturers Assoc	ken_gettman@nema.org
12.	Hatfield	Jim	Hatfield and Dawson	jbh@hatdaw.com
13.	Hubbell	Joshua	US AF Safety Center	joshua.hubbell@kirtland.af.mil
14.	Johnston	Sheila	Ind Consultant (Neuroscience)	sajohnston@eircom.net
15.	Klaenberg	B Jon	US Air Force Research Laboratory	b.jon.klaenberg@brooks.af.mil
16.	Lang	Sakari	Nokia	sakari.lang@nokia.com
17.	McQuade	Jill	US Air Force Research Laboratory	jill.mcquade@usafa.edu
18.	Meltz	Marty	University of Texas (Retired)	martin.meltz@yahoo.com
19.	Montgomery	Noel	US Air Force Research Laboratory	noel.montgomery@brooks.af.mil
20.	Morrissey	Joseph	Motorola Research Labs	ejm037@email.mot.com
21.	Murphy	Mike	US Air Force Research Laboratory	michael.murphy@brooks.af.mil
22.	Needy	Robert	Naval Surface Warfare Center	robert.needy@navy.mil
23.	Petersen	Ron	R C Petersen Associates LLC	r.c.petersen@ieee.org
24.	Pophof	Blanka	Fed Office for Rad Prot, DE	bpophof@bfs.de
25.	Roberts	Brad	CHPPM	Brad.Roberts@us.army.mil
26.	Swicord	Mays	Consultant - Motorola Labs	mays.swicord@motorola.com
27.	Tell	Ric	Richard A Tell Associates, Inc.	rtell@radhaz.com

	<b>Last Name</b>	<b>First Name</b>	<b>Affiliation</b>	<b>E-Mail Address</b>
28.	Testagrossa	Paul	Alcatel Lucent	ptestagrossa@lucent.com
29.	Thansandote	Art	Health Canada	art_thansandote@hc-sc.gc.ca
30.	Varanelli	Art	Independent Consultant	avaranelli@comcast.net
31.	Ziskin	Marv	Temple University Medical School	ziskin@temple.edu



# ICES

International Committee on Electromagnetic Safety

## AGENDA

### IEEE/ICES TC95 Subcommittee 4

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

Nokia House

6000 Connection Drive, Irving TX

Building NH1, Room 150

29 November 2007 (Thursday)

1300 – 1700 h

- |  |                           |
|--|---------------------------|
| 1. Call to Order                                       | <i>Ziskin/Thansandote</i> |
| 2. Introduction of those Present                       | <i>Ziskin/Thansandote</i> |
| 3. Approval of Agenda                                  | <i>Ziskin/Thansandote</i> |
| 4. Approval of the Minutes of 1 March 2007 Meeting     | <i>Ziskin/Thansandote</i> |
| 5. Secretary's Report                                  | <i>Petersen</i>           |
| 6. Chairman's Report                                   | <i>Ziskin/Thansandote</i> |
| 7. Old Business  | <i>Ziskin/Thansandote</i> |
| a. Matters arising from the minutes                    |                           |
| b. Literature surveillance                             |                           |
| c. Literature review/evaluation                        |                           |
| d. Health Physics article                              |                           |
| e. Temperature vs. peak spatial-average SAR            |                           |
| f. Amendment--status                                   |                           |
| g. THz Ad hoc  |                           |
| h. UWB Ad hoc  |                           |
| 8. New Business  | <i>Ziskin/Thansandote</i> |
| a. AT&T court ruling and the adequacy of safety margin | <i>Chou</i>               |
| b. Biological consequences of hyperthermia             | <i>Ziskin</i>             |
| 9. Date and Place of Next Meeting                      | <i>Ziskin/Thansandote</i> |
| 10. Adjourn  |                           |

## Standards requiring action in 2007:

- **C95.3-2002:** (RF measurements and computation: 100 kHz to 300 GHz)
  - ❖ Standard is dated-suggest submitting PAR for revision
- **C95.4-2002:** (Safe distance from antennas during blasting operations)
  - ❖ Stable – recommend reaffirmation
- **C95.6-2002:** (Safety levels – 0 to 3 kHz)
  - ❖ Recommend reaffirmation. If reaffirmed, submit PAR for new standard which would include revisions of C95.1 and C95.6 and would cover the 0 Hz to 300 GHz frequency range
- **1460-1996:** (Guide for measurement of quasi-static electric and magnetic fields)
  - ❖ Incorporate into annexes of C95.3.1 (RF measurements and computation: 0 Hz to 100 kHz) and withdraw



# *ICES TC95 Standards: Status*

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- **1460 -1996 will undergo a recirculation ballot**
- **C95.3-2002 is in a recirculation ballot that closes on 8 December, 2007**
- **C95.4-2002 will be on the RevCom March 2008 agenda**
- **C95.6-2002 is on the RevCom December 2007 agenda**
- **2-Year PAR extension request for PC95.3.1 “Draft Recommended Practice for Measurements and Computation of Electric, Magnetic and Electromagnetic Fields With Respect to Human Exposure to Such Fields, 0 - 100 kHz” is on the NesCom December 2007 agenda**

# ICES TC95 Standards: Status

## C95.6-2002 IEEE Standard for Safety Levels with Respect to Human Exposure to Electromagnetic Fields, 0–3 kHz

Ballot Open Date: 09/05/2007

Ballot Close Date: 10/05/2007

### RESPONSE RATE

This ballot has met the 75% returned ballot requirement.

54 eligible people in this ballot group.

51 affirmative votes

0 negative votes with comments

0 negative votes without comments

1 abstention votes

52 votes received = 96 % returned

2 % abstention

### APPROVAL RATE

The 75% affirmation requirement is being met.

51 affirmative votes

0 negative votes with comments

51 votes = 100% affirmative



# *ICES TC95 Standards: Status*

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## **Standards requiring action in 2010:**

- **C95.1-2005:** (Safety levels, 3 kHz – 300 GHz)
- **C95.2-1999 (R 2005):** (RF energy and current flow symbols)
- **C95.7-2005:** (RF safety programs)

**Actions Arising from 1 March 2007 SC4 Meeting**  
**MOA, London**

	<b>Action</b>	<b>Assigned to</b>	<b>Due</b>	<b>Status</b>
1.	Provide review/summary of non-thermal effect presentations from earlier ICES meetings and other meetings (e.g., COST 281) before the next SC4 meeting.	Balzano, Elder, Johnston and Swicord	15 November 2007	Open
2.	Circulate for comment the one-page press-release on the 2005 standard (with the public or the federal agencies as the targeted audience and which should also address the issue of non-thermal effects)	Chou, Elder and Johnston	1 April 2007.	Partially Complete
3.	Determine why the induced current ceiling limit does not appear in the 2005 revision of C95.1.	Editorial Committee	15 August 2007	Open (Will be addressed in Amendment)
4.	Initiate the formation of a Literature Review WG that will define the literature evaluation/review process and effect the literature evaluations. The WG should be formed and the process defined before the next SC4 meeting.	Ziskin	15 November 2007	Open
5.	Take the lead in setting up a short-course to be given at the next SC4 meeting that will address both C95.1-2005 and C95.7.	Varanelli	1 September 2007	Open – Deferred until next meeting: san Diego
6.	Ad hoc task group on temperature to follow-up on the discussion of T versus peak spatial-average SAR for localized exposure and present a position to serve as a basis for the revision or an amendment.	Chou, D'Andrea, Osepchuk and Ziskin	15 October 2007	Defer until later in this meeting

	Action	Assigned to	Due	Status
7.	The ad hoc amendment task group, to prepare an amendment addressing the “peak power density” versus “localized exposure” issue and the editorial suggestions raised by Harrington.	Chou, D’Andrea, Osepchuk, Petersen and Ziskin,	1 September 2007	Ongoing
8.	Once the draft amendment is prepared and ready to be circulated to SC4 for comment, submit a PAR to the SASB for the amendment.	Ziskin or Thansandote	15 October 2007	Open
9.	Summarize discussion of skin enhancement factor and prepare a response to Meier.	Chou, Petersen, Thansandote and Ziskin	15 April 2007	Closed
10.	Review Harrington’s comments, accept those that seem appropriate, share the results with the Editorial Committee, and respond to Harrington.	Petersen	1 September 2007	Open
11.	Form an ad hoc group to review the UWB issue and make recommendations to SC 4 at the next meeting.	Meltz, Murphy, Osepchuk Varanelli and Ziskin	15 November 2007	Open

Matthias Meier, Chairman  
IEC PT 62209

Dear Matthias:

The information that you have provided to us is credible. Because of tissue boundaries and field reflections between tissue layers, the SAR in the skin can exceed the values calculated in homogenous models. This is certainly true on the body trunk where a wireless device might be located, and where the SAR in the skin may be significantly greater than in internal organs. Therefore, your question of the advisability of introducing a scaling factor (greater than 1) to maintain the conservative nature of the SAR safety limits is appropriate.

SC4 listened to your presentation, and then held an in depth discussion of your question. Following the discussion, we took a vote to see if a scale factor should be required. The vote was unanimous that the scaling factor was not necessary.

Our discussion brought out that the skin is a good thermal barrier. It is designed to protect the body from environmental extremes of temperature, and is tolerant to temperature changes of more than 7°C [Hardy, JD, Wolff, HG and Goodell, H. Pain Sensations and Reactions, Baltimore, Williams and Wilkins Co., 1952. This is reference B53 in C95.1-2005. The relevant text in C95.1-2005 is found on page 97]. On the other hand, changes as small as 2°C in internal organs, such as the fetus and testes, can have significant adverse effects [IEEE C95.1-2005, page 90 (lines 2-4)]. In general the current safety limits are very conservative, and no additional correction factor is necessary to protect the skin.

We hope these comments will be helpful to you. Thank you for the opportunity to work with you on deciding this issue.  
Best Wishes,

Marvin Ziskin, M.D.  
Co-Chair ICES SC-4

Art Thansandote, Ph.D.  
Co-Chair ICES SC-4

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**Motions Arising from 1 March 2007 SC4 Meeting**

	<b>MOTION</b>	<b>MOVED/SECONDED</b>	<b>Y/N/A</b>
4.	Consider a temperature-based standard, i.e., to determine if it is possible to develop a thermal basis for a localized limit, especially at the higher frequencies	Meltz/D' Andrea	Withdrawn
5.	Establish an ad hoc working group comprised of selected members of TC 95, SC 4 and ANSI ASC Z136 (laser safety) to reexamine the basic restrictions and MPEs at the interface between the RF and the laser standards.	D' Andrea/Johnston	(Y): Unanimous

## **Open Action Item: Motion to investigate local tissue temperature thresholds for adverse effects**

### **Issues:**

- SAR and temperature do not correlate in all circumstances, leading to excessive restrictions and unnecessary compliance requirements.
- Lack of knowledge of local tissue temperature thresholds for adverse effects
- Spatial peak SAR limits (hence safety factors) were arbitrarily chosen instead of based on human thermoregulatory response.

### **Approach:**

- Keep whole body and localized SAR limits as they are to begin with. Later consider revision of localized SAR limits but not whole body limits. The latter relate to environmental limits (e.g. in FCC Rules), are conservative and have public acceptance.
- Define local tissue temperature thresholds for adverse effects.
- Revise existing SAR limits based on temperature thresholds with reasonable safety factors.

### **Motion:**

**Move that ICES TC95/SC4 pursue the investigation of relationships between localized tissue temperature increase and peak spatial-average SAR (100 kHz to 3 GHz) or power density (3 GHz to 300 GHz) as a basis for a decision on the need to revise ~~revising~~ the localized exposure limits at frequencies from 100 kHz to 300 GHz.**

**Discussion:** This motion recognizes that at frequencies above 100 kHz, excessive heating associated with RF exposure is the established interaction mechanism associated with adverse effects in humans (with the possible exception of effects related to electrostimulation for pulsed exposures up to 5 MHz).

### **Overview:**

During the C95.1-2005 revision process, there were a number of discussions on temperature effects and its relationship to SAR. These discussions were summarized at two SC4 meetings, first in Cancun 2006 and then in London 2007. (SC4 London meeting minutes Attachment 4: *IEEE ICES TC95 SC4 discussions on temperature issues.*)

The 2005 revision has been published and we now have to begin the revision process under the new leadership. As you may recall, a number of action items were left open and now is the time to address these issues and set the direction for the next revision of the standard. This is not a motion to solve all technical questions and revise the present limits now. It is a motion to look into this complex problem to see if parts of the standard may be improved based on a better scientific rationale. It will take a lot of discussion over the next few years.

The current standard assumes that localized SAR limits and the temperature are correlated—in effect meaning that the incorporated safety factor is the same for all locations etc. In fact the spatial peak limits were set in a completely arbitrary manner, i.e. 20 times WBA values for SAR. In certain situations, particularly where the geometry is complex and tissue properties vary, this is not the case. This results in an unnecessarily restrictive standard that provides no additional protection to the public but may lead to additional cost or inhibit improvements in technology. For the short term, one may continue to demonstrate compliance with the current standard by demonstrating that the SAR limits are met. However, this investigation proposed by the motion would try to seek an option for demonstrating compliance with the standard by showing that the temperature does not exceed a temperature that is related to the threshold for harm. It may be possible to find more reasonable safety factors and peak SAR limits that are based on established adverse effects. This option simply recognizes that the standard protects against excessive heating and is designed to prevent this possible harmful situation.

The proposal is *not* suggesting the introduction of new temperature limits, but rather the reassessment of our thermally based basic restrictions (WBA SAR, localized SAR and S) drawing on the considerable amount of new and ongoing research investigating relationships between RF heating and tissue temperature rise. For example, the following exposure parameter issues could benefit greatly from a thoughtful consideration of the new RF heating/thermal data:

1. The frequency break point between SAR and incident power flux density.
2. The appropriate levels for the localized SAR limits given data on tissue thermal sensitivities and comparisons to other common heat inputs. The current justifications for the SAR levels and safety factors are pretty thin.
3. The appropriate averaging time for localized SAR given thermal inertia effects. Should we consider thermal iso-effective dose, and the propensity of increased tissue damage with time?
4. What is the best averaging shape for localized SAR limits given the nature of thermal diffusion and heat transfer near the body surface?
5. Should the localized SAR limits be re-adjusted for different tissues? For example, given the highly efficient heat transfer in the brain due to its relatively high blood flow rate, should it still be considered a sensitive organ? Should the ears, skin and muscle of the head be considered as sensitive tissues?
6. Should the basic restriction for incident power flux density be replaced with the normal component of S at the exposed body surface? Poynting's theorem suggests that this would be much better correlated with power deposition and hence temperature rise.
7. Should SAR be replaced by a volumetric absorption rate, VAR ( $W/m^3$ ), as a better metric for localized heating effects since it is more closely related to steady state heat transfer as indicated in Penne's bioheat equation?

~~In summary, the main purpose of this motion is to help break out of the moribund thinking that has prevailed so far in RF exposure standards that only countenance small tinkering changes to the basic restrictions and MPE values that were developed many decades ago. Our knowledge has greatly improved since those days, and we should welcome a fresh appraisal that would be engendered by this motion to investigate the subject.~~

