



# **ICES**

*International Committee on Electromagnetic Safety*

## **ICES (SCC-39) Annual Report: 2007 – 2008**

**Includes**

**Technical Committee 34 (Product Safety Relative to the Safe  
Use of Electromagnetic Energy)**

*and*

**Technical Committee 95 (Safety Levels with Respect to Human  
Exposure to Electric, Magnetic and Electromagnetic Fields)**

**21 May 2008**

## CONTENTS

<b>1. Administrative Committee (AdCom)</b> .....	<b>4</b>
1.1 ICES Scope .....	4
1.2 AdCom Membership.....	4
1.3 Highlights (2007-2008).....	4
1.5 Policies and Procedures .....	5
1.6 ICES Website.....	5
<b>2. Technical Committee-34</b> .....	<b>7</b>
2.1 Scope.....	7
2.2 Reorganization .....	7
2.3 Membership Rosters .....	7
2.4 Meetings (2007-2008).....	7
2.5 Subcommittee activities .....	8
<b>2.5.1 Subcommittee 1 (SAR evaluation – measurement techniques)</b> .....	<b>8</b>
<b>2.5.2 Subcommittee 2 (SAR evaluation – numerical techniques)</b> .....	<b>9</b>
2.6 TC-34 PARs.....	11
<b>2.6.1 SC-1 PARs</b> .....	<b>11</b>
<b>2.6.2 SC-2 PARs</b> .....	<b>12</b>
2.7 Drafts.....	14
<b>2.7.1 SC-1 (Measurement Techniques)</b> .....	<b>14</b>
<b>2.7.2 SC-2 (Computational Techniques)</b> .....	<b>15</b>
2.8 Objectives and goals for the past year and the TC’s performance relative to meeting these goals and objectives. ....	15
<b>2.8.1 SC-1 (Measurement techniques)</b> .....	<b>15</b>
<b>2.8.2 SC-2 (Numerical techniques)</b> .....	<b>15</b>
2.9 Website .....	16
2.10 IEEE Staff support requirements .....	16
2.11 Liaison with other committees.....	16
2.12 Issues: Joint IEC/IEEE development project: IEC 62209 and IEEE 1528.....	17
2.13 Membership .....	17
<b>3. Technical Committee 95</b> .....	<b>25</b>
3.1 Scope.....	25
3.2 TC-95 Membership Roster .....	25
3.3 Meetings (2007-2008).....	25
<b>3.3.1 Main Committee</b> .....	<b>25</b>
<b>3.3.2 Subcommittee 1 (Measurements and Computation)</b> .....	<b>25</b>
<b>3.3.3 Subcommittee 2 (Warning Signs, Symbols and Hazard Communication)</b> .....	<b>26</b>
<b>3.3.4 Subcommittee 3 (Safety Levels – 0-3 kHz)</b> .....	<b>26</b>
<b>3.3.5 Subcommittee 4 (Safety Levels – 3 kHz to 300 GHz)</b> .....	<b>26</b>
<b>3.3.6 Subcommittee 5 (Safe Distances from Antennas during Blasting         Operations)</b> .....	<b>26</b>
3.4 Main Committee and Subcommittee Status.....	26
<b>3.4.1 Main Committee</b> .....	<b>26</b>

<b>3.4.2 Subcommittee 1 (Measurement and Computation)</b> .....	27
<b>3.4.3 Subcommittee 2 (RF Warning Symbols, Safety Programs and Hazard Communication)</b> .....	28
<b>3.4.4 Subcommittee 3 (Safety Levels – 0 to 3 kHz)</b> .....	28
<b>3.4.5 Subcommittee 4 (Safety Levels – 3 kHz -300-GHz)</b> .....	28
<b>3.4.6 Subcommittee 5 (Safe Distances from Antennas during Blasting Operations)</b> .....	29
3.5    PARs .....	29
<b>3.5.1 SC-1 PARs</b> .....	29
<b>3.5.2 SC-4 PARs</b> .....	30
3.6    Objectives and goals for the past year and the TC’s performance relative to meeting these goals and objectives. ....	30
3.7    Current levels of activity with milestones indicated.....	31
3.8    IEEE Staff .....	31
3.9    Other Activities:.....	32
3.10  Issues.....	32
<b>3.10.1 Recognition of C95 measurement standards by IEC TC106</b> .....	32
<b>3.10.2 Interaction with ICNIRP</b> .....	32
<b>3.10.3 IEEE C95.1, C95.6 and C95.7 – Publicly available documents?</b> .....	32
3.11  Membership .....	33

## **ICES (SCC-39) Annual Report: 2007 – 2008**

### **1. Administrative Committee (AdCom)**

#### **1.1 ICES Scope**

“Development of standards for the safe use of electromagnetic energy in the range of 0 Hz to 300 GHz relative to the potential hazards of exposure of humans, volatile materials, and explosive devices to such energy. Such standards will be based on established effects and include safety levels for human exposure to electric, magnetic and electromagnetic fields, including induced currents from such fields, methods for the assessment of human exposure to such fields, standards for products that emit electromagnetic energy by design or as a by-product of their operation, and environmental limits.”

#### **1.2 AdCom Membership**

The membership of the AdCom is shown below in Table 1; additional “at large” members are being sought, particularly from outside the US.

#### **1.3 Highlights (2007-2008)**

Continuing activities with the World Health Organization EMF Project and the International Commission on Non-Ionizing Radiation Protection (ICNIRP) are aimed at exploring paths toward the international harmonization of standards for the safe use of electromagnetic energy. The increased international membership in ICES provides greater influence within the international community. ICES participates in the important international meetings, e.g., the WHO EMF Project/IAC (International Advisory Committee) meetings), PIERS (Progress in Electromagnetics Research Symposium, URSI (Union Radio-Scientifique Inter-nationale), ITU (International Telecommunications Union), IEC (International Electrotechnical Commission), ICNIRP, IEEE EMB-S, and the Bioelectromagnetics Society (BEMS) Annual Meetings, during which ICES representatives have given presentations about the role of ICES in international standard setting. ICES members also play a role in drafting public documents on contemporary RF safety issues, e.g., the former Chair of the ICES Membership Committee, Tom McManus, was the main author of the WHO Model Legislation document, which included finding common ground where different opinions existed.

ICES was invited by special invitation to present at many ICNIRP Commission meetings. Michael Murphy, Chairman of the ICES Membership Committee represented ICES at the ICNIRP Commission Meeting in San Antonio in 2005 and Art Thansandote, Co-chairman of TC95/SC4 represented ICES at the ICNIRP Collaboration Meeting in Chicago in May 2006, ICES Chairman Ralf Bodemann and other ICES members represent ICES at ICNIRP meetings worldwide.

Highlights during the past two years include:

- A new standard, C95.7-2005, “IEEE Recommended Practice for Radio Frequency Safety Programs” was approved at the September 2005 SASB meeting and published in March

2006. This document provides the elements of an RF safety program that will be useful to those implementing IEEE C95.1-2005.

- The revision of IEEE Std C95.1-1991 (1999 edition), “IEEE Standard for Safety Levels with Respect to Human Exposure to Radio Frequency Electromagnetic Fields, 3 kHz to 300 GHz,” was accepted at the September 2005 SASB meeting and approved by the SASB in October 2005, published in April 2006, and approved by ANSI in November 2006. Following approval by the SASB, this standard was appealed – the appeal was heard by the Appeals Panel at the March 2006 SASB meetings and the appeal was denied.
- IEEE Std 1528a, “Amendment 1: Include CAD File for Human Head Model (SAM Phantom),” to IEEE Std 1528-2003, “IEEE Recommended Practice for Determining the Peak Spatial-Average Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques,” was approved at the September 2005 SASB meeting and published in February 2006.
- The Administrative Committee (AdCom) met in San Antonio, Piscataway. London and Dallas and several times between these meetings by teleconference. In addition to its other duties, the ICES AdCom plans and arranges the meetings of TC 34 and TC 95 and their subcommittees. It approves (or rejects) applications for membership on the ICES technical committees. Dr. Ralf Bodemann of Siemens AG in Germany, who serves as ICES Chairman, Dr. Tom McManus, consultant to the Irish Department of Communications and Natural and Marine Resources, former Membership Committee Chairman Dr. Sheila Johnston, an independent consulting neuroscientist from Ireland and current ICES Membership Committee Chairman, and Dr. Michael Murphy, US Air Force Research Laboratory, have become the ICES roving ambassadors to the EU member states and have each given several presentations in support of ICES and the IEEE open consensus process for standards setting. Dr. C-K Chou of Motorola Laboratories has given numerous presentations on the IEEE ICES standards throughout the Far East. Dr. Michael Murphy also serves as ICES liaison to the Bioelectromagnetics Society (BEMS), the pre-eminent Society on the study of the interaction and effects related to the exposure of living systems to electric, magnetic and electromagnetic fields at frequencies below 300 GHz. He and Dr. Sheila Johnston both serve on the BEMS Board of Directors.

## **1.5 Policies and Procedures**

The ICES Policies and Procedures were accepted by AudCom and the SASB at the June 2007 meeting.

## **1.6 ICES Website**

Members of the AdCom have been working to complete a new ICES website (<http://www.ices-emfsafety.org/>), which will include separate sections for TC-34 and TC-95. Each section will have private and public sections for the main committees and the subcommittees; FTP service for subcommittee activities will be included. ICES owns the above domain. The goal is to complete the website by the end of 2008.

**Table1—ICES AdCom**

<b>OFFICE</b>	<b>NAME</b>	<b>AFFILIATION</b>	<b>COUNTRY</b>
Chairman	Dr. Ralf Bodemann	Siemens AG	DE
Vice Chairman	Kenneth Gettman	NEMA	US
Executive Secretary	Ronald C Petersen	R C Petersen Associates LLC	US
Treasurer	Arthur Varanelli	Independent Consultant	US
Chairman, Membership Committee	Dr. Michael Murphy	Air Force Research Laboratory	US
Chairman TC-34	Dr. Wolfgang Kainz	USFDA/CDRH)	US
Chairman TC-95	Dr. C-K. Chou	Motorola Labs	US
Chairman Emeritus	Dr. John Osepchuk	Full Spectrum Consulting	US
At Large Member	Dr. Eleanor Adair	Independent Consultant	US
At Large Member	Dr. Sheila Johnston	Independent Consulting Neuroscientist	IE
At Large Member	Dr. Tom McManus	Consultant to the Dept of Communications, Marine and Natural Resources	IE
IEEE Staff Liaison	Bill Ash	IEEE Standards	US

## **2. Technical Committee-34**

### **2.1 Scope**

The scope of Technical Committee 34 (TC-34) is “The development of product performance standards relative to the safe use of electromagnetic energy for specific products that emit electromagnetic energy at frequencies between 0 and 300 GHz, i.e., the frequency range covered by the basic restrictions and maximum permissible exposure (MPE) values developed by the IEEE International Committee on Electromagnetic Safety (ICES).”

Standards developed by TC-34 are expressed in terms of easily measured parameters, e.g., output power, current, voltage, which are derived from the basic restrictions and MPE values found in the latest revisions of IEEE Stds C95.1 and C95.6. Included in the scope are standards, guides and recommended practices that describe measurement and computational protocols for determining compliance with the basic restrictions and derived limits (MPEs) found in the IEEE C95 standards and in other relevant national and international standards and guidelines. This committee was originally a collaborative effort between IEEE and the Electromagnetic Energy Association (EEA); EEA was disbanded in August 2001.

### **2.2 Reorganization**

The structure and activities of TC-34 were recently examined and a decision was made to reorganize the committee. Originally, TC-34 consisted of the following three subcommittees: SC-1 (Pleasure-boat radar), SC-2 (SAR evaluation), and SC-3 (Effectiveness of RF-protective clothing). Initially there was considerable interest in the activities of SC-1 and SC-3, but this interest has dwindled during the past few years. The decision was made to disband SC-1 and ask the EMB-S Committee on Man and Radiation (COMAR) to consider drafting a technical information statement on pleasure boat radar, and disband SC-3 until interest increases. SC-2 was divided logically into two subcommittees—SC-1 (SAR evaluation—measurement techniques) and SC-2 (SAR evaluation—numerical techniques). SC-2 includes the following four working groups: WG-1 (General requirements for using the FDTD method for SAR calculations); WG-2 (Specific requirements for FDTD Modeling of vehicle mounted antenna configurations); WG-3 (Specific requirements for FDTD modeling of mobile phones/personal wireless devices); and WG-4 (Requirements for using the finite-element method for SAR Calculations, specifically vehicle-mounted antennas and personal wireless devices). The two subcommittees and their working groups are very active and hold face-to-face meetings and teleconferences several times per year. The face-to-face meetings are usually held in conjunction with IEC TC106/PT62209, which has a similar scope and with whom TC-34 has a Category D Liaison.

### **2.3 Membership Rosters**

(See Tables TC-34-1 thru TC-34-4.)

### **2.4 Meetings (2007-2008)**

- Feb. 20-21, 2007, Columbia, MD (SC-2)
- June 15-17, 2007 – Kanazawa, Japan including joint meeting with IEC TC106, Project Team 62209 (SC-2)

- August 21, 2007 – by teleconference (SC-2)
- October 15-17, 2007 – Silver Spring, MD (SC-2)
- October 18, 2007 – Round-table Discussion on Development of SAR Evaluation Standards to Support Emergent Wireless Personal Communication Devices and Technologies, Silver Spring, MD (SC-2)
- December 11, 2007 – by teleconference (SC-2)
- February 11-14, 2008 – Plantation, FL including joint meeting with IEC TC106, Project Team 62209 (SC-2)
- April 17, 2008 – by teleconference (SC-2)
- May 13 – 18, 2008 – Shanghai, China: The 2<sup>nd</sup> International Conference on Bioinformatics and Biomedical Engineering (ICBBE 2008) May 16 – 18, 2008 (SC-1 and SC-2)
- August 19, 2008 – by teleconference (SC-1 and SC-2)
- October 22 – 24, 2008 – Paris France (SC-1 and SC-2)
- December 2008 (date TBD) – by teleconference (SC-2)

## 2.5 Subcommittee activities

### 2.5.1 Subcommittee 1 (SAR evaluation – measurement techniques)

- Joint meetings were held (and continue to be held) with IEC TC-106 – PT 62209 to work on the draft standard IEC 62209-2: Human exposure to radio frequency fields from handheld and body-mounted wireless communication devices – Human models, instrumentation, and procedures – Part 2: Procedure to determine the specific absorption rate (SAR) for mobile wireless communication devices used in close proximity to the human body (frequency range of 30 MHz to 6 GHz)
- An international inter-comparison of computed SAR in an anthropomorphic, dielectric-filled head phantom was initiated in 2007. The project involved numerical simulations taken in nine labs in Asia, Europe, and North America. This inter-comparison will be completed in June 2008. A journal publication will be written on the results.
- **P1528b:** Amendment 2 of IEEE Std 1528-2003 extends the frequency range of 1528-2003 to 6 GHz (from 3 GHz). A draft of this amendment was prepared for voting by the subcommittee in April 2007. 285 comments were submitted – the subcommittee has responded to most of the comments and new research projects have been initiated to respond to others. Because of the large number of changes resulting from ballot resolution, it was decided to revise the standard rather than complete the amendment. A request to withdraw P1528b and a PAR for the revision of 1528-2003 was submitted to NesCom in May 2008.
- **P1528:** Work has begun on the revision of IEEE 1528 (which also extends the frequency range of SAR measurement standards up to 6 GHz) with the



collaborative efforts of IEC P62209. In addition, SC-1 is collaborating with PT62209 toward the development of standards for devices held within 20 cm of the body (including body-worn, hand-held and desktop devices). It has been proposed that this work should be directed towards a jointly developed standard bearing a dual IEC/IEEE logo. This would further strengthen the harmonization of the two standards committees and eliminate unnecessary duplication.

### 2.5.2 Subcommittee 2 (SAR evaluation – numerical techniques)

- **P1528.1:** The section on the evaluation of the numerical uncertainty of FDTD simulations of 1528.1 has been finalized. It defines general methods for assessing the contribution of typical uncertainties of the FDTD technique, such as absorbing boundary conditions, grid resolution, etc., on the numerical model. The validation of the numerical model of the device under test requires basic experimental evaluation.
- The section for the code validation of 1528.1 has been finalized. It describes novel methods to evaluate the accuracy of standard FDTD implementations and possible extensions. Moreover, a set of generic benchmarks has been defined which allow the correct functioning of the FDTD simulation platform. Reference results for all benchmarks have been provided.
- A particular geometry, the “SAR Star”, has been defined. It tests the implementation of the SAR averaging algorithm defined in IEEE 95.3 for symmetry, averaging in edges and pointed structures as well as gaps.
- A task force has been formed to provide guidelines on power normalization considering antenna mismatch, power regulation, digital modulation etc.
- An annex on anatomical modeling and representation of biological tissue has been added to 1528.1.
- A study group has been formed to analyze techniques for SAR calculation and averaging for planar and stair-cased surfaces considering alignment and tissue content of the cube as well as numerical uncertainties.
- **P1528.2:** A working group was formed to identify the uncertainties associated with numerical evaluation of peak 1 g and 10 g average SAR and define the procedures and recommendations to minimize those uncertainties as applied to P1528.2 and P1528.3. The results of the initial work performed by this group indicates that many details of SAR computations and SAR averaging need to be specified and defined to minimize the uncertainty of the simulations.
- The draft of P1528.2 has been updated with definitions for specific benchmark test configurations for code validation and prerequisites for valid compliance simulations.
- The computational study on human body exposure evaluation has started with the goal to quantify the numerically evaluated SAR variation based on the visible human body model in standing and sitting positions.

- The specific approach to evaluate uncertainty in P1528.2 has been proposed which take into account the uncertainties of numerical SAR evaluation in bystander and passenger standards reference models, uncertainty associated with numerical modeling of vehicle in the typical standard exposure conditions and uncertainty associated with modeling the specific vehicle mount antennas.
- A separate project has started to derive reasonably conservative exposure models in 1528.2 as applied to the passenger exposure. The emphasis in this study is to understand the effect of certain mechanical features in the car that could affect exposure (e.g. metal seats, windshield printed antennas and defoggers).
- The bystander and passenger models which are based on the Visible Human model have been defined specifically for P1528.2 as a standard model. Both models have been articulated using specialized software to produce adequate bystander and seated man geometries applicable for P1528.2 exposure evaluation.
- The draft standard configurations for bystander and passenger exposure modeling have been defined. They include the standard vehicle model and specific pavement models that conservatively take into account the effect of the ground on bystander exposure.
- **P1528.3:** The activity of the past year mainly focused on the planning, preparation and launching the CAD cell phone inter-laboratory comparison study. Because the study includes usage of CAD models of the mobile phones, which contain sensitive information from the mobile phone manufacturers, the process of signing Non Disclosure Agreements (NDAs) between the participating labs and the CAD file providers took extensive time and was the main cause of the delay in starting the study. After the NDAs were finalized, the study was started on June 2007. During this period one face-to-face meeting and two conference calls were arranged to discuss the inter-lab study progress and the draft status of P1528.3. A mid-term study survey was carried out to check for possible problems of the participants with the provided CAD models and the protocol. The development of a generic model to validate the protocol was also on the agenda that was presented at the Shanghai meeting on 13 May 2008.
- There has not been much change in the P1528.3 draft during past year. There have been some discussions and inputs regarding the uncertainty section, but it is agreed that the changes will be considered together with the P1528.1 uncertainty section. The actual drafting process will continue after the 1<sup>st</sup> phase of inter-laboratory study is completed.
- Besides developing the generic model, this year's activity includes the completion of the CAD inter-lab comparison study. A workshop is planed to be organized in fall 2008, where each lab will present their detailed results and discuss all challenges and difficulties faced during the process of the study. It is expected that the results of that workshop will provide valuable inputs to for the development of P1528.3.

- **P1528.4:** PAR P1528.4 was on the NesCom May 2008 Continuous Processing agenda. In April 2006 the Working Group decided that there should be a PAR and a Recommended Practice on methods other than Finite Difference Time Domain; a representative of Ansoft Corporation took the lead. In February 2007 the Working Group decided that P1528.4 should concentrate on the Finite Element Method. The PAR and an early version of a Recommended Practice have been produced that cover the same topics as P1528.1, P1528.2 and P1528.3 combined. The P1528.4 draft closely follows the earlier PARs and frequently refers to them, while changing FDTD specific guidelines into FEM-specific guidelines. As the P1528.1, P1528.2 and P1528.3 continue to grow and evolve, so will those of P1528.4.

## 2.6 TC-34 PARs

### 2.6.1 SC-1 PARs

#### 2.6.1.1 P1528b (Approved September 2005)

The committee decided that based on the considerable number of changes in the draft amendment, it would be more appropriate to revise the standard rather than publish another amendment. Therefore P1528b, is being withdrawn and is listed under “Withdrawal Requests” on the June 2008 NesCom agenda – it will be replaced with P1528, listed under “PARs for Revision of Standards” on the same agenda.)

**Title:** Recommended Practice for Determining the Peak Spatial-Average Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques. Amendment 2: Additional Procedures for SAR Measurement at 3 – 6 GHz

**Scope:** The scope of this project is to specify protocols for the measurement of the peak spatial average SAR in a simplified model of the head of users of handheld radio transceivers used for personal wireless communications services and intended to be operated while held next to the ear. It applies to contemporary and future devices with the same operational characteristics as contemporary devices that operate in the 300 MHz–6 GHz frequency range and provides a conservative estimate of the peak spatial average SAR representative of that which would be expected to occur in the heads of a significant majority of persons during normal use of these devices, but which may not be the absolute maximum value that could possibly occur under every conceivable combination of head size, head shape, handset orientation, and spacing relative to the head.

**Purpose:** The purpose of this project is to extend the frequency range of IEEE 1528 to include the frequency range 3 – 6 GHz. This extension would bring the total applicable frequency range of IEEE 1528 to be 300 MHz – 6 GHz. Recommendations are needed for the measurement resolution, the probe geometry, the phantom specifications, the dielectric parameters of tissue equivalent liquids, and other measurement parameters.

### 2.6.1.2 P1528 (On NesCom June 2008 agenda)

**Title:** Recommended Practice for Determining the Peak Spatial-Average Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques

**Scope:** To specify protocols for the measurement of the peak spatial-average SAR in a simplified model of the head of users of handheld radio transceivers used for personal wireless communications services and intended to be operated while held next to the ear. It applies to contemporary and future devices with the same operational characteristics as contemporary devices that operate in the 300 MHz–6 GHz frequency range and provides a conservative estimate of the peak spatial-average SAR representative of that which would be expected to occur in the heads of a significant majority of persons during normal use of these devices, but which may not be the absolute maximum value that could possibly occur under every conceivable combination of head size, head shape, handset orientation, and spacing relative to the head.

**Purpose:** The purpose of this recommended practice is to provide a protocol for the measurement of the peak spatial-average SAR in an anatomical model of the human head of users of wireless handsets intended to be operated while held next to the ear. It provides the users with standardized and accepted protocols, measurement and validation techniques, and means for estimating the overall uncertainty in order to produce valid and repeatable data. Specific SAR limit values are not included since these are found in other documents, e.g., IEEE Std C95.1 and the International Commission on Non-Ionizing Radiation Protection (ICNIRP) guidelines.

## 2.6.2 SC-2 PARs

### 2.6.2.1 P1528.1 (Approved September 2005)

**Title:** Recommended Practice for Determining the Peak Spatial Average Specific Absorption Rate (SAR) in the Human Body from Wireless Communications Devices, 30 MHz - 6 GHz: General Requirements for using the Finite Difference Time Domain (FDTD) Method for SAR Calculations

**Scope:** This recommended practice describes the concepts, anatomical models for compliance assessments, techniques, validation procedures, uncertainties and limitations of the finite-difference time-domain technique (FDTD) when used for determining the spatial peak specific absorption rate (SAR) in standardized human anatomical models exposed to wireless communication devices. Recommendations for standardized anatomical models and general benchmark data for these models are provided. Specific SAR limit values (basic restrictions) are not included since these are found in other documents, e.g., IEEE C95.1-200X.

**Purpose:** The purpose of this recommended practice is to specify numerical techniques and standardized anatomical models used for determining the spatial peak specific absorption rates (SAR) in the human body of users for wireless

communication devices. SAR is determined by applying Finite Difference Time Domain (FDTD) techniques to simulate the field conditions produced by wireless devices in anatomically correct models of the human anatomy. Intended users of this practice will be (but will not be limited to) wireless communication device manufacturers and wireless service providers that are required to certify that their products comply with the applicable SAR limits, and government agencies.

#### **2.6.2.2 P1528.2 (Approved September 2005)**

**Title:** Recommended Practice for Determining the Peak Spatial Average Specific Absorption Rate (SAR) in the Human Body from Wireless Communications Devices, 30 MHz - 6 GHz: Specific Requirements for Finite Difference Time Domain (FDTD) Modeling of Vehicle Mounted Antenna Configurations

**Scope:** This recommended practice describes the concepts, techniques, vehicle models, validation procedures, uncertainties and limitations of the finite-difference time-domain technique (FDTD) when used for determining the spatial-peak specific absorption rate (SAR) in standardized human anatomical models exposed to vehicle mounted antennas. Recommended vehicle models and general benchmark data for these models are provided. Antenna locations, operating configurations, exposure conditions and positions of persons exposed to the vehicle mounted antennas are defined. Intended users of this practice will be (but will not be limited to) wireless communication devices manufacturers, service providers for wireless communication that are required to certify that their products comply with the applicable SAR limits and government agencies. Specific SAR limit values (basic restrictions) are not included since these are found in other documents, e.g., IEEE C95.1-200X.

**Purpose:** The purpose of this recommended practice is to specify numerical techniques, anatomical models, and vehicle models used for determining the spatial peak specific absorption rates (SAR) in the human body when exposed to vehicle-mounted antennas used by wireless communication devices. SAR is determined by applying Finite Difference Time Domain (FDTD) techniques to simulate the field conditions produced by wireless devices in standardized anatomically correct models of the human anatomy.

#### **2.6.2.3 P1528.3 (Approved March 2006)**

**Title:** Recommended Practice for Determining the Peak Spatial-Average Specific Absorption Rate (SAR) in the Human Body from Wireless Communications Devices, 30 MHz - 6 GHz: Specific Requirements for Finite Difference Time Domain (FDTD) Modeling of Mobile Phones/Personal Wireless Devices

**Scope:** The scope of this project is to describe the concepts, techniques, models, validation procedures, uncertainties and limitations of the finite-difference time-domain technique (FDTD) when used for determining the spatial-peak specific absorption rate (SAR) in standardized human anatomical models. These models are exposed to personal wireless devices, e.g. mobile phones. It recommends and provides guidance on modeling of personal wireless devices and provides

benchmark data for simulation of such models. It defines model contents and provides guidance on meshing and test positions at the anatomical models. This document will not recommend specific SAR values since these are found in other documents, e.g., IEEE C95.1-2005.

**Purpose:** The purpose of this document is to specify numerical techniques, and anatomical models to determine spatial peak specific absorption rates (SAR) in the human body of persons exposed to personal wireless devices. SAR will be determined by applying Finite Difference Time Domain (FDTD) techniques to simulate the field conditions produced by wireless devices. It will use standardized anatomically correct models of the human anatomy.

#### **2.6.2.4 P1528.4 (Approved by NesCom 2 May 2008)**

**Title:** Recommended Practice for Determining the Peak Spatial Average Specific Absorption Rate (SAR) in the Human Body from Wireless Communications Devices, 30 MHz - 6 GHz: Requirements for Using the Finite-Element Method for SAR Calculations, specifically involving Vehicle Mounted Antennas and Personal Wireless Devices

**Scope:** The scope of this recommended practice is to describe the concepts, techniques, models, validation procedures, uncertainties and limitations of the Finite-Element Method when used for determining the peak spatial average specific absorption rate (SAR) in standardized models of the human anatomy exposed to wireless communication devices, in particular vehicle-mounted antennas and personal wireless devices such as hand-held mobile phones. Guidance on modeling such devices and benchmark data for simulation are provided. It defines model contents, guidance on meshing and test positions at the anatomical models. This document does not recommend specific SAR values since these are found in other documents, e.g., IEEE C95.1-2005.

**Purpose:** The purpose of this document is to specify numerical techniques, anatomical models, and other models of the human anatomy and vehicles to determine the peak spatial average specific absorption rates (SAR) in the human body of persons exposed to wireless communication devices, in particular vehicle-mounted antennas and personal wireless devices, such as hand-held mobile phones. SAR is determined using a Finite-Element simulation of the electromagnetic field conditions produced by wireless devices in standardized models of the human anatomy. Intended users of this practice will be (but will not be limited to) wireless communication devices manufacturers, service providers for wireless communication that are required to certify that their products comply with the applicable SAR limits, and government agencies.

## **2.7 Drafts**

### **2.7.1 SC-1 (Measurement Techniques)**

A draft of P1528b (Amendment 2) was prepared and balloted by the subcommittee in April, 2007. It was decided at that time that it would be appropriate to revise the standard instead of providing an amendment because of the number of issues addressed. The PAR for P1528b has been withdrawn and a PAR submitted for the

revision of IEEE 1528-2005. A draft of the revision will be balloted by the subcommittee this year.

### **2.7.2 SC-2 (Computational Techniques)**

Partial first working drafts of P1528.1, P1528.2 and 1528.3 have been prepared. Important decisions have been made and parameters defined, e.g., head model, electrical properties of the dielectric phantom head material, distance between the handset and the head, measurement positions.

## **2.8 Objectives and goals for the past year and the TC's performance relative to meeting these goals and objectives.**

### **2.8.1 SC-1 (Measurement techniques)**

#### **2.8.1.1 Objectives (2007)**

- Hold ICES TC-34 SC-2 meetings, including joint meetings with IEC 62209 to foster harmonized measurement standards. (Met)
- Complete first draft of IEEE 1528b (Amendment 2) for subcommittee voting in 2007. (Not met – P1528b will be withdrawn and the standard will be revised instead)
- Develop scope and outline for a recommended practice for small boat radars or abandon project. (Not met – project dropped)
- Submit PAR for recommended practice on RF protective clothing. (Not met - project dropped)
- Explore the need for a standard for the assessment low-frequency magnetic field security devices. (Not met – ongoing)
- Complete revision of TC-34 P&Ps – 1<sup>st</sup> Q 07. (Completed. Included in ICES P&Ps – Accepted by AudCom)

#### **2.8.1.2 Current levels of activity with milestones indicated**

- Complete balloting draft of the revision of IEEE 1528-2003 (4<sup>th</sup> Q 08)
- Withdraw PAR for IEEE P1528b (2<sup>nd</sup> Q 08)
- Submit PAR for IEEE P1528-2005 revision (2<sup>nd</sup> Q 08)
- Continue to explore the process for jointly developed standards with IEC: for the following: maintenance of IEC 62209-1 and the revision of IEEE 1528-2003; and draft IEC62209-2 and IEEE 1528.
- Explore the need for a standard for the assessment low-frequency magnetic field security devices. (2<sup>nd</sup> Q 08)

### **2.8.2 SC-2 (Numerical techniques)**

#### **2.8.2.1 Objectives (2007)**

- Complete 1<sup>st</sup> working draft of P1528.1. (Met)

- Complete 1<sup>st</sup> working draft for P1528.2. (Met)
- Complete 1<sup>st</sup> working draft for 1528.3. (Met)
- Develop a healed version of the SAM CAD files. A new approach is needed to solve the problem of a unified and healed SAM CAD model. (Ongoing)
- Submit PAR for new standard (P1528.4) to address numerical analyses techniques other than FDTD, e.g., the Finite Element Method as soon as it becomes more clear which direction the work develops. (Met)

#### **2.8.2.2 Current levels of activity with milestones indicated**

- Complete 2<sup>nd</sup> working draft of P1528.1 (4<sup>th</sup> Q 08)
- Complete 2<sup>nd</sup> working draft for P1528.2 (4<sup>th</sup> Q 08)
- Complete 2<sup>nd</sup> working draft for 1528.3, (4<sup>th</sup> Q 08)
- Develop 1<sup>st</sup> working draft of P1528.4 (4<sup>th</sup> Q 08)
- Develop a healed version of the SAM CAD files. A new approach is needed to solve the problem of a unified and healed SAM CAD model.

### **2.9 Website**

A website and reflector was set up several years ago for SC-2 (now SC-1 and SC-2) and operates successfully. All meeting minutes, action items, motions, and drafts are posted on the web – SC balloting is carried out electronically. The site has recently been updated and reorganized. Public areas contain links to other sites important for subcommittee activities, e.g., the USAF Dosimetry Handbook, Tables of Dielectric Properties of Tissues (Gabriel), schedules for meetings. A private area contains draft sections of the practice, the results of measurements on canonical models, etc.

The website URL is: <http://grouper.ieee.org/groups/scc34/sc2/>

A reflector was also set up. The address is [stds-tc34sc2@ieee.org](mailto:stds-tc34sc2@ieee.org)

### **2.10 IEEE Staff support requirements**

In the past, secretarial services for SC-2 provided by the Cellular Telecommunications and Internet Association (CTIA) are now provided by volunteer committee members. Support in setting up meetings at IEEE Piscataway has been required in the past; availability of the IEEE Staff Engineer at meetings held at IEEE is desirable. Bill Ash is the Staff Engineer for both TC-34 and TC-95—his engineering background and broad knowledge of IEEE procedures is invaluable to this committee.

### **2.11 Liaison with other committees**

Liaison with other committees occurs via the circulation of drafts, common meetings and common membership on committees such as CENELEC, IEC, ITU, ARIB and other standards developing organizations, and through a “Category D” liaison with IEC TC106/PT62209. Coordination has also been established with IEEE societies, e.g., EMC-S via representation on the Standards and Advisory Coordination Committee (SACCom).



## **2.12 Issues: Joint IEC/IEEE development project: IEC 62209 and IEEE 1528**

TC-34 is seeking IEC approval of IEEE P1528 and IEC P62209 as a joint IEC/IEEE standards development project.

**Rationale:** IEC TC106/PT62209 and IEEE TC-34/SC-2 (now SC-1) have worked hand in hand to develop IEC 62209-1-2005 “Human Exposure to Radio Frequency Fields from Hand-held and Body-mounted Wireless Communication Devices - Human Models, Instrumentation, and Procedures - Part 1: Procedure to Determine the Specific Absorption Rate (SAR) for Hand-held Devices used in Close Proximity to the Ear (Frequency Range of 300 MHz to 3 GHz)” and IEEE 1528-2003 “IEEE Recommended Practice for Determining the Peak Spatial-Average Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques” and are now working together to develop Part 2 of 62209 and the revision of 1528. During the development of IEEE 1528-2003 and IEC62209-1-2005, a large number of TC-34 members also participated on the IEC PT, sharing drafts to ensure harmonization. Thus the two existing standards were developed jointly by many of the same people but issued separately as two distinct standards. PT62209 is now working on Part 2 of the standard (to address body-mounted radios); TC-34 has a Category D Liaison with PT62209 for development of this project and is working with the IEC PT. Both groups have to a large extent common membership (45% of the 62209 PT are TC-34/SC-1 members; 40% of TC-34/SC-1 are members of PT62209). Moreover, during the past two years, the TC-34 WG and PT62209 have held 6 face-to-face meetings and a number of joint teleconferences. While these are dedicated to PT62209 business, or TC-34 business (to limit the time), the discussion topics are common to both WGs and members of both WGs participate.

These are important standards to the wireless communications industry and harmonization is key. Having a single dual logo standard is important for a variety of reasons and both 62209 Project Team Leader and the leadership of TC-34/SC-1 believe that IEC 62209 and IEEE 1528 are ideal candidates for such a project.

## **2.13 Membership**

See Tables TC-34-1 through TC-34 4 for TC-34 membership information and the attached Excel file for detailed membership information.

**Table TC-34-1**  
**TC-34 Leadership**

<b>OFFICE</b>	<b>NAME</b>	<b>AFFILIATION</b>
Chair-	Dr. Wolfgang Kainz	US FDA/CDRH
Vice- chair	Dr. Mark Douglas	Motorola Labs
Secretary	Dr. John M. Osepchuk	Full Spectrum Consulting
Treasurer	Arthur Varanelli	Independent Consultant
Chair – SC-1 (SAR evaluation— measurement techniques)	Dr. Mark Douglas	Motorola Labs
Chair – SC-2 (SAR evaluation—numerical techniques)	Dr. Wolfgang Kainz	FDA/CDRH
Chair – WG-1 (P1528.1)	Andreas Christ	ETHZ
Chair – WG-2 (P1528.2)	Giorgi Bit-Babik	Motorola Labs
Chair – WG-3 (P1528.3)	Martin Siegbahn	Ericsson
Chair – WG-4 (P1528.4)	Martin Vogel	ANSOFT

**Table TC-34-2**  
**TC-34 Membership: Main Committee (May 2008)**

	LAST NAME	FIRST NAME	MI	AFFILIATION	INTEREST*	COUNTRY
1.	Adair	Eleanor	R.	Independent Consultant	GI	US
2.	Ash	Bill		IEEE SA Standards Dept	IEEE Staff	US
3.	Babij	Tadeusz	M.	Florida International University	GI-(A)	US
4.	Baron	David		AIHA Representative	U	US
5.	Bassen	Howard		FDA/CDRH	GI-(G)	US
6.	Beard	Brian		FDA/CRH (HFZ 133)	GI-(G)	US
7.	Bit-Babik	Giorgi		Motorola Research Labs	P	US
8.	Chadwick	Philip		EMFields Ltd	GI	UK
9.	Chan	Kwok	W	FCC Laboratory	GI-(G)	US
10.	Chang	Isaac	A	FDA/CDRH	GI-(G)	US
11.	Chou	C.K.		Motorola Labs	P	US
12.	Christ	Andreas		It IS-ETHS	GI	CH
13.	Cleveland	Robert	F.	EMF Consulting	U	US
14.	Curtis	Robert	A.	RF CHECK Incorporated	U	US
15.	Douglas	Mark	G.	Motorola, Inc	P	US
16.	Foster	Kenneth	R.	Univ. of Pennsylvania	GI-(A)	US
17.	Gandhi	Om	P.	Univ. of Utah, Dept. of Elec. Eng.	GI (A)	US
18.	Guy	Arthur	W.	Bioelectromagnetics Consulting	GI	US
19.	Hare	Ed		American Radio Relay League	U	US
20.	Joyner	Ken	H.	Motorola Australia Pty Ltd.	P	AU
21.	Kainz	Wolfgang		FDA/CDRH	GI-(G)	US
22.	Kim	Nam		Chungbuk National University	GI-(A)	KR
23.	Kuster	Niels		IT'IS Foundation	GI (A)	CH
24.	Mason	Patrick	A.	USAF/AFRL/HEDR	GI (G)	US
25.	Osepchuk	John	M.	Full Spectrum Consulting	U	US
26.	Petersen	Ronald	C.	R C Petersen Associates	GI	US
27.	Scanlon	William	G.	Queens University, Belfast	GI (A)	UK
28.	Siegbahn	Martin		Ericsson	P	FI
29.	Tell	Richard	A.	Richard Tell Assoc. Inc.	GI	US
30.	Thansandote	Art		Health Canada	GI (G)	CA
31.	Toropainen	Anssi		Nokia Research Ctr.	P	US
32.	Varanelli	Arthur	G.	Independent Consultant	U	US
33.	Vogel	Martin		Ansoft	GI	US

GI = General Interest

GI (A) = General Interest (Academic)

GI (G) = General Interest (Government)

P = Producer

U = User

**Table TC-34-3**

**TC-34 Membership: Subcommittee 1 (Measurement Techniques)**

	LAST NAME	FIRST NAME	AFFILIATION
1.	Balzano	Quirino	Independent Consultant
2.	Bassen	Howard	FDA/CDRH
3.	Beard	Brian	FDA/CRH (HFZ 133)
4.	Bit-Babik	Giorgi	Motorola Research Labs
5.	Burger	Ernst	EMSS
6.	Case	David	Cisco
7.	Chan	Kwok	FCC Laboratory
8.	Choi	Hyung-Do	ETRI
9.	Chou	C.K.	Motorola Labs
10.	Christ	Andreas	It IS-ETHS
11.	Cleveland	Robert	EMF Consulting
12.	Davis	Chris	University of MD
13.	Dian-Yuan	Qi	MLL TMC
14.	Douglas	Mark	Motorola, Inc
15.	Faraone	Antonio	Motorola, Inc.
16.	Foster	Kenneth	Univ. of Pennsylvania
17.	Gabriel	Sami	Microwave Consultants
18.	Goljan	Christofe	Nokia
19.	Grangeat	Christophe	Alcatel
20.	Hamada	Lira	NICT
21.	Harrington	Tim	Federal Communications Commission
22.	Heirman	Donald	Don HEIRMAN Consultants
23.	Hu	Andrew	Huawei Technologies
24.	Ivans	Veronica	Medtronic Inc.
25.	Jin	Hong-Bin	China Mobilejinhongbin@msn.com
26.	Kainz	Wolfgang	FDA/CDRH
27.	Keshvari	Jafar	Nokia
28.	Klynser	Leif	Nokia
29.	Kuster	Niels	IT'IS Foundation
30.	Lee	Ae-kyoung	ETRI
31.	Li	C.	Intertek Testing Services
32.	Loader	Benjamin	National Physical Laboratories
33.	Lu	Lin	Qualcomm
34.	Luebbbers	Raymond	Remcom Inc.
35.	Ma	Wenhua	China Mobile
36.	Manning	Michael	IndeXsar, Ltd
37.	Manteuffel	Dirk	IMST
38.	Monebhurrun	Vikass	SUPLEC

	<b>LAST NAME</b>	<b>FIRST NAME</b>	<b>AFFILIATION</b>
39.	Nadakuduti	Jagadish	Motorola
40.	Nappert	Hughes	Industry Canada
41.	Nicol	Stuart	APREL
42.	Onishi	Teruo	NTT DOCOMO
43.	Penny	Chris	Remcom
44.	Petersen	Ronald	R C Petersen Associates
45.	Picard	Stephane	IC
46.	Plicanic	Ramadan	Sony Ericsson
47.	Pokovic	Kayja	SPEAG
48.	Prokop	Alexander	CST
49.	Ramani	Vivek	Intel
50.	Roman	John	Intel
51.	Schiavoni	Andrea	Telecom Italia
52.	Schulteis	Geoff	Sierra Wireless
53.	Seabury	David	Chase Systems Inc.
54.	Shah	Yogi	Guidant
55.	Siegbahn	Martin	Ericsson
56.	Simon	Winfried	IMST
57.	Slattman	Peter	Ansoft
58.	Sotoudeh	Omid	Sony Ericsson
59.	Tanabe	Shinji	Mitsubishi Electric Corp.
60.	Thors	Bjorn	Ericsson
61.	Tornevik	Christer	Ericsson Radio Systems
62.	Toropainen	Anssi	Nokia Research Ctr.
63.	Vogel	Martin	Ansoft
64.	Watanabe	Soichi	Natl Inst of Information and Comm. Tech.
65.	Wuart	Joe	France Telecom R&D
66.	Williams	Lawrence	Ansoft
67.	Wittig	Tillmann	CST
68.	Wittwer	David	Intel
69.	Wojcik	Jacek	Spectrum Sciences Institute
70.	Ye	Quibo	CRC
71.	You	Feng	Nokia

**Table TC-34-4**  
**TC-34 Membership: 2 (Numerical Techniques)**

	LAST NAME	FIRST NAME	AFFILIATION
1.	Balzano	Quirino	Independent Consultant
2.	Bassen	Howard	FDA/CDRH
3.	Beard	Brian	FDA/CRH (HFZ 133)
4.	Bit-Babik	Giorgi	Motorola Research Labs
5.	Bonilla	Carlos	FCC
6.	Burger	Ernst	EMSS
7.	Case	David	Cisco
8.	Chan	Kwok	FCC Laboratory
9.	Choi	Hyung-Do	ETRI
10.	Chou	C.K.	Motorola Labs
11.	Christ	Andreas	It IS-ETHS
12.	Davis	Chris	University of MD
13.	Derat	Benoir	SAGEM
14.	Dian-Yuan	Qi	MLL TMC
15.	Douglas	Mark	Motorola, Inc
16.	Faraone	Antonio	Motorola, Inc.
17.	Forrester	John	Qualcomm
18.	Foster	Kenneth	Univ. of Pennsylvania
19.	Francavilla	Mauro	Telecomitalia
20.	Gabriel	Sami	Microwave Consultants
21.	Gallant	Josette	IC
22.	Grangeat	Christophe	Alcatel
23.	Hamada	Lira	NICT
24.	Harrington	Tim	Federal Communications Commission
25.	Hauswirth	Steve	Motorola
26.	Hayes	Gerard	Sony-Ericsson
27.	Heirman	Donald	Don HEIRMAN Consultants
28.	Hu	Andrew	Huawei Technologies
29.	Kainz	Wolfgang	FDA/CDRH
30.	Kaoru	Akagi	Sharp
31.	Keshvari	Jafar	Nokia
32.	Klynser	Leif	Nokia
33.	Krebill	Peter	Broadcom
34.	Kuster	Niels	IT'IS Foundation
35.	Lee	Ae-kyoung	ETRI
36.	Lee	Duncan	Samsung
37.	Li	C.	Intertek Testing Services
38.	Liu	Steve	PC Test Lab

	<b>LAST NAME</b>	<b>FIRST NAME</b>	<b>AFFILIATION</b>
39.	Loader	Benjamin	National Physical Laboratories
40.	Lu	Lin	Qualcomm
41.	Luebbers	Raymond	Remcom Inc.
42.	Manning	Michael	IndeXsar, Ltd
43.	Manteuffel	Dirk	IMST
44.	McIntosh	Robert	Telstra
45.	McMillen	Shawn	Metlabs
46.	Monebhurrin	Vikass	SUPLEC
47.	Nadakuduti	Jagadish	Motorola
48.	Nappert	Hughes	Industry Canada
49.	Nicol	Stuart	APREL
50.	Onishi	Teruo	NTT DOCOMO
51.	Parmentier	Jack	Lenovo
52.	Penny	Chris	Remcom
53.	Petersen	Ronald	R C Petersen Associates
54.	Picard	Stephane	IC
55.	Plicanic	Ramadan	Sony Ericsson
56.	Poirier	Marcel	GC
57.	Pokovic	Kayja	SPEAG
58.	Prokop	Alexander	CST
59.	Ramani	Vivek	Intel
60.	Roman	John	Intel
61.	Schiavoni	Andrea	Telecom Italia
62.	Schild	Stephan	IT'IS ETHZ
63.	Schulteis	Geoff	Sierra Wireless
64.	Seabury	David	Chase Systems Inc.
65.	Shah	Yogi	Guidant
66.	Shapter	Hugh	Nokia
67.	Siegbahn	Martin	Ericsson
68.	Simon	Winfried	IMST
69.	Slattman	Peter	Ansoft
70.	Solderman	Magnus	Sony Ericsson
71.	Sotoudeh	Omid	Sony Ericsson
72.	Tanabe	Shinji	Mitsubishi Electric Corp.
73.	Thors	Bjorn	Ericsson
74.	Tornevik	Christer	Ericsson Radio Systems
75.	Toropainen	Anssi	Nokia Research Ctr.
76.	Vogel	Martin	Ansoft
77.	Watanabe	Soichi	Natl Inst of Information and Comm Tech
78.	Whelan	Conrad	Acceleware
79.	Wiert	Joe	France Telecom R&D
80.	Williams	Lawrence	Ansoft
81.	Wittig	Tillmann	CST

	<b>LAST NAME</b>	<b>FIRST NAME</b>	<b>AFFILIATION</b>
82.	Wittwer	David	Intel
83.	Wojcik	Jacek	Spectrum Sciences Institute
84.	Ye	Quibo	CRC
85.	You	Feng	Nokia
86.	Zhang	Paul	Huawei



### **3. Technical Committee 95**

#### **3.1 Scope**

The scope of ICES TC-95 is:

“Development of standards for the safe use of electromagnetic energy in the range of 0 Hz to 300 GHz relative to the potential hazards of exposure of man, volatile materials, and explosive devices to such energy. It is not intended to include infrared, visible, ultraviolet, or ionizing radiation. The committee will coordinate with other committees whose scopes are contiguous with TC-95.” (The scope remains the same as the scope of SCC-28 before reorganization.)

#### **3.2 TC-95 Membership Roster**

(See Tables TC-95-2 through Table TC-95-7 and attached Excel file.)

With the leadership of Dr. Sheila Johnston (former Membership Chairman), and Dr. Michael Murphy, International Liaison Chairman and Membership Chairman, the non-US membership of ICES continues to grow. During the period covered by this report, six new members were added to TC-95.

Several members of TC-95 have been inactive or have changed e-mail address and can no longer be contacted; their continuing status is now being addressed by the Membership Committee. In terms of stakeholders, the membership continues to be well balanced. About 50% of the TC-95 membership are IEEE members, not all of which are SA members. This is to be expected and defended in view of the interdisciplinary nature of our membership. TC-95 is grateful for their voluntary contributions under conditions where it would be an unreasonable imposition to require IEEE membership. However, IEEE SA membership is required of all TC-95 leadership (e.g., Committee and Subcommittee Chairs, Co-Chairs) and is encouraged for all members.

#### **3.3 Meetings (2007-2008)**

##### **3.3.1 Main Committee**

- March 2, 2007: London, England
- November 30, 2007: Irving TX
- June 8, 2008: San Diego, CA
- December 2008: San Antonio TX (Tentative – Date and location TBD)
- June 2009: (Venue TBD)

##### **3.3.2 Subcommittee 1 (Measurements and Computation)**

- February 28, 2007: London, England
- Feb 7, 2008: Teleconference
- Feb 19, 2008: White Oak Maryland
- Sept 2008: White Oak Maryland: (Date TBD)

- December 2008: San Antonio TX (Tentative – Date and location TBD)
- June 2009: (Venue TBD)

### **3.3.3 Subcommittee 2 (Warning Signs, Symbols and Hazard Communication)**

- March 1, 2007: London, England
- November 28, 2007: Irving, TX
- August 2008 – Venue TBD
- December 2008: San Antonio TX (Tentative – Date and location TBD)
- June 2009: (Venue TBD)

### **3.3.4 Subcommittee 3 (Safety Levels – 0-3 kHz)**

- February 28, 2007: London, England
- November 2007: Irving, TX (date TBD)
- June 2008 – San Diego, CA (date TBD)
- December 2008: San Antonio TX (Tentative – Date and location TBD)
- June 2009: (Venue TBD)

### **3.3.5 Subcommittee 4 (Safety Levels – 3 kHz to 300 GHz)**

- March 1, 2007 – London, England
- November 29, 2007: Irving, TX
- June 7, 2008: San Diego, CA
- December 2008: San Antonio TX (Tentative – Date and location TBD)
- June 2009: (Venue TBD)

### **3.3.6 Subcommittee 5 (Safe Distances from Antennas during Blasting Operations)**

- November 28, 2007 – Irving, TX
- June 2008 – San Diego, CA (Date TBD)
- December 2008: San Antonio TX (Tentative – Date and location TBD)
- June 2009: (Venue TBD)

## **3.4 Main Committee and Subcommittee Status**

### **3.4.1 Main Committee**

A major effort during the past several years has been to increase the membership of ICES, particularly non-U.S. members. TC-95 now has members from Australia (4), Bulgaria (1), Canada (4), China (1), Finland (3), France (1), Germany (1), Greece (3), Hungary (1), Ireland (4), Israel (1), Italy (3), Japan (1), Korea (2), Malaysia (3), the Netherlands (2), New Zealand (1), Poland (1), Sweden (1), Slovenia (1), South Africa (2), Switzerland (3), Thailand (1), the United Kingdom (7) and the United States (65), i.e., approximately 45% of the main committee membership is from outside the US.

The TC-95 mailing list now approaches 350, including the many observers on the Subcommittees. Eight years ago, the long-standing practice of sending hard copies of our extensive documents through the mail to our global mailing list was discontinued – all communications are now via e-mail and the Internet; meeting minutes are posted on the ICES website. The ICES Website (<http://www.ices-emfsafety.org/index.php5>) contains both open and private pages for TC-95 and its subcommittees and links to TC-34 and its subcommittees. All agendas, approved meeting minutes, white papers, RF research databases, draft standard documents, and many special reports are publicly available; certain proprietary or working documents are available only to members of the subcommittees on private sections of the site. The TC-95/SC-4 literature database, containing more than 2500 titles, which now appears on the WHO website, is also publicly available (<http://www.who.int/peh-emf/research/database/IEEEdatabase/>).

During the past year, two reaffirmations were approved by the IEEE SASB and two reaffirmations are on the June RevCom agenda. The reaffirmations are:

- C95.6-2002(2007): IEEE Standard for Safety Levels with Respect to Human Exposure to Electromagnetic Fields, 0–3 kHz. (Approved December 2007.)
- C95.4-2002(2008): IEEE Recommended Practice for Determining Safe Distances from Radio Frequency Transmitting Antennas When Using Electric Blasting Caps During Explosive Operations. (Approved March 2008.)
- 1460-1996(2002): IEEE Guide for the Measurement of Quasi-Static Magnetic and Electric Fields. (On June 2008 RevCom agenda.)
- IEEE C95.3-2002: IEEE Recommended Practice for Measurements and Computations of Radio Frequency Electromagnetic Fields With Respect to Human Exposure to Such Fields, 100 kHz–300 GHz. (On June 2008 RevCom agenda.)

### **3.4.2 Subcommittee 1 (Measurement and Computation)**

Subcommittee 1 has responsibility for IEEE C95.3 and IEEE 1460 and is now in the process of developing a new standard, PC95.3.1 “Recommended Practice for Measurements and Computation of Electric, Magnetic and Electromagnetic Fields With Respect to Human Exposure to Such Fields, 0 - 100 kHz,” which will extend the frequency range of ICES measurement standards. A partial working draft has been completed – action items have been assigned to the subcommittee members with the goal of completing a balloting draft during the 3<sup>rd</sup> Q 2008.

IEEE Std C95.3-2002 “Recommended Practice for Measurements and Computations of Radio Frequency Electromagnetic Fields with Respect to Human Exposure to Such Fields, 100 kHz-300 GHz” was approved for reaffirmation by ballot in Dec. 2007 and is now on the June 2008 RevCom agenda. IEEE 1460 “Guide for the Measurement of Quasi-Static Magnetic and Electric Fields” also was balloted for reaffirmation and is also on the June 2008 RevCom agenda. IEEE 1460 will be incorporated into PC95.3.1 and will be withdrawn following approval of PC95.3.1; C95.3 will be incorporated into the revision of C95.3-2002.

### **3.4.3 Subcommittee 2 (RF Warning Symbols, Safety Programs and Hazard Communication)**

Subcommittee 2 has responsibility for the following standards: C95.7-2005 and C95.2-1999(2006). C95.2 was reaffirmed at the September 2005 SASB meeting; C95.7 was approved at the same SASB meeting and published in March, 2006. At this time there are no PARs for new or existing projects. Plans are underway to develop a short-course describing the implementation of an RF safety program based on C95.7.

Several new documents are planned that would demonstrate the application of C95.7-2005 for RF safety programs for different work scenarios. It is anticipated that these new documents would become guides, or amendments to C95.7.

There is still some interest in compiling a glossary of terms used in ELF and RF safety. A number of such terms have been compiled over the years by SC-2 and by the EMB-S Committee on Man and Radiation (COMAR). The subcommittee is also considering developing a standard for safety programs where exposure may occur at frequencies below 100 kHz.

### **3.4.4 Subcommittee 3 (Safety Levels – 0 to 3 kHz)**

Subcommittee 3 has responsibility for C95.6-2002. During the past five years, members of SC-3 have presented four short courses on C95.6-2002; two in the US, one in Canada and one in Ireland. Each was very well received. The attendees are mainly from the power utilities and government agencies.

At present, no major revisions of this standard are anticipated but key members of SC-3 continue open dialog with members of other organizations with similar interests, e.g., the International Commission on Non-Ionizing Radiation Protection (ICNIRP), to iron out philosophical differences in the rationale for each of the standards and guidelines. In addition, members of SC-3 are in the process of exploring the development of an “application guide” as an adjunct to C95.6-2002(2007). There are no PARs for new or existing projects. C95.6 will eventually be incorporated into the revision of IEEE C95.1-2005 (see below).

### **3.4.5 Subcommittee 4 (Safety Levels – 3 kHz -300-GHz)**

Subcommittee 4 has responsibility for the C95.1 standard. This standard was first published as a USASI standard in 1966 and revisions were published as ANSI standards in 1974 and 1982. In 1991 a revision was published as an IEEE standard. It was reaffirmed in 1997, a corrigendum published in 1999 and an amendment in 2004. The latest revision, C95.1-2005 was approved by the SASB at the September 2005 meeting and published in April 2006. The revision is the result of a major effort by SC-4 to fully review and evaluate the relevant scientific literature. An amendment (PC95.1a) is being developed to address the following issues: ceiling values to the induced and contact current limits; distinguish between peak power density and localized exposure; and correct other technical issues that have been brought to the attention of SC-4. A PAR has been submitted and is on the June 2008 NesCom agenda. It is expected that sponsor balloting will occur early in the fall of 2008 and the draft will be submitted to RevCom in time for consideration at the December 2008 meeting. Revision of C95.1-2005 will begin after Amendment 1 is approved. IEEE C95.6 will be incorporated into this revision. Following approval of the revision of

C95.1, which will now cover the frequency range of 0 to 300 GHz, C95.6 will be withdrawn.

SC-4 is now pursuing 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. All evidence indicates that established adverse effects are thermal in nature and, therefore, changes in temperature under localized exposure conditions is important with respect to devices that produce such exposures, e.g., mobile telephones. The results would provide a scientifically sound basis for the current SAR limits for localized exposure or the basis for a change.

An ad hoc committee has been established to address bio-effects at THz frequencies. This is the continuation of a joint effort between members of SC-4 and ANSI ASC Z136 (laser safety) that began informally in 2000. While there was little data in 2000, there is a growing body of data that can be used to provide additional science-based support for reaffirming or revising the maximum permissible exposure values at 300 GHz (the upper frequency of IEEE C95.1 and the lower frequency of ANSI Z136.1).

#### **3.4.6 Subcommittee 5 (Safe Distances from Antennas during Blasting Operations)**

Subcommittee 5 is responsible for C95.4-2002 (IEEE Recommended Practice for Determining Safe Distances from Radio Frequency Transmitting Antennas When Using Electric Blasting Caps during Explosive Operations). The standard was reaffirmed at the March 2008 SASB meeting. There are no PARs for new or existing projects.

### **3.5 PARs**

The only active TC-95 PARs are PC95.3.1 (Approved December 2003) and PC95.1a (on the June 2008 NesCom agenda).

#### **3.5.1 SC-1 PARs**

##### **PC95.3.1 (Approved December 2003, extension approved December 2007):**

**Title:** Recommended Practice for Measurements and Computation of Electric, Magnetic and Electromagnetic Fields With Respect to Human Exposure to Such Fields, 0 - 100 kHz

**Project scope:** This recommended practice describes 1) methods for measuring external electric and magnetic fields and contact currents to which persons may be exposed, 2) instrument characteristics and the methods for calibrating such instruments, and 3) methods for computation and the measurement of the resulting fields and currents that are induced in bodies of humans exposed to these fields. This recommended practice is applicable over the frequency range of 0 to 100 kHz.

**Project purpose:** The purpose of this recommended practice is to describe preferred measurement techniques and computational methods that can be used to ascertain compliance with contemporary standards for human exposure to electric and magnetic fields in the frequency range of 0 to 100 kHz such as IEEE Stds C95.1, C95.6 and similar standards. This document is intended primarily for use by engineers, biophysicists, and other specialists who are familiar with basic

electromagnetic (EM) field theory and practice, and the potential hazards associated with exposure to EM fields. It will also be useful to bioeffects researchers, instrument developers and manufacturers, those developing calibration systems and standards, and individuals involved in critical hazard assessments or surveys.

### 3.5.2 SC-4 PARs

#### PC95.1a (On NesCom June 2008 agenda)

**Title:** Standard for Safety Levels with Respect to Human Exposure to Radio Frequency Electromagnetic Fields, 3 kHz to 300 GHz - Amendment: Amendment 1: Specifies Ceiling Limits for Induced and Contact Current, Clarifies Distinctions between Localized Exposure and Spatial Peak Power Density, and Corrects Other Known Errors in C95.1-2005

**Scope:** This amendment specifies ceiling values for induced and contact current, clarifies the distinctions between “localized exposure” and “spatial peak power density,” and corrects other known technical and editorial errors.

**Purpose:** The purpose of this amendment is to provide ceiling values for induced and contact current that appeared in IEEE Std C95.1, 1999 Edition, but were inadvertently omitted in IEEE Std C95.1-2005, and to clarify the distinctions between “localized exposure” and “spatial peak power density, and correct other known errors.

### 3.6 Objectives and goals for the past year and the TC’s performance relative to meeting these goals and objectives.

- Work with the ICES AdCom, with the guidance of IEEE staff, to develop a fund-raising program to support critical travel, special projects and meetings, visiting scientists and experts, and other critical needs – 4<sup>th</sup> Q 2007. (Ongoing)
- Continue international membership expansion led by Drs. McManus, Johnston and Murphy. Introduce new leadership with emphasis on non-US members, women and younger members. (Ongoing)
- Strengthen liaisons with ICNIRP, IEC, WHO, COST 281. (Ongoing)
- Arrange for 2008 meetings of TC-95 and its subcommittees – 4<sup>th</sup> Q 2007. (Met)
- Pursue the project on publicizing ICES and C95.1 standards in the literature and at international meetings. (Ongoing)
- Complete the TC-95 portion of the ICES website (<http://www.ices-emfsafety.org/>), include subcommittee sections, and provide FTP service for subcommittee activities – 4<sup>th</sup> Q, 2007. (Partially met)
- Complete subcommittee balloting draft of PC95.3.1 “Recommended Practice for Measurements and Computations with Respect to Human Exposure to Electric and Magnetic Fields, 0 to 100 kHz” – 4<sup>th</sup> Q 2007. (Not met)
- Complete draft of commonly used terms – 2<sup>nd</sup> Q 2008. (Not met)
- Complete guide for the application of C95.6 – 3<sup>rd</sup> Q 2007. (Not met)

- Publish general interest paper on C95.1-2005 (e.g., in *IEEE Spectrum*) and technical paper (e.g., in *Health Physics*) – 4<sup>th</sup> Q 2007. (Partially met)
- Complete reaffirmation ballots on IEEE 1460, C95.3, C95.4 and C95.6 – 3<sup>rd</sup> Q, 2007. (Met)
- Submit PAR for C95.1a (Amendment 1) – 4<sup>th</sup> Q, 2007. (Met – submitted 2<sup>nd</sup> Q 2008)
- Complete draft, subcommittee balloting and sponsor balloting on C95.1a – 4<sup>th</sup> Q 2008 (Ongoing)
- Organize first meeting of the SC-4 “THz ad hoc” with key members of ANSI ASC Z136 (laser safety) to discuss new data and address issues relating to the interface (300 GHz) between IEEE C95.1-2005 and ANSI Z136.1-2007 – 1<sup>st</sup> Q, 2008. (Met)

### 3.7 Current levels of activity with milestones indicated

- Work with the ICES AdCom, with the guidance of the IEEE staff, to develop a fund-raising program to support critical travel, support for special projects and meetings, support for visiting scientists and experts, and other critical needs – 4<sup>th</sup> Q 2008.
- Continue international expansion led by Drs. McManus, Johnston and Murphy. Introduce new leadership with emphasis on non-U.S. and younger members – Ongoing
- Strengthen liaisons with ICNIRP, IEC, WHO, COST 281, etc. – Ongoing
- Arrange for 2009 meetings of TC-95 and its subcommittees – 4<sup>th</sup> Q 2008.
- Pursue the project on publicizing ICES and C95.1 standards in the literature and at international meetings – Ongoing.
- Complete the TC-95 portion of the ICES website (<http://www.ices-emfsafety.org/>), include subcommittee sections, provide FTP service for subcommittee activities – 4<sup>th</sup> Q, 2008
- Complete subcommittee balloting draft of PC95.3.1 “Recommended Practice for Measurements and Computations with Respect to Human Exposure to Electric and Magnetic Fields, 0 to 100 kHz” – 3<sup>rd</sup> Q 2008
- Complete sponsor balloting draft of PC95.3.1 – 4<sup>th</sup> Q 2008
- Complete draft of commonly used terms – 1<sup>st</sup> Q 2009
- Complete guide for the application of C95.6 – 3<sup>rd</sup> Q 2009
- Complete draft, subcommittee balloting and sponsor balloting on C95.1a – 4<sup>th</sup> Q 2008
- Submit PAR and begin the revision of C95.1-2005 (incorporating C95.6) – 2<sup>nd</sup> Q 2009
- Submit PAR and begin revision of C95.3-2002 (incorporating C95.3.1) – 3<sup>rd</sup> Q 2009

### 3.8 IEEE Staff

Support in setting up meetings at IEEE Piscataway has been required in the past; availability of the IEEE Staff Engineer at meetings held at IEEE is desirable. Since Bill Ash is the Staff

Engineer for both TC-34 and TC-95—his engineering background and broad knowledge of IEEE procedures is invaluable to this committee.

### **3.9 Other Activities:**

Members of ICES TC-95 are continually involved in a wide spectrum of activities that relate to standard-setting including research, education, and drafting of regulations. Members participate in the governmental activities in many nations, as well. These include the FCC and FDA in the US, the EU/EC in Europe, and Standard setting bodies in China. TC-95 members participate in the broad activities of the WHO and its EMF Project as well as the European EBEA, and in various other meetings around the world.

### **3.10 Issues**

#### **3.10.1 Recognition of C95 measurement standards by IEC TC106**

ICES has twice submitted without success C95.3-2002 to the IEC for consideration as an IEC/IEEE dual logo standard. The issue seems to focus on objections by a number of EU countries who are looking for a standard that specifically addresses EC Directives, e.g., CENELEC standards. It is unlikely that further attempts will succeed as the C95.3 is due to be revised.

#### **3.10.2 Interaction with ICNIRP**

ICES has tried unsuccessfully to coordinate activities with the International Commission on Non-Ionizing Radiation Protection (ICNIRP). ICNIRP, a group of 14 individuals develops safety limits for exposure to electromagnetic energy over the frequency range of 0 to 300 GHz, i.e. the same frequency range as IEEE C95.6 (0 – 3 kHz) and C95.1 (3 kHz – 300 GHz). The ICNIRP process for developing guidelines is closed, uncertain, and relies on claims of “no commercial vested interests” to maintain “credibility,” especially within the EU states. Members of the ICES AdCom have met several times with members of ICNIRP (twice at ICNIRP’s request) to discuss methods of coordination but attempts at sharing documents are one-way only. ICES will continue to discuss the IEEE standards and process at major international fora to help recruit key scientists and engineers who have no other way of participating in setting safety standards. Indications are that there may be a closer relationship with ICNIRP in the future. This stems from an issue in the EU whereby an EC Worker Safety Directive to implement ICNIRP in the workplace has been set back four years (until 2012) because MRI operators performing certain interventional procedures would be exposed to low frequency magnetic fields in excess of the ICNIRP limits. The relevant ICNIRP limits are far more restrictive than those of IEEE C95.6 and the incorporation of extremely large safety factors in the ICNIRP limits has never been explained. Some of these issues may be discussed at a roundtable symposium on exposure standards at the 2008 meeting of the Bioelectromagnetics Society. Ric Tell and C-K Chou (TC-95 Chair) are scheduled to represent ICES and Paolo Vecchia (ICNIRP Chair) and James Lin will represent ICNIRP. This roundtable will provide a forum to promote further harmonization of the two major international standards.

#### **3.10.3 IEEE C95.1, C95.6 and C95.7 – Publicly available documents?**

Since about 1994, IEEE C95.1-1991 has been the basis for NATO Standardization Agreement (STANAG) 2345 “Evaluation and Control of Personnel Exposure to Radio Frequency Fields - 3kHz to 300 GHz.” This was encouraged by the US



members of the STANAG Ad Hoc (mostly from the Air Force – with a few members of ICES). Most of the NATO nations are EU members and are inclined to follow the EC Directive “Worker Safety Directive 2004/40/EC of the European Parliament and of the Council of 29 April 2004 on the minimum health and safety requirements regarding the exposure of workers to the risks arising from physical agents (electromagnetic fields).” Included in the Directive are references to the ICNIRP guidelines. However, that Directive has just been delayed 4 years due to MRI compliance issues. There is a chance that the STANAG, as an international document, could be used in the interim (IEEE rather than ICNIRP limits). The issue is that since IEEE Stds C95.1, C95.6 and C95.7 are public health and safety documents (not specifications or performance standards), they should be publicly available on the web at no expense. If they are, NATO could incorporate these standards into the STANAG by reference instead of incorporating tables and values as it does now. Representatives of DoD and members of ICES have met with IEEE staff to discuss the issue and are trying to work out a suitable arrangement – which may include licensing fees for unlimited use of the standards.

### **3.11 Membership**

See Tables TC-95-1 through Table TC-95-7 for committee and subcommittee membership information and the attached Excel file for detailed membership information for TC-95 Main Committee.

This report was prepared and submitted by:

Ron Petersen

Executive Secretary, ICES

May 21, 2008

**Table TC-95-1**  
**TC-95 Leadership**

<b>OFFICE</b>	<b>NAME</b>	<b>AFFILIATION</b>	<b>COUNTRY</b>
Chairman	Dr. C-K Chou	Motorola Labs	US
Vice Chairman (Vacant)			
Secretary	Ron Petersen	R C Petersen Associates LLC	US
Treasurer	Arthur Varanelli	Independent Consultant	US
Chairman, SC-1	Howard Bassen	US FDA Cntr. for Devices and Rad. Health	US
Chairman, SC-2	Richard Tell	Richard A Tell Associates, Inc.	US
Co-Chairman, SC-3	Dr. Philip Chadwick	EMFields Ltd.	UK
	Thanh Dovan	SP AusNet Pty. Ltd.	AU
Co-Chairman, SC-4	Dr. Art Thansandote	Health Canada	CA
	Dr. Marvin Ziskin, MD	Temple University Medical School	US
Chairman, SC-5	Robert Needy	Naval Surface Warfare Ctr.	US

**Table TC-95-2**  
**TC-95 Membership: Main Committee (May 2008)**

	LAST_NAME	FIRST_NAME	MI	AFFILIATION	COUNTRY	INT CATEGORY
1.	Adair	Eleanor	R.	Independent Consultant	US	GI
2.	Ammann	Max	J	Dublin Institute of Technology	IE	GI (A)
3.	Anderson	Vitas		THL Australia Pty Ltd	AU	P
4.	Ash	Bill		IEEE SA Standards Dept	US	IEEE Staff
5.	Balzano	Quirino		Independent Consultant	US	GI (A)
6.	Baron	David		AIHA Representative	US	GI
7.	Bassen	Howard		FDA/CDRH	US	GI (G)
8.	Bavin	John		Consumers Energy	US	P
9.	Bellier	Pascale		Health Canada	CA	GI (G)
10.	Bergeron	John	A.	Independent Consultant	US	GI
11.	Black	David	R	Independent Consultant	NZ	GI
12.	Blick	Dennis	W.	Independent Consultant	US	GI(G)
13.	Bodemann	Ralf		Siemens AG	DE	U
14.	Brecher	Aviva		DOT/RSPA Volpe Ctr.	US	GI(G)
15.	Brooker	Ian		Tyco Safety Products, Sensormatic	IE	P
16.	Bushberg	Jerrold	T.	U. of California, Davis	US	GI (A)
17.	Cassata	Jim		Navy Med Non-Ionizing Rad. Branch	US	GI(G)
18.	Chadwick	Philip		EMFields Ltd	UK	GI
19.	Chiang	Huai		Zhejiang Medical University	CN	GI (A)
20.	Chiusano	Stephen		Lawrence Livermore Nat'l Lab.	US	U
21.	Chou	C.K.		Motorola, Inc.	US	P
22.	Cleveland	Robert	F.	Independent Consultant	US	GI (G)
23.	Coghill	Roger	W.	Coghill Research Labs	UK	U
24.	Cohen	Jules		Jules Cohen P.E.	US	GI
25.	Curtis	Robert	A.	RF Check, Inc	US	U
26.	D'Andrea	John	A.	Naval Health Research Ctr.	US	GI (G)
27.	de Jager	Linda		School of Health Technology	ZA	GI (A)
28.	DeFrank	John	J.	USACHPPM	US	GI (G)
29.	d'Inzeo	Guglielmo		La Sapienza University of Rome	IT	U
30.	Dovan	Thanh		SP AusNet Pty. Ltd.	AU	P
31.	Durrenberger	Gregor		ETH	CH	U
32.	DuToit	Leon		Department of Health	ZA	GI (G)
33.	Erdreich	Linda	S.	Exponent	US	U

	LAST_NAME	FIRST_NAME	MI	AFFILIATION	COUNTRY	INT CATEGORY
34.	Filippopoulos	George		Greek Atomic Energy Commission	GR	GI (G)
35.	Foster	Kenneth	R.	Univ. of Pennsylvania	US	GI (A)
36.	Gajsek	Peter		Institute of Public Health	SI	GI (G)
37.	Gandhi	Om	P.	Univ. of Utah, Dept. of Elec. Eng.	US	GI (A)
38.	Gardner	Robert	C.	MOD D S&F Pol	UK	GI (G)
39.	Geber	Kurt		Dynamac Corporation	US	U
40.	George	David	L.	Unisys Corp.	US	U
41.	Gettman	Ken		Nat'l Electrical Manu Assoc.	US	GI
42.	Grandolfo	Martino		Laboratorio di Fisica	IT	GI
43.	Guy	Arthur	W.	Bioelectromagnetics Consulting	US	U
44.	Haes, Jr.	Donald	L.	Consultant	US	GI
45.	Halkiotis	Konstantinos		Medical School of Athens	GR	GI (A)
46.	Hare	Ed		American Radio Relay League	US	U
47.	Hatfield	James	B	Hatfield & Dawson	US	U
48.	Heirman	Donald	N.	Don HEIRMAN Consultants	US	U
49.	Heroux	Paul		McGill University	CA	GI (A)
50.	Holley	Jeff	L	Florida Power and Light	US	P
51.	Ikehata	Masateru		Railway Technical Research Institute	JP	GI (A)
52.	Israel	Michel		National Centre of Hygiene	BL	GI (G)
53.	Ivans	Veronica		Medtronic Inc.	US	U
54.	Jaffa	Kent	C.	Pacificorp	US	P
55.	Johnston	Sheila		Independent Consultant	UK	GI
56.	Joyner	Ken	H.	Motorola Australia Pty Ltd.	AU	P
57.	Kandel	Shaiela		Hebrew University of Jerusalem	IL	GI (A)
58.	Karabetsos	Efthymios		Greek Atomic Energy Commission	GR	GI (G)
59.	Kavet	Robert	I	EPRI	US	GI
60.	Kemp	Ray		Galson Sciences Limited	UK	GI
61.	Kim	Nam		Chungbuk National University	KR	GI (A)
62.	Klauenberg	B. Jon		USAF	US	GI (G)
63.	Koepfinger	Joseph	L.	Consultant	US	GI
64.	Kuster	Niels		IT'IS Foundation	CH	GI (A)
65.	Lang	Sakari		Nokia Research Ctr.	FI	P
66.	Leszczynski	Dariusz		STUK-Rad and Nuclear Rad Lab	FI	GI (G)
67.	Lin	James	C.	University of Illinois	US	GI (A)
68.	Maletskos	C.J.		National Council for Rad.	US	GI (G)
69.	Manatrakul	Nisakorn		Ministry of Public Health	TH	GI (G)
70.	Manning	Michael		IndeXsar, Ltd	UK	U

	LAST_NAME	FIRST_NAME	MI	AFFILIATION	COUNTRY	INT CATEGORY
71.	Mason	Patrick	A.	USAF/AFRL/HEDR	US	GI (G)
72.	Maurer	Stewart		RF & ELF Consultant	US	GI
73.	McManus	Tom		Independent Consultant	IE	GI
74.	McNamee	James	P.	Health Canada	CA	GI (G)
75.	McQuade	Jill		AFRL- USAF Academy	US	GI (A)
76.	Meltz	Martin	L.	Dept of Rad Oncology	US	GI (A)
77.	Montgomery	Noel	D.	Air Force Research Laboratory	US	GI (G)
78.	Moore	Michael	R.	Oak Ridge National Lab	US	GI (G)
79.	Mukhopadhyay	Amitabha		Con Edison	US	P
80.	Murphy	Michael	R.	Directed Energy Bioeffects	US	GI (G)
81.	Nazaruddin	Abd Rahman		Universiti Tenaga Nasional	MY	GI (A)
82.	Needy	Robert		Naval Surface Warfare Ctr.	US	GI (G)
83.	Nelson	David		Michigan Technical University	US	GI (A)
84.	Ng	Kwan-Hoong		Dept of Radiation	MY	GI (G)
85.	Osepchuk	John	M.	Full Spectrum Consulting	US	GI
86.	Packer	Malcolm		Harris RF Communications	US	P
87.	Pakhomov	Andrei	G.	McKesson Bio Services	US	GI
88.	Paul	William	F.	Int. Brotherhood of Elect. Workers	US	U
89.	Persson	Bertil	R.	Lund University	SE	GI (A)
90.	Petersen	Ronald	C.	R C Petersen Associates	US	GI
91.	Ravazzani	Paolo		Italian Nat Res Council	IT	GI
92.	Reilly	J. Patrick		Metatec Associates	US	U
93.	Repacholi	Michael	H.	World Health Organization	CH	U
94.	Roach	Pat		AFRL/HEDR	US	GI (G)
95.	Roberts	Brad	J.	US Army CHPPM	US	GI (G)
96.	Root	Ervin	D.	Alliant Energy	US	GI
97.	Samaras	Theodoros		Aristotle University of Thessaloniki	GR	GI (A)
98.	Scanlon	William	G.	Queens University, Belfast	UK	GI (A)
99.	Sheppard	Asher	R.	Asher Sheppard Consulting	US	GI
100.	Sirugo	Jon	H	Southern California Edison	US	P
101.	Swicord	Mays	L.	Motorola	US	P
102.	Szmigielski	Stanislaw		Mil Inst of Hyg & Epidemiology	PL	GI (G)
103.	Tang, MD	Rosa	M	UTMB, Galveston	US	U
104.	Tattersall	John		DSTL	UK	GI
105.	Tell	Richard	A.	Richard Tell Assoc. Inc.	US	GI
106.	Testagrossa	Paul	A	Lucent Technologies Inc.	US	P
107.	Thansandote	Art		Health Canada	CA	GI (G)

	LAST_NAME	FIRST_NAME	MI	AFFILIATION	COUNTRY	INT CATEGORY
108.	Thomas	Robert		AFRL	US	GI (G)
109.	Thuroczy	Gyorgy		Nat Res Inst for Radiobiology	HU	GI (A)
110.	Utteridge	Tammy		Inst of Medical & Veterinary Science	AU	GI (G)
111.	van Rongen	Eric		Health Council of the Netherlands	NL	GI (G)
112.	Varanelli	Arthur	G.	Independent Consultant	US	GI
113.	Wagenaar	Femme-Michelle		PhoneVision International	NL	GI
114.	Wan Nor	Liza Mahadi		University of Malaya Lambah Pantai	MY	GI (A)
115.	Wuart	Joe		France Telecom R&D	FR	P
116.	Williams, Jr.	Louis	A.	Louis A. Williams Jr. & Associates	US	GI
117.	Yoo	Done-Sik		Elect & Telecom Res Inst	KR	GI
118.	Zipse	Donald	W.	Electrical Forensics, LLC	US	GI
119.	Ziriaux	John		Microwave Department	US	GI (G)
120.	Ziskin, MD	Marvin	C.	Temple Univ. Medical School	US	GI (A)

GI – General Interest      GI (G) – General Interest Government      GI (A) – General Interest Academic  
P – Producer      U – User

**Table TC-95-3****TC-95 Membership: SC-1 (Techniques, Procedures, Instrumentation and Computation)**

	<b>LAST NAME</b>	<b>FIRST NAME</b>	<b>MI</b>	<b>AFFILIATION</b>	<b>COUNTRY</b>
1.	Adair	Eleanor	R.	Independent Consultant	US
2.	Anderson	Vitas		THL Australia Pty Ltd	AU
3.	Ash	Bill		IEEE SA Standards Dept	US
4.	Balzano	Quirino		Independent Consultant	US
5.	Baron	David		AIHA Representative	US
6.	Bassen	Howard		FDA/CDRH	US
7.	Bodemann	Ralf		Siemens AG	DE
8.	Brecher	Aviva		DOT/RSPA Volpe Ctr.	US
9.	Chan	Kwok	W	FCC Laboratory	US
10.	Chou	C.K.		Motorola, Inc.	US
11.	Cleveland	Robert	F.	Independent Consultant	US
12.	Cohen	Jules		Jules Cohen P.E.	US
13.	Cox	Diane		US Navy, NHRC	
14.	Curtis	Robert	A.	RF Check, Inc	US
15.	Dovan	Thanh		SP AusNet Pty. Ltd.	AU
16.	Frazier	William	F	Laurence Behr Associates, Inc.	US
17.	Gandhi	Om	P.	Univ. of Utah, Dept. of Elec. Eng.	US
18.	Guy	Arthur	W.	Bioelectromagnetics Consulting	US
19.	Hare	Ed		American Radio Relay League	US
20.	Hatfield	James	B	Hatfield & Dawson	US
21.	Hubbard	Roy		Tech Services International (TSI)	ZA
22.	Iskra	Steve		Telstra Corp	
23.	Ivans	Veronica		Medtronic Inc.	US
24.	Johnston	Sheila		Independent Consultant	UK
25.	Khalil	Kathy		SPAWARSSYSCEN Charleston	US
26.	Kim	Jin Suk		ETRI	KR
27.	Kumbier	Werner		Narda Safety Test Solutions	DE
28.	Kuster	Niels		IT'IS Foundation	CH
29.	Lotz	Gregory		NIOSH	US
30.	Luebbbers	Raymond		Remcom Inc.	US
31.	Mair	Peter		Fronius International GMBH	

	LAST NAME	FIRST NAME	MI	AFFILIATION	COUNTRY
32.	Manning	Michael		IndeXsar, Ltd	UK
33.	Mantiply	Ed		FCC/OET	US
34.	Maurer	Stewart		RF & ELF Consultant	US
35.	Misakian	Martin		Nat. Inst. of Stds & Technology	US
36.	Montgomery	Noel	D.	Air Force Research Laboratory	US
37.	Moore	Michael	R.	Oak Ridge National Lab	US
38.	Needy	Robert		Naval Surface Warfare Ctr.	US
39.	Osepchuk	John	M.	Full Spectrum Consulting	US
40.	Persson	Bertil	R.	Lund University	SE
41.	Petersen	Ronald	C.	R C Petersen Associates	US
42.	Roberts	Brad	J.	US Army CHPPM	US
43.	Rowley	Jack		Telstra Research Labs	AU
44.	Schueller	Michael		Mannesmann Mobilfunk Gmbh	DE
45.	Seabury	David		Chase Systems Inc.	US
46.	Tell	Richard	A.	Richard Tell Assoc. Inc.	US
47.	Testagrossa	Paul	A	Lucent Technologies Inc.	US
48.	Thansandote	Art		Health Canada	CA
49.	Umbdenstock	Donald	J.	Sensormatic Electronics Corp.	US
50.	Varanelli	Arthur	G.	Independent Consultant	US
51.	Watanabe	Soichi		Natl Inst of Inf and Comm Tech	JP
52.	Williams, Jr.	Louis	A.	Louis A. Williams Jr. & Associates	US
53.	Zirix	John		Microwave Department	US
54.	Zollman	Peter		Vodafone Group R&D	UK



**Table TC-95-4**

**TC-95 Membership: SC-2: (Terminology, Units of Measurements and Hazard Communication)**

	LAST NAME	FIRST NAME	MI	AFFILIATION	COUNTRY
1.	Adair	Eleanor	R.	Independent Consultant	US
2.	Anderson	Vitas		THL Australia Pty Ltd	AU
3.	Ash	Bill		IEEE SA Standards Dept	US
4.	Baron	David		AIHA Representative	US
5.	Bassen	Howard		FDA/CDRH	US
6.	Bellier	Pascale		Health Canada	CA
7.	Biby	Richard	P.	Crown Castle International	US
8.	Black	David	R	Independent Consultant	NZ
9.	Bodemann	Ralf		Siemens AG	DE
10.	Boyer	Jim		Lawrence Livermore National Labs	US
11.	Brecher	Aviva		DOT/RSPA Volpe Ctr.	US
12.	Bushberg	Jerrold	T.	U. of California, Davis	US
13.	Charlow	Kevin	J	NISE	US
14.	Chou	C.K.		Motorola, Inc.	US
15.	Cleveland	Robert	F.	Independent Consultant	US
16.	Coghill	Roger	W.	Coghill Research Labs	UK
17.	Cohen	Jules		Jules Cohen P.E.	US
18.	Conover	David		NIOSH Contractor	US
19.	Curtis	Robert	A.	RF Check, Inc	US
20.	D'Andrea	John	A.	Naval Health Research Ctr.	US
21.	DeFrank	John	J.	USACHPPM	US
22.	Erdreich	Linda	S.	Exponent	US
23.	Everist	Donald	G	Cohen, Dipell and Everist	
24.	Gajda	Greg		Health Canada	CA
25.	Gettman	Ken		Nat'l Electrical Manuf. Assoc.	US
26.	Guy	Arthur	W.	Bioelectromagnetics Consulting	US
27.	Haes, Jr.	Donald	L.	Consultant	US
28.	Hare	Ed		American Radio Relay League	US
29.	Hatfield	James	B	Hatfield & Dawson	US
30.	Hubbard	Roy		Tech Services International (TSI)	ZA
31.	Ivans	Veronica		Medtronic Inc.	US
32.	Johnson	Robert	E.	L-3 Microwave NARDA	US
33.	Johnston	Sheila		Independent Consultant	UK

	<b>LAST NAME</b>	<b>FIRST NAME</b>	<b>MI</b>	<b>AFFILIATION</b>	<b>COUNTRY</b>
34.	Joyner	Ken	H.	Motorola Australia Pty Ltd.	AU
35.	Kantner	Kimberly		AT&T	US
36.	Khalil	Kathy		SPAWARSYSCEN Charleston	US
37.	Kierl	Bill		Motorola, Inc	
38.	Klauenberg	B. Jon		USAF	US
39.	Kumbier	Werner		Narda Safety Test Solutions	DE
40.	Kuster	Niels		IT'IS Foundation	CH
41.	Lathrop	Janet		Resource Strategies, Inc	US
42.	Mantipty	Ed		FCC/OET	US
43.	Maurer	Stewart		RF & ELF Consultant	US
44.	Meltz	Martin	L.	Dept of Rad Oncology	US
45.	Mercer	Christopher		Vodacom Group, Pty Ltd	ZA
46.	Montgomery	Noel	D.	Air Force Research Laboratory	US
47.	Murphy	Michael	R.	Directed Energy Bioeffects	US
48.	Nappert	Hughes		Industry Canada	CA
49.	Needy	Robert		Naval Surface Warfare Ctr.	US
50.	Norman	Larry		Pike Electric	
51.	Osepchuk	John	M.	Full Spectrum Consulting	US
52.	Persson	Bertil	R.	Lund University	SE
53.	Petersen	Ronald	C.	R C Petersen Associates	US
54.	Proctor	Ken	R.	US Army	US
55.	Roberts	Brad	J.	US Army CHPPM	US
56.	Rowley	Jack		Telstra Research Labs	AU
57.	Scanlon	William	G.	Queens University, Belfast	UK
58.	Seabury	David		Chase Systems Inc.	US
59.	Smith	Matthew		Dade Moeller & Associates	US
60.	Strickland	Richard		RF Safety Solutions	US
61.	Tell	Richard	A.	Richard Tell Assoc. Inc.	US
62.	Testagrossa	Paul	A	Lucent Technologies Inc.	US
63.	Thansandote	Art		Health Canada	CA
64.	Ulcek	Jerry		FCC	US
65.	Vanetta-Richard	Anne		Lucent Technologies Inc	
66.	Varanelli	Arthur	G.	Independent Consultant	US
67.	Wagenaar	Femme-Michelle		PhoneVision International	NL
68.	Williams, Jr.	Louis	A.	Louis A. Williams Jr. & Associates	US
69.	Ziskin, MD	Marvin	C.	Temple Univ. Medical School	US

**Table TC-95-5**

**TC-95 Membership: SC-3 (Safety Levels with Respect to Human Exposure, 0-3 kHz)**

	LAST NAME	FIRST NAME	MI	AFFILIATION	COUNTRY
1.	Adair	Eleanor	R.	Independent Consultant	US
2.	Adlkofer	Franz		VerUm Foundation	DE
3.	Ammann	Max	J	Dublin Institute of Technology	IE
4.	Ash	Bill		IEEE SA Standards Dept	US
5.	Bailey	William	H.	Exponent Inc.	US
6.	Barker	J. Richard		General Cable	US
7.	Baron	David		AIHA Representative	US
8.	Bassen	Howard		FDA/CDRH	US
9.	Bavin	John		Consumers Energy	US
10.	Bellier	Pascale		Health Canada	CA
11.	Bergeron	John	A.	Independent Consultant	US
12.	Black	David	R	Independent Consultant	NZ
13.	Bodemann	Ralf		Siemens AG	DE
14.	Boeggeman	Charles	J.	PECO Energy Co.	US
15.	Brecher	Aviva		DOT/RSPA Volpe Ctr.	US
16.	Brooker	Ian		Tyco Safety Products, Sensormatic	IE
17.	Carberry	Robert	E.	Northeast Utilities	US
18.	Cassata	Jim		Navy Med Non-Ionizing Rad Branch	US
19.	Chadwick	Philip		EMFields Ltd	UK
20.	Chikamoto	Kazuhiko		Japan Nus Co. Ltd. (JANUS)	JP
21.	Coghill	Roger	W.	Coghill Research Labs	UK
22.	Curtis	Robert	A.	RF Check, Inc	US
23.	Dale	Steiner	J.	ABB Power T&D Company	US
24.	D'Andrea	John	A.	Naval Health Research Ctr.	US
25.	de Jager	Linda		School of Health Technology	ZA
26.	DeFrank	John	J.	USACHPPM	US
27.	d'Inzeo	Guglielmo		La Sapienza University of Rome	IT
28.	Douglas-Miller	Ruth		Kansas State University	US
29.	Dovan	Thanh		SP AusNet Pty. Ltd.	AU
30.	DuToit	Leon		Department of Health	ZA
31.	Duvdevany	Amnon	Y	Israeli Defense Forces	IL
32.	Feero	William	E.	Independent Consultant	US
33.	Fichtenberg	David	S	State of Washington, Med Asst Ad	US
34.	Filippopoulos	George		Greek Atomic Energy Commission	GR

	LAST NAME	FIRST NAME	MI	AFFILIATION	COUNTRY
35.	Gandhi	Om	P.	Univ. of Utah, Dept. of Elec. Eng.	US
36.	Geber	Kurt		Dynamac Corporation	US
37.	George	David	L.	Unisys Corp.	US
38.	Gettman	Ken		Nat'l Electrical Manuf Assoc.	US
39.	Gibney.	Kelly	B	Retired	CA
40.	Goldberg	Georges		Advisory Comm. on EMC	CH
41.	Goulet	Daniel		Hydro-Quebec	CA
42.	Haes,	Donald	L.	Consultant	US
43.	Hanna	Bob		DCMNR, Ireland	IE
44.	Hernandez	Martin	A.	Florida Power & Light Co.	US
45.	Herz	Michael	C.	Pacific Gas & Electric Co.	US
46.	Hicks	Danny	O.	South Carolina Electric & Gas Co.	US
47.	Holley	Jeff	L	Florida Power and Light	US
48.	Hubbard	Roy		Technology Serv. Int (TSI)	ZA
49.	Ikehata	Masateru		Railway Technical Research Institute	JP
50.	Ivans	Veronica		Medtronic Inc.	US
51.	Jaffa	Kent	C.	Pacificorp	US
52.	Johnston	Sheila		Independent Consultant	UK
53.	Karabetsos	Efthymios		Greek Atomic Energy Commission	GR
54.	Kautz	Richard	W.	Ford	US
55.	Kavet	Robert	I	EPRI	US
56.	Kim	Nam		Chungbuk National University	KR
57.	Koepfinger	Joseph	L.	Consultant	US
58.	Kuster	Niels		IT'IS Foundation	CH
59.	Lathrop	Janet		Resource Strategies, Inc	US
60.	Leszczynski	Dariusz		STUK-Rad and Nuclear Rad Lab	FI
61.	Lotz	Gregory		NIOSH	US
62.	Mair	Peter		Fronius International GMBH	
63.	Manatrakul	Nisakorn		Ministry of Public Health	TH
64.	Mason	Patrick	A.	USAF/AFRL/HEDR	US
65.	McManus	Tom		Independent Consultant	IE
66.	McNamee	James	P.	Health Canada	CA
67.	Merritt	James	H.	USAF Research Lab	US
68.	Montgomery	Noel	D.	Air Force Research Laboratory	US
69.	Murphy	Michael	R.	Directed Energy Bioeffects	US
70.	Nazaruddin	Abd Rahman		Universiti Tenaga Nasional	MY
71.	Needy	Robert		Naval Surface Warfare Ctr.	US

	LAST NAME	FIRST NAME	MI	AFFILIATION	COUNTRY
72.	Nelson	David		Michigan Technical University	US
73.	Ng	Kwan-Hoong		Dept of Radiation	MY
74.	O'Connor	Roger	E	Dept of Comm, Marine and Nat Res	IE
75.	Osepchuk	John	M.	Full Spectrum Consulting	US
76.	Paul	William	F.	Int. Brotherhood of Elect. Workers	US
77.	Petersen	Ronald	C.	R C Petersen Associates	US
78.	Pittman	Steve		Potlach Pulp and Paperboard	US
79.	Podhrasky	Robert	J.	Garrett Metal Detectors	US
80.	Polson	Peter		Ausa Research	US
81.	Proctor	Ken	R.	US Army	US
82.	Ravazzani	Paolo		Italian Nat Res Council	IT
83.	Reilly	J. Patrick		Metatec Associates	US
84.	Roberts	Brad	J.	US Army CHPPM	US
85.	Root	Ervin	D.	Alliant Energy	US
86.	Sahl	Jack	D.	J. Sahl Associates	US
87.	Samaras	Theodoros		Aristotle University of Thessaloniki	GR
88.	Sawdon	Dave		IBM Global Services	UK
89.	Sheppard	Asher	R.	Asher Sheppard Consulting	US
90.	Sirugo	Jon	H	Southern California Edison	US
91.	Slesin	Louis		Microwave News	US
92.	Sliney	David		US Army CHPPM Retired	US
93.	Swicord	Mays	L.	Motorola	US
94.	Szmigielski	Stanislaw		Mil Inst of Hygiene & Epidemiology	PL
95.	Tell	Richard	A.	Richard Tell Assoc. Inc.	US
96.	Thansandote	Art		Health Canada	CA
97.	Thuroczy	Gyorgy		Nat Res Inst for Radiobiology	HU
98.	Valberg	Peter	A	Gradient Corporation	US
99.	van Rongen	Eric		Health Council of the Netherlands	NL
100.	Varanelli	Arthur	G.	Independent Consultant	US
101.	Vijayalaxmi			Univ. Texas Health Science Ctr.	US
102.	Wagenaar	Femme-Michelle		PhoneVision International	NL
103.	Wan Nor	Liza Mahadi		U of Malaya Lambah Pantai	MY
104.	Wuart	Joe		France Telecom R&D	FR
105.	Williams, Jr.	Louis	A.	Louis A. Williams Jr. & Associates	US
106.	Woods	Richard	W.	Sensormatic Electronics	US
107.	Yandek	Edward	M.	GE Lighting	US
108.	Yoo	Done-Sik		Elect & Telecom Res Inst	KR

	<b>LAST NAME</b>	<b>FIRST NAME</b>	<b>MI</b>	<b>AFFILIATION</b>	<b>COUNTRY</b>
109.	Zipse	Donald	W.	Electrical Forensics, LLC	US
110.	Ziriaux	John		Microwave Department	US
111.	Ziskin, MD	Marvin	C.	Temple Univ. Medical School	US

**Table TC-95-6**  
**TC-95 Membership: SC-4 (Safety Levels with Respect to Human Exposure,  
 3 kHz – 300 GHz)**

	LAST NAME	FIRST NAME	MI	AFFILIATION	COUNTRY
1	Adair	Eleanor	R.	Independent Consultant	US
2	Ammann	Max	J	Dublin Institute of Technology	IE
3	Anderson	Vitas		THL Australia Pty Ltd	AU
4	Ash	Bill		IEEE SA Standards Dept	US
5	Babij	Tadeusz	M.	Florida International University	US
6	Bailey	William	H.	Exponent Inc.	US
7	Baron	David		AIHA Representative	US
8	Bassen	Howard		FDA/CDRH	US
9	Bellier	Pascale		Health Canada	CA
10	Bergeron	John	A.	Independent Consultant	US
11	Black	David	R	Independent Consultant	NZ
12	Blick	Dennis	W.	Independent Consultant	US
13	Bodemann	Ralf		Siemens AG	DE
14	Brecher	Aviva		DOT/RSPA Volpe Ctr.	US
15	Brooker	Ian		Tyco Safety Products, Sensormatic	IE
16	Bushberg	Jerrold	T.	U. of California, Davis	US
17	Cassata	Jim		Navy Med Non-Ionizing Rad Branch	US
18	Chadwick	Philip		EMFields Ltd	UK
19	Chesnick	Scott		National Heart Lung Blood Institute	US
20	Chiang	Huai		Zhejiang Medical University	CN
21	Chikamoto	Kazuhiko		Japan Nus Co. Ltd. (JANUS)	JP
22	Chou	C.K.		Motorola, Inc.	US
23	Cleveland	Robert	F.	Independent Consultant	US
24	Coghill	Roger	W.	Coghill Research Labs	UK
25	Cohen	Jules		Jules Cohen P.E.	US
26	Curtis	Robert	A.	RF Check, Inc	US
27	D'Andrea	John	A.	Naval Health Research Ctr.	US
28	de Jager	Linda		School of Health Technology	ZA
29	DeFrank	John	J.	USACHPPM	US
30	d'Inzeo	Guglielmo		La Sapienza University of Rome	IT

	LAST NAME	FIRST NAME	MI	AFFILIATION	COUNTRY
31	Dovan	Thanh		SP AusNet Pty. Ltd.	AU
32	Durrenberger	Gregor		ETH	CH
33	DuToit	Leon		Department of Health	ZA
34	Duvdevany	Amnon	Y	Israeli Defense Forces	IL
35	Elder	Joe	A	Motorola	US
36	Erdreich	Linda	S.	Exponent	US
37	Fichtenberg	David	S	State of Washington, Med Asst Ad	US
38	Filippopoulos	George		Greek Atomic Energy Commission	GR
39	Foster	Kenneth	R.	Univ. of Pennsylvania	US
40	Gajsek	Peter		Institute of Public Health	SI
41	Gandhi	Om	P.	Univ. of Utah, Dept. of Elec. Eng.	US
42	Gardner	Robert	C.	MOD D S&F Pol	UK
43	Geber	Kurt		Dynamac Corporation	US
44	George	David	L.	Unisys Corp.	US
45	Gettman	Ken		Nat'l Electrical Manufacturers Assoc.	US
46	Glaser	Marne		Public Representative	US
47	Goldberg	Georges		Advisory Comm. on EMC	CH
48	Haes	Donald	L.	Consultant	US
49	Halkiotis	Konstantinos		Medical School of Athens	GR
50	Hanna	Bob		DCMNR, Ireland	IE
51	Hatfield	James	B	Hatfield & Dawson	US
52	Healer	Janet		Dept. of Commerce	US
53	Heirman	Donald	N.	Don HEIRMAN Consultants	US
54	Heroux	Paul		McGill University	CA
55	Hubbard	Roy		Technology Services International	ZA
56	Ikehata	Masateru		Railway Technical Research Institute	JP
57	Ilieva	Michael	D		
58	Israel	Michel		National Centre of Hygiene	BL
59	Ivans	Veronica		Medtronic Inc.	US
60	Johnston	Sheila		Independent Consultant	UK
61	Joyner	Ken	H.	Motorola Australia Pty Ltd.	AU
62	Kandel	Shaiela		Hebrew University of Jerusalem	IL
63	Kantner	Kimberly		AT&T	US
64	Karabetsos	Efthymios		Greek Atomic Energy Commission	GR
65	Kavet	Robert	I	EPRI	US



	LAST NAME	FIRST NAME	MI	AFFILIATION	COUNTRY
66	Kean	John		BTS IEEE	US
67	Kemp	Ray		Galson Sciences Limited	UK
68	Kim	Nam		Chungbuk National University	KR
69	Klauenberg	B. Jon		USAF	US
70	Koepfinger	Joseph	L.	Consultant	US
71	Kwee	Sianette		University of Aarhus	DK
72	Lang	Sakari		Nokia Research Ctr.	FI
73	Leszczynski	Dariusz		STUK-Rad and Nuclear Rad Lab	FI
74	Lin	James	C.	University of Illinois	US
75	Lotz	Gregory		NIOSH	US
76	Maletskos	C.J.		NCRP	US
77	Manatrakul	Nisakorn		Ministry of Public Health	TH
78	Manning	Michael		IndeXsar, Ltd	UK
79	Mantiply	Ed		FCC/OET	US
80	Mason	Patrick	A.	USAF/AFRL/HEDR	US
81	Maurer	Stewart		RF & ELF Consultant	US
82	McKenzie	Roy		Telstra Research labs	AU
83	McManus	Tom		Independent Consultant	IE
84	McNamee	James	P.	Health Canada	CA
85	McQuade	Jill		USAF	US
86	Meltz	Martin	L.	Dept of Rad Oncology	US
87	Montgomery	Noel	D.	Air Force Research Laboratory	US
88	Moore	Michael	R.	Oak Ridge National Lab	US
89	Morrissey	Joe		Motorola	US
90	Murphy	Michael	R.	Directed Energy Bioeffects	US
91	Nazaruddin	Abd Rahman		Universiti Tenaga Nasional	MY
92	Needy	Robert		Naval Surface Warfare Ctr.	US
93	Nelson	David		Michigan Technical University	US
94	Ng	Kwan-Hoong		Dept of Radiation	MY
95	Osepchuk	John	M.	Full Spectrum Consulting	US
96	Pakhomov	Andrei	G.	McKesson Bio Services	US
97	Persson	Bertil	R.	Lund University	SE
98	Petersen	Ronald	C.	R C Petersen Associates	US
99	Polson	Peter		Ausa Research	US
100	Proctor	Ken	R.	US Army	US

	LAST NAME	FIRST NAME	MI	AFFILIATION	COUNTRY
101	Ravazzani	Paolo		Italian Nat Res Council	IT
102	Reilly	J. Patrick		Metatec Associates	US
103	Roach	Pat		AFRL/HEDR	US
104	Roberts	Brad	J.	US Army CHPPM	US
105	Rogers	Walt		Veridian Eng/RFR Branch	US
106	Rybak	Terence		General Motors Proving Grnd.	US
107	Samaras	Theodoros		Aristotle University of Thessaloniki	GR
108	Santomaa	Veli	A	Independent Consultant	FI
109	Scanlon	William	G.	Queens University, Belfast	UK
110	Sheppard	Asher	R.	Asher Sheppard Consulting	US
111	Swicord	Mays	L.	Motorola	US
112	Szmigielski	Stanislaw		Mil Inst of Hygiene and Epidemiology	PL
113	Tattersall	John		DSTL	UK
114	Tell	Richard	A.	Richard Tell Assoc. Inc.	US
115	Testagrossa	Paul	A	Lucent Technologies Inc.	US
116	Thansandote	Art		Health Canada	CA
117	Thomas	Robert		AFRL	US
118	Thuroczy	Gyorgy		Nat Res Inst for Radiobiology	HU
119	Utteridge	Tammy		Institute of Med & Vet Science	AU
120	van Rongen	Eric		Health Council of the Netherlands	NL
121	Varanelli	Arthur	G.	Independent Consultant	US
122	Wagenaar	Femme-Michelle		PhoneVision International	NL
123	Wan Nor	Liza Mahadi		U of Malaya Lambah Pantai	MY
124	Weller	Robert	D.	Hammett & Edison, Inc.	US
125	Wiar	Joe		France Telecom R&D	FR
126	Williams, Jr.	Louis	A.	Louis A. Williams Jr. & Associates	US
127	Woods	Richard	W.	Sensormatic Electronics	US
128	Yoo	Done-Sik		Elect & Telecom Res Inst	KR
129	Zipse	Donald	W.	Electrical Forensics, LLC	US
130	Ziskin, MD	Marvin	C.	Temple Univ. Medical School	US

**Table TC-95-7**

**TC-95 Membership: SC-5 (Safety Levels with Respect to Electro-Explosive Devices)**

	<b>FIRST NAME</b>	<b>LAST NAME</b>	<b>MI</b>	<b>AFFILIATION</b>	<b>COUNTRY</b>
1.	Adair	Eleanor	R.	Independent Consultant	US
2.	Ash	Bill		IEEE SA Standards Dept	US
3.	Babij	Tadeusz	M.	Florida International University	US
4.	Balzano	Quirino		Independent Consultant	US
5.	Bean	John		Naval Surface Warfare Center	US
6.	Colville	Frank		U.S. Army CHPPM	US
7.	DeFrank	John	J.	USACHPPM	US
8.	Duvdevany	Amnon	Y	Israeli Defense Forces	IL
9.	Harmon	Ray		EG&G	US
10.	Hatfield	James	B	Hatfield & Dawson	US
11.	Joyner	Ken	H.	Motorola Australia Pty Ltd.	AU
12.	Leidel	David		Halliburton Energy Services	US
13.	Petersen	Ronald	C.	R C Petersen Associates	US
14.	Roberts	Brad	J.	US Army CHPPM	US
15.	Stuart	James		Franklin Applied Physics	US
16.	Thompson	Ramie		Franklin Applied Physics	US