



ICES

International Committee on Electromagnetic Safety

ICES (SCC-39) Annual Report: 2006 – 2007

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)**

10 August 2007

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ICES (SCC-39) Annual Report: 2006 – 2007

1. Administrative Committee (AdCom)

1.1 Reorganization

The reorganization of the International Committee on Electromagnetic Safety (ICES) was approved at the March 2005 SASB Meeting in Atlanta, GA. Specifically, IEEE SCC-28 (International Committee on Electromagnetic Safety – ICES) and SCC-34 (Product Performance Relative to the Safe Use of Electromagnetic Energy) were combined into a single Type 2 Standards Coordinating Committee (SCC-39), called ICES. SCC-28 is now Technical Committee 95 (TC-95 – in line with the C95 standards it develops); SCC-34 is now TC-34. Each TC functions as it did in the past, retaining the same structure, subcommittees and policies and procedures. An Administrative Committee (AdCom) has been established to oversee the operation of ICES, including fundraising and liaison with IEEE and non-IEEE national and international organizations of similar scope, including the International Commission on Non-Ionizing Radiation Protection (ICNIRP), WHO, IEC, NATO, national groups, such as the National Council on Radiation Protection and Measurements (NCRP), the American Conference of Government Industrial Hygienists (ACGIH), and the relevant federal agencies of the US, e.g., FDA, FCC, OSHA, NIOSH, as well as corresponding national agencies of other countries.

The authorization in 2000 by the IEEE Standards Board to rename SCC-28 the International Committee on Electromagnetic Safety (ICES), and the authorization in 2005 to combine SCC-28 and SCC-34 under the ICES banner has proved to be a giant forward step toward an international forum for broad consensus in the setting of safety standards across the frequency range of 0 to 300 GHz. During the past few years, ICES, its committees and products have become far better known around the world and we expect this trend to continue.

1.2 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 will 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.”

1.3 AdCom Membership

The current makeup of the AdCom is shown below in Table 1; additional “at large” members are being sought.

Table 1—ICES AdCom

| Office | Name | Affiliation |
|---|---------------------|---|
| 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. Sheila Johnston | Independent Consulting Neuroscientist (UK) |
| Chairman, International Liaison 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. Tom McManus | Consultant to the Dept of Communications, Marine and Natural Resources (IE) |
| IEEE Staff Liaison | Bill Ash | IEEE Standards |

1.4 Highlights (2006-2007)

ICES held its first meeting (as SCC-39) in Dublin Castle, Dublin, Ireland, in June 2005. The five days of meetings of TC-34, TC-95 and their subcommittees were graciously hosted by the Irish Government (Department of Communications, Marine and Natural Resources). The meetings were held in conjunction with the annual meeting of the Bioelectromagnetics Society (BEMS – which were held nearby at Trinity University). This brought a number of non-US attendees from the BEMS meetings to the ICES meetings, thereby strengthening our potential for international recognition and growth.

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 (PIERS)), URSI (Union Radio-Scientifique Internationale), ITU (International Telecommunications Union), IEC (International Electrotechnical Commission), ICNIRP, IEEE EMB-S, and the Bioelectromagnetics Society Annual Meetings, during many of 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 drafter of the WHO Model Legislation document – trying to put into English what others wanted and finding common ground where different opinions existed.

ICES has been invited by special invitation to present at many ICNIRP Commission meetings. Michael Murphy, Chairman of the ICES International Liaison 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.

Other highlights during the past two years include:

- a) 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.
- b) 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.
- c) 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.
- d) The last of four well-received short-courses to introduce IEEE Std C95.6-2002 (IEEE Standard for Safety Levels with Respect to Human Exposure to Electromagnetic Fields, 0 to 3 kHz) was held in Dublin Ireland in June 2005. The first was held in conjunction with the “Canadian Electrical Association (CEA) Subcommittee on EMF” Workshop in Ottawa, Canada in March 2003; the second was held in Washington DC in June 2004, the third in San Antonio, TX in December 2004, the fourth in Dublin, Ireland in June 2005. All were well-attended and the feedback was very positive. Plans are being made to present similar short-courses that address the IEEE C95.1-2005 and C95.7-2005 at the TC 95 meeting in San Diego, CA in June 2008. November.
- e) The Administrative Committee (AdCom) met in San Antonio, Piscataway and London and several times between these meetings by teleconference. The ICES AdCom plans and arranges the two main meetings per year of TC 34 and 95. It approves (or rejects) applications for membership on 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 and former ICES Membership Committee Chairman, Dr. Sheila Johnston, an independent consulting neuroscientist from the UK and current ICES Membership Committee Chairman, and Dr. Michael Murphy, US Air Force Research Laboratory and Chairman of the International Liaison Committee, 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 in standards setting. Dr. Michael Murphy also serves as ICES liaison to the Bioelectromagnetics Society (BEMS). 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 and transfer existing TC-34 and TC-95 components by the end of 2007.

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); the EEA was disbanded in August 2001.

2.2 Membership Rosters

(See Table TC-34-2 and Table TC-34-3.)

2.3 Meetings (2006-2008)

2.3.1 Main Committee

Subcommittee 2 is the only active TC-34 subcommittee at present. Since SC-2 meets frequently (see below), it was decided to hold the next annual TC-34 meeting in conjunction with the next annual meeting of the Bioelectromagnetics Society (BEMS) and TC-95, June 2008, in San Diego, CA.

- June 27, 2005 – Dublin Ireland, in conjunction with the semi-annual ICES TC-95 meetings and the BEMS Annual Meeting
- June 2008 – San Diego, CA, in conjunction with the semi-annual ICES TC-95 meetings and the BEMS Annual Meeting (tentative)

2.3.2 Subcommittee 1 (Recreational Marine Radar)

(No longer active) ¹

2.3.3 Subcommittee 2 (Wireless Handset Certification)

- November 7-10, 2005 – Ottawa, Ontario, including joint meeting with IEC TC106, Project Team 62209 (November 9-10)
- March 10, 2006 – by teleconference
- April 3-4, 2006 – Stockholm, Sweden, including joint meeting with IEC TC106, Project Team 62209 (April 5)
- June 9-10, 2006, Cancun, Mexico, including joint meeting with IEC TC106, Project Team 62209 (June 11)
- August 22, 2006 – by teleconference
- October 24-25, 2006 – Tokyo, Japan including joint meeting with IEC TC106, Project Team 62209 (October 26)
- Feb. 20-21, 2007, Columbia, MD
- June 15-17, 2007 – Kanazawa, Japan including joint meeting with IEC TC106, Project Team 62209 (June 17)
- August. 21, 2007 – by teleconference
- October 15-17, 2007 – Silver Spring, MD
- October 18, 2007 – Round-table Discussion on Development of SAR Evaluation Standards to Support Emergent Wireless Personal Communication Devices and Technologies, Silver Spring, MD
- December 11, 2007 – by teleconference
- February 11-14, 2008 – Plantation, FL including joint meeting with IEC TC106, Project Team 62209 (February 13, 14)
- April 8, 2008 – by teleconference
- May 2008 (date TBD) – Shanghai, China: before or after the 2nd International Conference on Bioinformatics and Biomedical Engineering (ICBBE 2008) May 28-31, 2008,
- August 2008 (date TBD) – by teleconference

2.3.4 Subcommittee 3 (RF Protective Garments)

(No longer active)

¹ Because of the decreasing lack of interest by the federal agencies, this subcommittee decided against moving forward with a standard on small boat radars and instead will draft a Committee on Man and Radiation (COMAR) Technical Information Statement for publication in EMBS Magazine.

- June 2005 – Dublin Ireland (informal)
- December 8, 2005 – San Antonio, TX (informal)

2.4 Main Committee and Subcommittee Status

2.4.1 Main Committee

Additional representatives from outside the US have been added to the committee (including the Chairman of CENELEC). (See Table TC-34-1 for TC-34 leadership, Table TC-2 for the main committee, and Table TC-34-3 for SC-2 membership information.) The first standard developed by TC-34, 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 June 2003 SASB meeting and published in December 2003; 1528a, “Amendment 1: Includes CAD File for Human Head Model (SAM Phantom),” was approved at the September 2005 SASB meeting and published in February, 2006.

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

| Office | Name | Affiliation |
|-------------------------|--|------------------------------|
| Chair- | Dr. Wolfgang Kainz | US FDA/CDRH |
| Vice- chair | Dr. Mark Douglas | Motorola Labs |
| Secretary | Dr. John M. Osephchuk | Full Spectrum Consulting |
| Treasurer | Arthur Varanelli | Independent Consultant |
| Chair – SC-1 (Inactive) | Arthur Varanelli | Independent Consultant |
| Co-chairs – SC-2 | Dr. Mark Douglas Dr. Wolfgang Kainz | Motorola Labs US FDA/CDRH |
| Chair – WG-1 | Dr. Mark Douglas | Motorola Labs |
| Chair – WG-2 | Dr. Wolfgang Kainz | US FDA/CDRH |
| Chair SC-3 (Inactive) | Richard A. Tell | Richard A Tell Associates |

2.4.2 Subcommittee 1 (Recreational Marine Radar)

(No longer active)

In 1997 the current chair of SC-1 met with FCC Office of Engineering and Technology (OET) Senior Scientist Dr. Robert Cleveland to discuss their interest in standards relating to recreational marine radar. Dr. Cleveland indicated that an IEEE product performance standard would address FCC RF exposure concerns and that the FCC would encourage the development of such a standard. Following this meeting and expressed interest by the FDA Center for Devices and Radiological Health (CDRH) in small boat radar as a

consumer electronic product, TC-34 Subcommittee 1 (SC-1) was established to consider the development of a standard to address the safety aspects of these devices. The standard would include measurement techniques for assessing exposure, rules of thumb for mounting radars based on average output power, and other practical guidance. Potential members from pleasure-boat radar manufacturers were identified and agreed to participate on SC-1 once a clear objective was defined. Over the past 5 years members of SC-1 met informally a number of times, and also met with FCC and FDA/CDRH staff. During this time, however, emphasis by the federal agencies has shifted to other devices, e.g., article surveillance and anti-theft devices. Moreover, the work of SC-2 (wireless handsets) was of paramount importance to both the FDA and the FCC and with the limited resources of both agencies, their effort has been devoted to completing the wireless handset standard (IEEE Std 1528-2003) and Amendment 1 to 1528 (IEEE Std 1528a-2005). Although a PAR for a small-boat radar standard has not yet been submitted, a dialog was established with the interested parties identified in Table TC-34-2. Because of the decreasing lack of material interest in these devices by the federal agencies, SC-1 decided against moving forward with a standard on small boat radars and instead will draft a Committee on Man and Radiation (COMAR) Technical Information Statement for publication in EMBS Magazine.

2.4.3 Subcommittee 2 (Certification of Wireless Handsets)

Subcommittee 2 was established in February 1997 to develop standard protocols for certifying that certain portable wireless devices, such as hand-held radio transceivers, wireless LANs and similar devices, meet specific absorption rate (SAR) criteria. Initially two working groups were established within SC-2 to develop measurement (WG-1 – P1528) and computational (WG-2 – P1529) protocols for certifying that hand-held mobile phones meet the prescribed SAR limits of IEEE Std C95.1 and other standards and guidelines, e.g., ICNIRP. Although the scope of SC-2 covers a variety of devices, it initially focused on a recommended practice (P1528) devoted exclusively to handsets used for personal wireless communication services. The first standard (IEEE Std 1528-2003) specifies protocols for the measurement of the peak spatial-average SAR in the head of users of certain hand-held radio transceivers that are used for personal wireless communications, operate in the 300 MHz – 3 GHz frequency range, and are intended to be operated while held against the ear. Specifically, this recommended practice describes the concepts, measurement techniques, instruments, calibration techniques, phantom models for SAR system validation, and limitations of systems used for measuring the radio frequency (RF) electric field strength for purposes of determining the spatial-peak mass-averaged SAR, e.g., per 1 gram or 10 grams of tissue, in simulated tissue models, including homogeneous anatomical models of the human head. Protocol requirements of IEEE Std 1528-2003 have been incorporated into IEC Std 62209-1 and “Supplement C” of the FCC Office of Engineering and Technology (OET) Bulletin 65. The standard is also expected to be adopted by the FCC by reference. Because of the urgency, the major activity of TC-34/SC-2 was the work of WG-1 (IEEE Std 1528-2003 and Amendment 1 – 1528a-2005). Although WG-2 developed a partial draft of a complementary standard based on numerical techniques, this draft was put on hold and the PAR (P1529) withdrawn pending completion of 1528-2003.

Howard Bassen (USFDA/CDRH), Chair of SC-2 since it was established, stepped down as Chair on September 30, 2005. SC-2 is now co-chaired by Wolfgang Kainz (USFDA/CDRH) and Mark Douglas (Motorola Labs). The membership of SC-2 now stands at 69, with many members from Europe and the Far East (see Table TC-34-3 for

membership information). Approximately one-fourth to one-third of the membership has attended each of the subcommittee/working group meetings held since August 1997. (Additional meetings, e.g., Editorial WG meetings, are much smaller and attended mainly by the section editors of the P1528 and P1529 drafts.) In addition, a Standards Harmonization Working Group was established that in the beginning met with other product-standards developers (ARIB, CENELEC TC106X and IEC TC106). These committees are also developing similar standards for measurement protocols. (Because of common membership on these committees, the International Harmonization Working Group was disbanded.) While the IEC and the IEEE standard are in complete harmony, and both slightly differ from CENELEC standard, IEEE Std 1528-2003 is by far the most comprehensive and detailed of the three documents.

2.4.3.1 Subcommittee 2-Working Group 1 (Measurement Techniques)

The primary tasks of WG 1 in 2006 and 2007 were to expand the 1528 standard. Major accomplishments of WG 1 include the following:

- 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 measured SAR in an anthropomorphic, dielectric-filled head phantom was initiated in 2005. Participants included Mobile Manufacturers Forum (MMF) members as well as several commercial and government research laboratories (USA, Japan, and China). The MMF sponsored this project that involved measurements taken in labs in Asia, Europe, and North America. This inter-comparison was completed successfully in Feb 2006. A paper has been written on the design and results and was presented at the *Bioelectromagnetics Society 2007 Annual Meeting*. This work follows from a previous inter-laboratory comparison using a simplified setup that was published in *IEEE Transactions on Electromagnetic Compatibility* in August 2006.
- Amendment 1 to IEEE Std 1528-2003 entitled, “IEEE 1528a - Recommended Practice for Determining the Peak Spatial-Average Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques - Amendment 1: CAD File for Head Model (SAM)” was balloted, approved by the IEEE SASB in September 2005 and published in February 2006.
- A PAR for Amendment 2 of IEEE Std 1528-2003, entitled, “IEEE P1528b - 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,” was approved at the September 2005 SASB meeting. This PAR 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. The results of the vote were: 12 (Y), 1 (N), 2 (A)—285 comments were submitted.

The working group is currently working to respond to the comments. New research projects have been initiated to respond to some of the comments.

- The working group has begun work on a new revision of IEEE 1528. The work will combine the efforts of IEEE 1528b to extend the frequency range of SAR measurement standards up to 6 GHz with the collaborative efforts with IEC 62209-2 for the development of standards for other 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 dual-logo standard with IEC PT 62209. This would further strengthen the harmonization of the two standards committees and eliminate unnecessary duplication.

2.4.3.2 Subcommittee 2-Working Group 2 (Numerical Techniques)

Because of the focus on completing IEEE Std 1528-2003, work on P1529 (computational techniques) had been stopped. WG-2 was recently reconstituted and met several times since January 2003 to begin updating and completing the draft (now approximately 50% complete). Major accomplishments of WG-2 include the following:

- Explored the needs for additional computational compliance standards and a computational standard for active implantable medical devices was proposed. A teleconference with ADVAMED and implant manufacturers followed. Implant manufacturers, specifically Medtronic, made it clear that currently a computational standard for active implantable medical devices is not needed. Implant manufacturers and ADVAMED met later during the year again and concluded that a specific standard is not required at this time because of the following reasons:
 - Industry experience is limited at this point as medical implant communication service (MICS) equipment is currently being developed
 - The development of a standard might be more appropriate a few years down the road as the industry understands computations modeling better
 - Current FCC requirements are sufficient;

WG-2 agreed that to reevaluate this decision in the future as circumstances change and as the industry accumulates more experience with devices of this type. The industry will maintain a dialog with WG 2 and remain alert for additional information that might warrant industry participation in the development of a computational standard for SAR.

- A new concept for computational compliance standards was proposed. The new concept is based on a document defining the general requirements for using the Finite Difference Time Domain (FDTD) method for computational compliance. Standards for specific compliance needs can be developed

building on these general requirements. WG-2 proposed the development of P1528.1, “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,” and P1528.2, “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 Antennas.” PARs P1528.1 and P1528.2 were approved at the September 2005 SASB meeting. Detailed outlines for P1528.1 and P1528.2 have been developed by WG-2.

- Commenced work on developing a protocol for inter-comparison of various numerical simulation tools and head models, including the SAM (Specific Anthropomorphic Mannequin) phantom developed by members of SC-2/WG-1. The CAD file for SAM, which was included with IEEE Std 1528a-2005, has also been adopted by IEC 62209-1. A number of other head models will be compared by WG-2 members via an inter-laboratory comparison program. The purpose of this program is to assess the overall uncertainty and accuracy of the numerical simulation software now being used throughout the world by comparing SAR distributions in each of the head models.
- Released (July 1, 2005) “Draft Protocol for the Computational Comparison of the SAM Phantom to Anatomically Correct Models of the Human Head.”
- A major medical device manufacturer (Medtronic) asked FCC for additional frequency allocations for MICS applications and a low-power exclusion for AIMDs (Active Implantable Medical Devices) is under FCC’s consideration, an area of interest and possible opportunity to TC-34.
- Issues relating to the SAM CAD files were resolved. Legitimate copies of the SAM CAD data are now available from a number of sources. A digital signature procedure of the SAM CAD file is therefore no longer necessary.
- Code validation procedures and uncertainty procedures for computational compliance methods have been a major topic of interest leading to in-depth discussions at the WG meetings.
- A proposal for a new project, P1528.3 “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” was approved by the WG. A PAR, P1528.3 was submitted to NesCom and approved by the SASB at the March 2006 meeting. Timeline for 1528.3 development is 5 years – a partial draft was discussed at the April 2006 meeting in Stockholm. The drafting group Chair is working closely with section authors of P1528.1 and P1528.2 to achieve consistency of the documents and avoid overlap.

- P1528.1: It was decided not to include FDA's repaired anatomical CAD models. P1528.1 will recommend the SAM phantom, the elliptical phantom described in IEC 62209 and the "Virtual Family" which is currently under development.
- Members of SC-2/WG-2 are coordinating with IEEE 1597.
- Section authors for P1528.1 and P1528.2 presented first drafts in Stockholm, Sweden (3-5 April 2006).
- Members of SC-2/WG-2 prepared draft sections on 'Uncertainty' for P1528.1 and P1528.2. A first draft was presented at the meeting in Cancun in June 2006.
- The 'Code Validation' sections for P1528.1 and 1528.2 were prepared – the first draft was presented at the meeting in Cancun in June 2006.
- A healed version of the SAM CAD files from 1528 was distributed and tested by various groups. The healed version was not compatible with all existing software. A new approach is needed to solve the problem of a unified and healed SAM CAD model. Experts in CAD recommend contracting this task to CAD specialists. Funding for this project was discussed in the meeting in Cancun in June 2006.
- A number of Items discussed in the current 1528.2 draft need additional or benchmark validations to verify error margins and appropriateness before they can be recommended as suitable procedures in 1528.2.
- The committee had in depth discussions if other methods than FDTD should be included in 1528.1. A section to 1528.1 defining what is meant by FDTD and possible FDTD extensions (e.g., FIT) will be added to the draft.
- A PAR for other CEM (Computational Electromagnetic Methods) is being considered.
- 1st draft of 1528.3 was sent to the working group for comment – input is being sought from members with experience in CAD based SAR computational evaluation and from software manufacturers. Uncertainty sources are being identified and classified.

2.4.4 Subcommittee 3 (Evaluation of RF Protective Clothing)

(No longer active)

SC-3 was established at the June 1998 SCC-34 Annual Meeting to develop protocols for characterizing RF-protective garments. Members of the subcommittee, which is now inactive, include members from the federal agencies, garment manufacturers, their representatives and a number of academics. Currently several manufacturers supply such garments and each tests the performance of the clothing according to their own in-house protocols. The garment manufacturers and the FCC, OSHA and NIOSH (who consider the use of protective garments as a means for controlling exposure) have encouraged the development of standardized procedures for testing the effectiveness of such garments.

The first official meeting of SC-3 was held on January 27, 1999 in Ft. Lauderdale, FL. At this meeting, it was agreed that the subcommittee should develop a draft "Recommended Practice for Evaluating the Performance Characteristics of RF Protective Clothing." The following scope was suggested:

“This Recommended Practice applies to clothing that is worn to protect persons from excessive exposure to radiofrequency electromagnetic fields. It addresses SAR, induced and contact current reduction, and surface arcing issues. While providing guidance on matters related to but not limited to flammability, durability, comfort, heat stress, and visual acuity, this recommended practice does not address applicable industrial textile requirements.”

A rough outline of a Recommended Practice was produced by May 30, 1999 for discussion at the second meeting of the subcommittee held on June 18, 1999 in Long Beach, CA. Lengthy discussion during the second meeting suggested the need to revisit the overall outline prior to submitting a PAR. Informal meetings were held in 2001, 2002, 2003, 2004 and 2005 to try to reach consensus on the outline but so far the scope is tentative. A formal meeting of SC-3 was held in conjunction with other TC-34 meetings in December 2005 in San Antonio, TX. The primary purpose of the December 2005 meeting was to reach a decision on the continuation of the subcommittee or its dissolution. Extended discussion was held at the meeting as well as a presentation by an industry representative who manufactures RF protective clothing. It was decided that there seems to be a general lack of interest in RF protective clothing and the subcommittee is inactive at this time.

2.5 PARs (SC-2)

Subcommittee 2 (certification of wireless handsets) is the only TC-34 subcommittee that has submitted PARs. The following TC-34/SC-2 PARs have been approved:

2.5.1 P1528b (Approved September 2005)

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

Project 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.

Project 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.

2.5.2 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

Project 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.

Project 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.

2.5.3 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

Project 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.

Project 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.

2.5.4 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

Project 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.

Project 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.

Project reason: Computational electromagnetic techniques have reached a level of maturity which allows their use in compliance assessments of professional and consumer wireless communication devices. The increasing costs of assessing product compliance with exposure standards calls for new compliance techniques. Such techniques should be time efficient and cost effective. The benefits to the user include standardized and accepted protocols and standardized anatomical models, validation techniques, benchmark data, reporting format and means for estimating the overall uncertainty in order to produce valid and repeatable and reproducible data. 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.

2.5.5 P1528.4 (PAR not submitted)

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 this. In February 2007 the Working Group decided that 1528.4 should concentrate on the Finite Element Method. Early versions of a PAR and a Recommended Practice have been produced that cover the same ground as those of 1528.1, 1528.2 and 1528.3 combined. The general direction of these early versions was discussed in the June 2007 meeting. Several members of the Working Group volunteered to proof-read the draft and provide feedback. The

documents for 1528.4 follow the earlier ones closely and refer to those frequently, while changing FDTD specific guidelines into FEM-specific guidelines. As the documents of 1528.1, 1528.2 and 1528.3 continue to grow and evolve, so will those of 1528.4. A PAR for 1528.4 has not yet been submitted. This will be done when it becomes clearer in which direction the work develops.

2.6 Drafts

2.6.1 SC-2 (Working Group 1: Measurement Techniques)

The final draft of IEEE Std 1528a was approved at the SASB September 2005 meeting.

A draft of IEEE Std 1528b was prepared for subcommittee balloting. Subcommittee members voted and commented on the draft in April, 2007.

2.6.3 SC-2 (Working Group 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.

2.7 Website (SC-2)

A website and reflector was set up several years ago for 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 SC-2 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 new reflector was also set up. The address is stds-tc34sc2@ieee.org

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

- 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 for subcommittee voting in 2007 – Met
- Complete outline for a recommended practice for the evaluation of RF-protective garments – (Not met - project dropped before a PAR was submitted)
- 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. (1st Q 06) – (Completed. Included in ICES P&Ps – Accepted by AudCom)

2.9 Current levels of activity with milestones indicated

- Develop 2nd Draft of 1528b. (3rd Q 08)
- Complete 1st working draft of P1528.1 “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.” (4th Q 07)
- Complete 1st working draft for P1528.2 “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.” (4th Q 07)
- Complete 1st working draft for 1528.3, “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.” (4th Q 07)
- Explore the need for a standard for the assessment low-frequency magnetic field security devices. (4th Q 07)
- 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. (4th Q 07)
- A new PAR (P1528.4) will be submitted 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. (2nd Q 08)

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. Since Bill Ash is the Staff Engineer for both TC-34 and TC-95, his attendance at the semi annual/annual TC-34 meetings is appropriate. His engineering background and broad knowledge of IEEE procedures is invaluable to this committee.

2.11 Summary of other activities

2.11.1 Liaison with other committees

Liaison with ICES occurs via the circulation of drafts, common membership and common meetings of TC-34 and ICES. Liaison with CENELEC, IEC, ARIB and

other standards developing organizations is via common membership, sharing of drafts and meetings with members of the SC-2 harmonization WG, and “Category D” liaisons. 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

2.12.1 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 TC34/SC2/WG1 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 Amendment 2 of 1528. During the development of IEEE 1528 and IEC62209, a large number of TC34 WG 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); TC34 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 TC34/SC2/WG1 members; 40% of TC34/SC2/WG1 are members of PT62209). Moreover, during the past two years, the TC34 WG and PT62209 have held 6 face-to-face meetings and a number of joint teleconferences. While these are dedicated to PT62209 business, or TC34 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 TC34/SC2 believe that IEC 62209 and IEEE 1528 are ideal candidates for such a project.

2.13 Membership

See Table TC-34-2 and Table TC-34-3, respectively, for TC-34 and TC-34/SC-2 membership information and the attached Excel files for detailed membership information.

Table TC-34-2
TC-34 Membership: [Main Committee](#) (August 2007)

| | LAST NAME | FIRST NAME | MI | AFFILIATION | INTEREST* | COUNTRY |
|-----|-------------|------------|----|----------------------------------|-----------|---------|
| 1. | Adair | Eleanor | R. | Independent Consultant | GI | US |
| 2. | Ash | Bill | | IEEE SA Standards Dept | GI | 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. | Bell | Clark | H | HF Plus | U | 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, Inc. | P | US |
| 12. | Cleveland | Robert | F. | Independent Consultant | GI | US |
| 13. | Curtis | Robert | A. | Independent Consultant | U | US |
| 14. | Dini | David | | Underwriters Laboratory | U | US |
| 15. | Douglas | Mark | G. | Motorola, Inc | P | US |
| 16. | Foster | Kenneth | R. | Univ. of Pennsylvania | GI-(A) | US |
| 17. | Gandhi | Om | P. | U of Utah, Dept. of Elec. Eng. | GI A) | US |
| 18. | Guy | Arthur | W. | Bioelectromagnetics Con. | 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 | CH |
| 24. | MacLean | Kathy | | APREL Laboratories-SSI | U | CA |
| 25. | Mason | Patrick | A. | USAF/AFRL/HEDR | GI-(G) | US |
| 26. | Osepchuk | John | M. | Full Spectrum Consulting | GI | US |
| 27. | Petersen | Ronald | C. | R C Petersen Associates | GI | US |
| 28. | Santomaa | Veli | A | Independent Consultant | GI | FI |
| 29. | Scanlon | William | G. | Queens University, Belfast | GI-(A) | UK |
| 30. | Tell | Richard | A. | Richard Tell Assoc. Inc. | U | US |
| 31. | Thansandote | Art | | Health Canada | GI-(G) | CA |
| 32. | Toropainen | Anssi | | Nokia Research Ctr. | P | US |
| 33. | Varanelli | Arthur | G. | Independent Consultant | 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 2](#) (Certification of Wireless Handsets)

| | 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-Choi | ETRI |
| 9. | Chou | C.K. | Motorola, Inc. |
| 10. | Christ | Andreas | ETHZ |
| 11. | Cleveland | Robert | Independent Consultant |
| 12. | Davis | Chris | Univ MD |
| 13. | Douglas | Mark | Motorola, Inc |
| 14. | Faraone | Antonio | Motorola, Inc. |
| 15. | Foster | Kenneth | Univ. of Pennsylvania |
| 16. | Gabriel | Sami | Microwave Consultants |
| 17. | Goljan | Christofer | Nokia |
| 18. | Grangeat | Christophe | Alcatel |
| 19. | Hamada | Lira | NICT |
| 20. | Harrington | Tim | Federal Communications Commission |
| 21. | Heirman | Donald | Don HEIRMAN Consultants |
| 22. | Ivans | Veronica | Medtronic |
| 23. | Kainz | Wolfgang | FDA/CDRH |
| 24. | Karkkainen | Kimo | Nokia |
| 25. | Keshvari | Jafar | Nokia |
| 26. | Klysner | Leif | |
| 27. | Kuster | Niels | IT'IS Foundation |
| 28. | Lee | Ae-kyoung | ETRI |
| 29. | Li | C. K. | Kyocera-Wireless |
| 30. | Loader | Benjamin | NPL |
| 31. | Lin | Lu | Qualcomm |
| 32. | Luebbers | Ray | Remcom |
| 33. | MacLean | Kathy | APREL Laboratories-SSI |

| | LAST NAME | FIRST NAME | AFFILIATION |
|-----|------------------|-------------------|-------------------------|
| 34. | Manning | Michael | IndeXsar, Ltd |
| 35. | Manteuffel | Dirk | IMST |
| 36. | Monebhurrun | Vickass | SUPELEC |
| 37. | Nadakuduti | Jagadish | Motorola |
| 38. | Nappert | Hughes | IC |
| 39. | Nichol | Stuart | APREL |
| 40. | Onishi | Teruo | NTT DOCOMO |
| 41. | Penny | Chris | Remcom |
| 42. | Petersen | Ronald | R C Petersen Associates |
| 43. | Wittwer | David | Intel |
| 44. | Wojcik | Jack | APREL |
| 45. | Ye | Qiubo | CRC |
| 46. | You | Feng | Nokia |

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 Table TC-95-2 through Table TC-95-7.)

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

Several members of TC-95 have been inactive and their continuing status has been 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, with a fewer number of 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 encouraged for all members.

3.3 Meetings (2005-2007)

3.3.1 Main Committee

- June 26, 2005 – Dublin Ireland
- December 11, 2005 – San Antonio, TX
- June 10, 2006 – Cancun Mexico (SC-4)
- August 30, 2006 – IEEE Piscataway, NJ
- March 2, 2007 – London, England
- November 30, 2007 – Irving TX
- June 2008 – San Diego, CA (date TBD)

3.3.2 Subcommittee 1 (Measurements and Computation)

- September 2005 – by teleconference
- November 2005 – by teleconference
- January 2006 – Rockville, MD

- April 2006 – Teleconference
- August 29, 2006 – IEEE, Piscataway, NJ
- February 28, 2007 – London, England
- November 2007 – Irving, TX (date TBD)
- June 2008 – San Diego, CA (date TBD)

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

- June 24, 2005 – Dublin Ireland
- December 8, 2005 – San Antonio, TX
- August 28, 2006 – IEEE, Piscataway, NJ
- March 1, 2007 – London, England
- November 2007 – Irving, TX (date TBD)
- June 2008 – San Diego, CA (date TBD)

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

- June 26, 2005 – Dublin Ireland
- December 9, 2005 – San Antonio, TX
- August 29, 2006 – IEEE, Piscataway, NJ
- February 28, 2007 – London, England
- November 2007 – Irving, TX (date TBD)
- June 2008 – San Diego, CA (date TBD)

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

- June 25, 2005 – Dublin Ireland
- December 10, 2005 – San Antonio, TX,
- June 10, 2006 – Cancun, Mexico
- March 1, 2007 – London, England
- November 2007 – Irving, TX (date TBD)
- June 2008 – San Diego, CA (date TBD)

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

- June 25, 2005 – Dublin Ireland
- December 9, 2005 – San Antonio, TX
- August 30, 2006 – IEEE, Piscataway, NJ
- November 2007 – Irving, TX (date TBD)

- June 2008 – San Diego, CA (date 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 (3), Israel (1), Italy (3), Japan (1), Korea (2), Malaysia (1), the Netherlands (2), New Zealand (1), Poland (1), Sweden (1), Slovenia (1), South Africa (2), Switzerland (3), Thailand (1), the United Kingdom (8) and the United States (67), i.e., approximately 43% 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. Seven 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. The ICES Website contains both open and private sites for TC-95 and its subcommittees. Subcommittee 4 makes all agendas, approved meeting minutes, white papers, RF research database, draft standard documents, and many special reports available to all, with certain proprietary or working documents available only to members of the subcommittee on private sections of the site. The TC-95 SC-4 literature database, containing more than 2500 titles, now appears on the WHO website and is also accessible to all. <http://www.who.int/peh-emf/research/database/IEEEdatabase/>.

During the past two years, one new standard, one revised standard and one reaffirmation were approved by the SASB. Specifically, IEEE C95.1-2005, “IEEE Standard for Safety Levels with Respect to Human Exposure to Radio Frequency Electromagnetic Fields, 3 kHz to 300 GHz,” and IEEE C95.7-2005, “IEEE Recommended Practice for Radiofrequency Safety Programs” were approved. C95.1-2005 replaces IEEE C95.1-1991: 1999 edition (including Amendment 2); C95.7 is a new standard. IEEE Std C95.2-1999, “IEEE Standard for Radio Frequency Energy and Current Flow Symbols” was reaffirmed.

Table TC-95-1
TC-95 Leadership

| Office | Name | Affiliation |
|------------------------|--|--|
| Chairman | Dr. C-K Chou | Motorola Labs |
| Vice Chairman (Vacant) | | |
| Secretary | Ron Petersen | R C Petersen Associates LLC |
| Treasurer | Arthur Varanelli | Independent Consultant |
| Chairman, SC-1 | Howard Bassen | US FDA Center for Devices and Rad. Health |
| Chairman, SC-2 | Richard Tell | Richard A Tell Associates, Inc. |
| Co-Chairman, SC-3 | Dr. Philip Chadwick Thanh Dovan | EMFields Ltd. SP AusNet Pty. Ltd. |
| Co-Chairman, SC-4 | Dr. Art Thansandote Dr. Marvin Ziskin, MD | Health Canada Temple University Medical School |
| Co-Chairman, SC-5 | G. A. (Drew) Koban Robert Needy | Naval Surface Warfare Ctr. Naval Surface Warfare Ctr. |

3.4.2 Subcommittee 1 (Measurement and Computation)

Subcommittee 1 is 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 first draft during the 3rd Q, 2007. At present, there is an issue relating to the proper exposure metric for certain fields to allow comparison of measured and numerical exposure fields with the limits set forth in IEEE C96.6-2002. 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” is now (August 2007) undergoing reaffirmation ballot. Following the reaffirmation ballot, a PAR for the revision of C95.3-2002 with an extended scope to cover the frequency range of 0-300 GHz will be submitted. PC95.3 will then be incorporated into the revision. IEEE 1460 “Guide for the Measurement of Quasi-Static Magnetic and Electric Fields” is also undergoing reaffirmation ballot. This standard will be incorporated into PC95.3.1 and ultimately C95.3.

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

Subcommittee 2 has responsibility for two standards (C95.7-2005 and C95.2-1999). 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. SC-2 will develop several new documents as examples of the application of C95.7-2005 for RF safety programs that would be appropriate to different work scenarios. It is anticipated that these new documents would become guides, a part of the C95.7 family of standards. There is still some interest in compiling a glossary of terms used in ELF and RF safety, portions of which have been compiled over the years. The subcommittee expressed interest in developing a standard for ELF safety programs.

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

Subcommittee 3 has responsibility for C95.6-2002. During the past three 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 guidelines, 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. There are no PARs for new or existing projects but this standard is now (August 2007) undergoing reaffirmation ballot. If the reaffirmation fails, a PAR will be submitted for its revision. This standard will eventually be incorporated into IEEE C95.1 (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 is being considered to clarify language that could not be clarified during final review without substantive changes. A PAR will be submitted for this amendment following the November 2007 meeting. A PAR for the revision of C95.1 with an extended scope to cover the frequency range of 0-300 GHz will be submitted next year. IEEE C95.6 will be incorporated into this revision; following approval, C95.6 will be withdrawn.

Plans are underway to develop a short-course that explains the differences between the 2005 and 1991 standards and describes the implementation of the safety limits.

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 has been reviewed and is now (August 2007) undergoing reaffirmation ballot. There are no PARs for new or existing projects.

3.5 PARs

The only active TC-95 PAR is the SC-1 PAR for a new standard project – PC95.3.1 (Approved December 2003)

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.

3.6 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 the IEEE staff, to develop a fundraising program to support critical travel, support for special projects and meetings, support for visiting scientists and experts, and other critical need – 2nd Q 2006. (Ongoing)
- Continue international expansion led by Drs. McManus 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 summer 2006 meetings of TC-95 and its subcommittees – 1st Q 2006. (Met).
- Pursue the project on publicizing ICES and C95.1 standards in the literature, with the assistance of IEEE staff – 2nd Q 2006. (Not met)
- Reassess the plans for an electronic newsletter in recognition of ICES objectives – 2nd Q 2006. (Not met)
- Attempt to carry out a third closed leadership meeting with ICNIRP, possibly during the June 2006 meetings in Cancun – 2nd Q 2006. (Not met – however, a representative of ICES was invited to meet with ICNIRP at their Commission meetings in 2005 and 2006)
- Update the TC-95 website, include SC sections, and provide FTP service for subcommittee activities – 1st Q, 2006. (Partially met)

- Complete 1st draft of new project “Recommended Practice for Measurements and Computations with Respect to Human Exposure to Electric and Magnetic Fields, 0 to 100 kHz” – 1st Q 2006. (Partially met)
- Complete draft of commonly used terms – 2nd Q 2006. (Ongoing)
- Complete guide for the application of C95.6 – 3rd Q 2006. (Partially met)
- Review plans for future activities related to electro-explosive devices (SC-5). (Met)
- Publish revision of C95.1 – 4th Q 2005. (Met – standard approved in September 2005 and published in April 2006)
- Publish revision of C95.7 – 4th Q 2005. (Met – standard approved in September 2005 and published in March 2006)

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 – 4th Q 2007.
- 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 2008 meetings of TC-95 and its subcommittees – 4th Q 2007.
- Pursue the project on publicizing ICES and C95.1 standards in the literature – Ongoing.
- Complete the TC-95 portion of the ICES website (<http://www.ices-emfsafety.org/>), include subcommittee sections, provide FTP service for subcommittee activities – 4th Q, 2007
- 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” – 4th Q 2007
- Complete draft of commonly used terms – 2nd Q 2008
- Complete guide for the application of C95.6 – 3rd Q 2007
- Publish general interest paper on C95.1-2005 (e.g., in *IEEE Spectrum*) and technical paper (e.g., in *Health Physics*) – 4th Q 2007
- Complete reaffirmation ballots on IEEE 1460, C95.3, C95.4 and C95.6 – 3rd Q, 2007
- Submit PAR for C95.1a (Amendment 1) – 4th Q, 2007
- Complete draft, subcommittee balloting and sponsor balloting on C95.1a – 4th Q 2008
- Submit PAR for revision of C95.3-2002 – 3rd Q, 2007 (if reaffirmation ballot fails)
- Submit PAR for revision of IEEE 1460 -1996 (R2002) – 3rd Q, 2007 (if reaffirmation ballot fails)

- Submit PAR for revision of C95.4 – 3rd Q, 2007 (if reaffirmation ballot fails)
- Submit PAR for revision of IEEE C95.6-2002 – 3rd Q, 2007 (if reaffirmation ballot fails)
- 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 – 1st Q, 2008

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 attendance at the semi annual/annual TC-34 meetings is appropriate. 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 standards 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.

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 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 twice with members of ICNIRP (at ICNIRP’s request) to discuss methods of coordination but attempts at sharing documents are one-way only. ICES will continue to discuss ICES and the IEEE process at major international meetings to help recruit key people who have no other way of participating in setting safety standards. For the 2008 BEMS annual meeting, Bob Cleveland has organized a roundtable symposium on exposure standards. Ric Tell and C-K Chou will represent ICES and Paolo Vecchia and James Lin will represent ICNIRP. This round table will offer a forum to promote further harmonization of the two major international standards.

3.11 Membership

See Table TC-95-2 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
August 20, 2007

Table TC-95-2

TC-95 Membership: Main Committee (May 2007)

| | 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 | |
| 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 | | 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. | OSHA - USDOL | US | GI (G) |
| 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. | Dini | David | | Underwriters Laboratory | US | U |
| 30. | d'Inzeo | Guglielmo | | La Sapienza University of Rome | IT | U |
| 31. | Dovan | Thanh | | SP AusNet Pty. Ltd. | AU | P |
| 32. | Durrenberger | Gregor | | ETH | CH | U |
| 33. | DuToit | Leon | | Department of Health | ZA | GI (G) |
| 34. | Erdreich | Linda | S. | Exponent | US | U |

| | LAST_NAME | FIRST_NAME | MI | AFFILIATION | COUNTRY | INT CATEGORY |
|-----|-------------|--------------|----|--------------------------------------|---------|--------------|
| 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. | Kemp | Ray | | Galson Sciences Limited | UK | GI |
| 60. | Kim | Nam | | Chungbuk National University | KR | GI (A) |
| 61. | Klaenberg | B. Jon | | USAF | US | GI (G) |
| 62. | Koban | George | A. | Naval Surface Warfare Center | 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 |
| 71. | Mason | Patrick | A. | USAF/AFRL/HEDR | US | GI (G) |

| | LAST_NAME | FIRST_NAME | MI | AFFILIATION | COUNTRY | INT CATEGORY |
|------|--------------|------------|----|--------------------------------------|---------|--------------|
| 72. | Maurer | Stewart | | RF & ELF Consultant | US | GI |
| 73. | McManus | Tom | | | IE | GI |
| 74. | McNamee | James | P. | Health Canada | CA | GI (G) |
| 75. | Meltz | Martin | L. | Dept of Rad Oncology | US | GI (A) |
| 76. | Montgomery | Noel | D. | Air Force Research Laboratory | US | GI (G) |
| 77. | Moore | Michael | R. | Oak Ridge National Lab | US | GI (G) |
| 78. | Mukhopadhyay | Amitabha | | Con Edison | US | P |
| 79. | Murphy | Michael | R. | Directed Energy Bioeffects | US | GI (G) |
| 80. | Needy | Robert | | Naval Surface Warfare Ctr. | US | GI (G) |
| 81. | Nelson | David | | Michigan Technical University | US | GI (A) |
| 82. | Ng | Kwan-Hoong | | Dept of Radiation | MY | GI (G) |
| 83. | Osepchuk | John | M. | Full Spectrum Consulting | US | GI |
| 84. | Packer | Malcolm | | Harris RF Communications | US | P |
| 85. | Pakhomov | Andrei | G. | McKesson Bio Services | US | GI |
| 86. | Paul | William | F. | Int. Brotherhood of Elect. Workers | US | U |
| 87. | Persson | Bertil | R. | Lund University | SE | GI (A) |
| 88. | Petersen | Ronald | C. | R C Petersen Associates | US | GI |
| 89. | Ravazzani | Paolo | | Italian Nat Res Council | IT | GI |
| 90. | Reilly | J. Patrick | | Metatec Associates | US | U |
| 91. | Repacholi | Michael | H. | World Health Organization | CH | U |
| 92. | Roach | Pat | | AFRL/HEDR | US | GI (G) |
| 93. | Roberts | Brad | J. | US Army CHPPM | US | GI (G) |
| 94. | Root | Ervin | D. | Alliant Energy | US | GI |
| 95. | Samaras | Theodoros | | Aristotle University of Thessaloniki | GR | GI (A) |
| 96. | Santomaa | Veli | A | Independent Consultant | FI | GI |
| 97. | Scanlon | William | G. | Queens University, Belfast | UK | GI (A) |
| 98. | Sheppard | Asher | R. | Asher Sheppard Consulting | US | GI |
| 99. | Sirugo | Jon | H | Southern California Edison | US | P |
| 100. | Swicord | Mays | L. | Motorola | US | P |
| 101. | Szmigielski | Stanislaw | | Mil Inst of Hyg & Epidemiology | PL | GI (G) |
| 102. | Tang, MD | Rosa | M | UTMB, Galveston | US | U |
| 103. | Tattersall | John | | DSTL | UK | GI |
| 104. | Tell | Richard | A. | Richard Tell Assoc. Inc. | US | GI |
| 105. | Testagrossa | Paul | A | Lucent Technologies Inc. | US | P |
| 106. | Thansandote | Art | | Health Canada | CA | GI (G) |
| 107. | Thuroczy | Gyorgy | | Nat Res Inst for Radiobiology | HU | GI (A) |
| 108. | Utteridge | Tammy | | Inst of Medical & Veterinary Science | AU | GI (G) |

| | LAST_NAME | FIRST_NAME | MI | AFFILIATION | COUNTRY | INT CATEGORY |
|------|---------------|----------------|----|------------------------------------|---------|--------------|
| 109. | van Rongen | Eric | | Health Council of the Netherlands | NL | GI (G) |
| 110. | Varanelli | Arthur | G. | Independent Consultant | US | GI |
| 111. | Wagenaar | Femme-Michelle | | PhoneVision International | NL | GI |
| 112. | Wiert | Joe | | France Telecom R&D | FR | P |
| 113. | Williams, Jr. | Louis | A. | Louis A. Williams Jr. & Associates | US | GI |
| 114. | Yoo | Done-Sik | | Elect & Telecom Res Inst | KR | GI |
| 115. | Zipse | Donald | W. | Electrical Forensics, LLC | US | GI |
| 116. | Ziriaux | John | | Microwave Department | US | GI (G) |
| 117. | 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)**

| | 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 | Babij | Tadeusz | M. | Florida International University | US |
| 5 | Balzano | Quirino | | Independent Consultant | US |
| 6 | Baron | David | | AIHA Representative | US |
| 7 | Bassen | Howard | | FDA/CDRH | US |
| 8 | Bergeron | John | A. | Independent Consultant | US |
| 9 | Bodemann | Ralf | | Siemens AG | DE |
| 10 | Brecher | Aviva | | DOT/RSPA Volpe Ctr. | US |
| 11 | Chan | Kwok | W | FCC Laboratory | US |
| 12 | Chou | C.K. | | Motorola, Inc. | US |
| 13 | Cleveland | Robert | F. | Independent Consultant | US |
| 14 | Cohen | Jules | | Jules Cohen P.E. | US |
| 15 | Cox | Diane | | US Navy, NHRC | |
| 16 | Curtis | Robert | A. | OSHA - USDOL | US |
| 17 | Dovan | Thanh | | SP AusNet Pty. Ltd. | AU |
| 18 | Feero | William | E. | Independent Consultant | US |
| 19 | Frazier | William | F | Laurence Behr Associates, Inc. | US |
| 20 | Gandhi | Om | P. | Univ. of Utah, Dept. of Elec. Eng. | US |
| 21 | Guy | Arthur | W. | Bioelectromagnetics Consulting | US |
| 22 | Hare | Ed | | American Radio Relay League | US |
| 23 | Hatfield | James | B | Hatfield & Dawson | US |
| 24 | Hubbard | Roy | | Tech Services International (TSI) | ZA |
| 25 | Iskra | Steve | | Telstra Corp | |
| 26 | Ivans | Veronica | | Medtronic Inc. | US |
| 27 | Johnston | Sheila | | Independent Consultant | UK |
| 28 | Khalil | Kathy | | SPAWARSYSCEN Charleston | US |
| 29 | Kim | Jin Suk | | ETRI | KR |
| 30 | Kumbier | Werner | | Narda Safety Test Solutions | DE |
| 31 | Kuster | Niels | | IT'IS Foundation | CH |

| | LAST NAME | FIRST NAME | MI | AFFILIATION | COUNTRY |
|----|---------------|------------|----|------------------------------------|---------|
| 32 | Lotz | Gregory | | NIOSH | US |
| 33 | Luebbers | Raymond | | Remcom Inc. | US |
| 34 | MacLean | Kathy | | APREL Laboratories-SSI | CA |
| 35 | Mair | Peter | | Fronius International GMBH | |
| 36 | Manning | Michael | | IndeXsar, Ltd | UK |
| 37 | Mantiply | Ed | | FCC/OET | US |
| 38 | Maurer | Stewart | | RF & ELF Consultant | US |
| 39 | Misakian | Martin | | Nat. Inst. of Stds & Technology | US |
| 40 | Montgomery | Noel | D. | Air Force Research Laboratory | US |
| 41 | Moore | Michael | R. | Oak Ridge National Lab | US |
| 42 | Needy | Robert | | Naval Surface Warfare Ctr. | US |
| 43 | Osepchuk | John | M. | Full Spectrum Consulting | US |
| 44 | Persson | Bertil | R. | Lund University | SE |
| 45 | Petersen | Ronald | C. | R C Petersen Associates | US |
| 46 | Roberts | Brad | J. | US Army CHPPM | US |
| 47 | Rowley | Jack | | Telstra Research Labs | AU |
| 48 | Santomaa | Veli | A | Independent Consultant | FI |
| 49 | Schueller | Michael | | Mannesmann Mobilfunk Gmbh | DE |
| 50 | Seabury | David | | Chase Systems Inc. | US |
| 51 | Tell | Richard | A. | Richard Tell Assoc. Inc. | US |
| 52 | Testagrossa | Paul | A | Lucent Technologies Inc. | US |
| 53 | Thansandote | Art | | Health Canada | CA |
| 54 | Umbdenstock | Donald | J. | Sensormatic Electronics Corp. | US |
| 55 | Varanelli | Arthur | G. | Independent Consultant | US |
| 56 | Watanabe | Soichi | | Natl Inst of Inf and Comm Tech | JP |
| 57 | Watkins | Cleveland | F. | | US |
| 58 | Williams, Jr. | Louis | A. | Louis A. Williams Jr. & Associates | US |
| 59 | Zirix | John | | Microwave Department | US |
| 60 | 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 | | 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. | OSHA - USDOL | 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 |

| | LAST NAME | FIRST NAME | MI | AFFILIATION | COUNTRY |
|-----|-----------------|----------------|----|------------------------------------|---------|
| 34. | Joyner | Ken | H. | Motorola Australia Pty Ltd. | AU |
| 35. | Kantner | Kimberly | | AT&T | US |
| 36. | Khalil | Kathy | | SPAWARSSYSCEN Charleston | US |
| 37. | Kierl | Bill | | Motorola, Inc | |
| 38. | Klaunberg | B. Jon | | USAF | US |
| 39. | Koban | George | A. | Naval Surface Warfare Center | US |
| 40. | Kumbier | Werner | | Narda Safety Test Solutions | DE |
| 41. | Kuster | Niels | | IT'IS Foundation | CH |
| 42. | Lathrop | Janet | | Resource Strategies, Inc | US |
| 43. | MacLean | Kathy | | APREL Laboratories-SSI | CA |
| 44. | Mantiply | Ed | | FCC/OET | US |
| 45. | Maurer | Stewart | | RF & ELF Consultant | US |
| 46. | Meltz | Martin | L. | Dept of Rad Oncology | US |
| 47. | Mercer | Christopher | | Vodacom Group, Pty Ltd | ZA |
| 48. | Montgomery | Noel | D. | Air Force Research Laboratory | US |
| 49. | Murphy | Michael | R. | Directed Energy Bioeffects | US |
| 50. | Nappert | Hughes | | Industry Canada | CA |
| 51. | Needy | Robert | | Naval Surface Warfare Ctr. | US |
| 52. | Norman | Larry | | Pike Electric | |
| 53. | Osepchuk | John | M. | Full Spectrum Consulting | US |
| 54. | Persson | Bertil | R. | Lund University | SE |
| 55. | Petersen | Ronald | C. | R C Petersen Associates | US |
| 56. | Proctor | Ken | R. | US Army | US |
| 57. | Roberts | Brad | J. | US Army CHPPM | US |
| 58. | Rogers | Walt | | Veridian Eng/RFR Branch | US |
| 59. | Rowley | Jack | | Telstra Research Labs | AU |
| 60. | Scanlon | William | G. | Queens University, Belfast | UK |
| 61. | Seabury | David | | Chase Systems Inc. | US |
| 62. | Smith | Matthew | | Dade Moeller & Associates | US |
| 63. | Strickland | Richard | | RF Safety Solutions | US |
| 64. | Tell | Richard | A. | Richard Tell Assoc. Inc. | US |
| 65. | Testagrossa | Paul | A | Lucent Technologies Inc. | US |
| 66. | Thansandote | Art | | Health Canada | CA |
| 67. | Ulcek | Jerry | | FCC | US |
| 68. | Vanetta-Richard | Anne | | Lucent Technologies Inc | |
| 69. | Varanelli | Arthur | G. | Independent Consultant | US |
| 70. | Wagenaar | Femme-Michelle | | PhoneVision International | NL |
| 71. | Williams, Jr. | Louis | A. | Louis A. Williams Jr. & Associates | US |

| | LAST NAME | FIRST NAME | MI | AFFILIATION | COUNTRY |
|-----|------------------|-------------------|-----------|-----------------------------|----------------|
| 72. | 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. | OSHA - USDOL | 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. | Gandhi | Om | P. | Univ. of Utah, Dept. of Elec. Eng. | US |

| | LAST NAME | FIRST NAME | MI | AFFILIATION | COUNTRY |
|-----|-------------|------------|----|--------------------------------------|---------|
| 35. | Geber | Kurt | | Dynamac Corporation | US |
| 36. | George | David | L. | Unisys Corp. | US |
| 37. | Gettman | Ken | | Nat'l Electrical Manuf Assoc. | US |
| 38. | Gibney | Kelly | B | Retired | CA |
| 39. | Goldberg | Georges | | Advisory Comm. on EMC | CH |
| 40. | Goulet | Daniel | | Hydro-Quebec | CA |
| 41. | Haes, Jr. | Donald | L. | Consultant | US |
| 42. | Hanna | Bob | | DCMNR, Ireland | IE |
| 43. | Hernandez | Martin | A. | Florida Power & Light Co. | US |
| 44. | Herz | Michael | C. | Pacific Gas & Electric Co. | US |
| 45. | Hicks | Danny | O. | South Carolina Electric & Gas Co. | US |
| 46. | Holley | Jeff | L | Florida Power and Light | US |
| 47. | Hubbard | Roy | | Technology Serv Int (TSI) | ZA |
| 48. | Ikehata | Masateru | | Railway Technical Research Institute | JP |
| 49. | Ivans | Veronica | | Medtronic Inc. | US |
| 50. | Jaffa | Kent | C. | Pacificcorp | US |
| 51. | Johnston | Sheila | | Independent Consultant | UK |
| 52. | Karabetsos | Efthymios | | Greek Atomic Energy Commission | GR |
| 53. | Kautz | Richard | W. | Ford | US |
| 54. | Kim | Nam | | Chungbuk National University | KR |
| 55. | Koepfinger | Joseph | L. | Consultant | US |
| 56. | Kuster | Niels | | IT'IS Foundation | CH |
| 57. | Lathrop | Janet | | Resource Strategies, Inc | US |
| 58. | Leszczynski | Dariusz | | STUK-Rad and Nuclear Rad Lab | FI |
| 59. | Lotz | Gregory | | NIOSH | US |
| 60. | Mair | Peter | | Fronius International GMBH | |
| 61. | Manatrakul | Nisakorn | | Ministry of Public Health | TH |
| 62. | Mason | Patrick | A. | USAF/AFRL/HEDR | US |
| 63. | McManus | Tom | | | IE |
| 64. | McNamee | James | P. | Health Canada | CA |
| 65. | Merritt | James | H. | USAF Research Lab | US |
| 66. | Montgomery | Noel | D. | Air Force Research Laboratory | US |
| 67. | Munzner | Robert | | | US |
| 68. | Murphy | Michael | R. | Directed Energy Bioeffects | US |
| 69. | Needy | Robert | | Naval Surface Warfare Ctr. | US |
| 70. | Nelson | David | | Michigan Technical University | US |
| 71. | Ng | Kwan-Hoong | | Dept of Radiation | MY |
| 72. | O'Connor | Roger | E | Dept of Comm, Marine and Nat Res | IE |

| | LAST NAME | FIRST NAME | MI | AFFILIATION | COUNTRY |
|------|---------------|----------------|----|--------------------------------------|---------|
| 73. | Osepchuk | John | M. | Full Spectrum Consulting | US |
| 74. | Paul | William | F. | Int. Brotherhood of Elect.Workers | US |
| 75. | Petersen | Ronald | C. | R C Petersen Associates | US |
| 76. | Pittman | Steve | | Potlach Pulp and Paperboard | US |
| 77. | Podhrasky | Robert | J. | Garrett Metal Detectors | US |
| 78. | Polson | Peter | | Ausa Research | US |
| 79. | Proctor | Ken | R. | US Army | US |
| 80. | Ravazzani | Paolo | | Italian Nat Res Council | IT |
| 81. | Reilly | J. Patrick | | Metatec Associates | US |
| 82. | Roberts | Brad | J. | US Army CHPPM | US |
| 83. | Root | Ervin | D. | Alliant Energy | US |
| 84. | Sahl | Jack | D. | J. Sahl Associates | US |
| 85. | Samaras | Theodoros | | Aristotle University of Thessaloniki | GR |
| 86. | Sawdon | Dave | | IBM Global Services | UK |
| 87. | Sheppard | Asher | R. | Asher Sheppard Consulting | US |
| 88. | Sirugo | Jon | H | Southern California Edison | US |
| 89. | Slesin | Louis | | Microwave News | US |
| 90. | Sliney | David | | US Army CHPPM Retired | US |
| 91. | Swicord | Mays | L. | Motorola | US |
| 92. | Szmigielski | Stanislaw | | Mil Inst of Hygiene & Epidemiology | PL |
| 93. | Tell | Richard | A. | Richard Tell Assoc. Inc. | US |
| 94. | Thansandote | Art | | Health Canada | CA |
| 95. | Thuroczy | Gyorgy | | Nat Res Inst for Radiobiology | HU |
| 96. | Valberg | Peter | A | Gradient Corporation | US |
| 97. | van Rongen | Eric | | Health Council of the Netherlands | NL |
| 98. | Varanelli | Arthur | G. | | US |
| 99. | Vijayalaxmi | | | Univ. Texas Health Science Ctr. | US |
| 100. | Wagenaar | Femme-Michelle | | PhoneVision International | NL |
| 101. | Watkins | Cleveland | F. | | US |
| 102. | Wuart | Joe | | France Telecom R&D | FR |
| 103. | Williams, Jr. | Louis | A. | Louis A. Williams Jr. & Associates | US |
| 104. | Woods | Richard | W. | Sensormatic Electronics | US |
| 105. | Yandek | Edward | M. | GE Lighting | US |
| 106. | Yoo | Done-Sik | | Elect & Telecom Res Inst | KR |
| 107. | Zipse | Donald | W. | Electrical Forensics, LLC | US |
| 108. | Ziriaux | John | | Microwave Department | US |
| 109. | 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 | | 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. | OSHA - USDOL | US |
| 27 | Cyr | W. Howard | | USFDA/CDRH | US |
| 28 | D'Andrea | John | A. | Naval Health Research Ctr. | US |
| 29 | de Jager | Linda | | School of Health Technology | ZA |
| 30 | DeFrank | John | J. | USACHPPM | US |
| 31 | Dini | David | | Underwriters Laboratory | US |

| | LAST NAME | FIRST NAME | MI | AFFILIATION | COUNTRY |
|----|--------------|--------------|----|---------------------------------------|---------|
| 32 | d'Inzeo | Guglielmo | | La Sapienza University of Rome | IT |
| 33 | Dovan | Thanh | | SP AusNet Pty. Ltd. | AU |
| 34 | Durrenberger | Gregor | | ETH | CH |
| 35 | DuToit | Leon | | Department of Health | ZA |
| 36 | Duvdevany | Amnon | Y | Israeli Defense Forces | IL |
| 37 | Elder | Joe | A | Motorola | US |
| 38 | Erdreich | Linda | S. | Exponent | US |
| 39 | Fichtenberg | David | S | State of Washington, Med Asst Ad | US |
| 40 | Foster | Kenneth | R. | Univ. of Pennsylvania | US |
| 41 | Futch | James | | Florida Dept. of Health | US |
| 42 | Gajsek | Peter | | Institute of Public Health | SI |
| 43 | Gandhi | Om | P. | Univ. of Utah, Dept. of Elec. Eng. | US |
| 44 | Gardner | Robert | C. | MOD D S&F Pol | UK |
| 45 | Geber | Kurt | | Dynamac Corporation | US |
| 46 | George | David | L. | Unisys Corp. | US |
| 47 | Gettman | Ken | | Nat'l Electrical Manufacturers Assoc. | US |
| 48 | Glaser | Marne | | Public Representative | US |
| 49 | Goldberg | Georges | | Advisory Comm. on EMC | CH |
| 50 | Haes, Jr. | Donald | L. | Consultant | US |
| 51 | Halkiotis | Konstantinos | | Medical School of Athens | GR |
| 52 | Hanna | Bob | | DCMNR, Ireland | IE |
| 53 | Hatfield | James | B | Hatfield & Dawson | US |
| 54 | Healer | Janet | | Dept. of Commerce | US |
| 55 | Heirman | Donald | N. | Don HEIRMAN Consultants | US |
| 56 | Heroux | Paul | | McGill University | CA |
| 57 | Hubbard | Roy | | Technology Services International | ZA |
| 58 | Ikehata | Masateru | | Railway Technical Research Institute | JP |
| 59 | Ilieva | Michael | D | | |
| 60 | Israel | Michel | | National Centre of Hygiene | BL |
| 61 | Ivans | Veronica | | Medtronic Inc. | US |
| 62 | Johnston | Sheila | | Independent Consultant | UK |
| 63 | Joyner | Ken | H. | Motorola Australia Pty Ltd. | AU |
| 64 | Kandel | Shaiela | | Hebrew University of Jerusalem | IL |
| 65 | Kantner | Kimberly | | AT&T | US |
| 66 | Karabetsos | Efthymios | | Greek Atomic Energy Commission | GR |

| | LAST NAME | FIRST NAME | MI | AFFILIATION | COUNTRY |
|-----|-------------|------------|----|-------------------------------|---------|
| 67 | Kean | John | | BTS IEEE | US |
| 68 | Kemp | Ray | | Galson Sciences Limited | UK |
| 69 | Kim | Nam | | Chungbuk National University | KR |
| 70 | Klauenberg | B. Jon | | USAF | US |
| 71 | Koepfinger | Joseph | L. | Consultant | US |
| 72 | Kwee | Sianette | | University of Aarhus | DK |
| 73 | Lang | Sakari | | Nokia Research Ctr. | FI |
| 74 | Leszczynski | Dariusz | | STUK-Rad and Nuclear Rad Lab | FI |
| 75 | Lin | James | C. | University of Illinois | US |
| 76 | Lotz | Gregory | | NIOSH | US |
| 77 | Maletskos | C.J. | | National Council for Rad. | US |
| 78 | Manatrakul | Nisakorn | | Ministry of Public Health | TH |
| 79 | Manning | Michael | | IndeXsar, Ltd | UK |
| 80 | Mantipty | Ed | | FCC/OET | US |
| 81 | Mason | Patrick | A. | USAF/AFRL/HEDR | US |
| 82 | Maurer | Stewart | | RF & ELF Consultant | US |
| 83 | McKenzie | Roy | | Telstra Research labs | AU |
| 84 | McManus | Tom | | | IE |
| 85 | McNamee | James | P. | Health Canada | CA |
| 86 | McQuade | Jill | | USAF | US |
| 87 | Meltz | Martin | L. | Dept of Rad Oncology | US |
| 88 | Montgomery | Noel | D. | Air Force Research Laboratory | US |
| 89 | Moore | Michael | R. | Oak Ridge National Lab | US |
| 90 | Morrissey | Joe | | Motorola | US |
| 91 | Murphy | Michael | R. | Directed Energy Bioeffects | US |
| 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 |
| 101 | Ravazzani | Paolo | | Italian Nat Res Council | IT |

| | LAST NAME | FIRST NAME | MI | AFFILIATION | COUNTRY |
|-----|---------------|----------------|----|--------------------------------------|---------|
| 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 | Stolwijk | Jan A. | J. | Yale University | US |
| 112 | Swicord | Mays | L. | Motorola | US |
| 113 | Szmigielski | Stanislaw | | Mil Inst of Hygiene and Epidemiology | PL |
| 114 | Tattersall | John | | DSTL | UK |
| 115 | Tell | Richard | A. | Richard Tell Assoc. Inc. | US |
| 116 | Testagrossa | Paul | A | Lucent Technologies Inc. | US |
| 117 | Thansandote | Art | | Health Canada | CA |
| 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. | | US |
| 122 | Wagenaar | Femme-Michelle | | PhoneVision International | NL |
| 123 | Weller | Robert | D. | Hammett & Edison, Inc. | US |
| 124 | Wiert | Joe | | France Telecom R&D | FR |
| 125 | Williams, Jr. | Louis | A. | Louis A. Williams Jr. & Associates | US |
| 126 | Woods | Richard | W. | Sensormatic Electronics | US |
| 127 | Yoo | Done-Sik | | Elect & Telecom Res Inst | KR |
| 128 | Zipse | Donald | W. | Electrical Forensics, LLC | US |
| 129 | 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)

| | FIRST NAME | LAST NAME | MI | AFFILIATION | COUNTRY |
|-----|-------------------|------------------|-----------|----------------------------------|----------------|
| 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. | Koban | George | A. | Naval Surface Warfare Center | US |
| 13. | Leidel | David | | Halliburton Energy Services | US |
| 14. | Petersen | Ronald | C. | R C Petersen Associates | US |
| 15. | Roberts | Brad | J. | US Army CHPPM | US |
| 16. | Stuart | James | | Franklin Applied Physics | US |
| 17. | Thompson | Ramie | | Franklin Applied Physics | US |