ICES

International Committee on Electromagnetic Safety

ICES (SCC-39) Annual Report: 2015 – 2016

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)

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25 November 2016

CONTENTS

ICES (SCC-39) Annual Report: 2015 – 2016

1. Scope

"Development of standards for the safe use of electromagnetic energy in the range of 0 Hz to 300 GHz relative to the potential hazards of exposure of humans, volatile materials, and explosive devices to such energy. Such standards will be based on established effects and include safety limits 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 factors."

The structure of ICES/SCC-39 is shown below in Figure 1.

2. Administrative Committee (AdCom)

2.1 AdCom Membership

The membership of the AdCom is shown below in Table 1. New members include Dr. Jafar Keshvari (Aalto University, Finland) who replaced Dr. Wolfgang Kainz as TC34 Chairman; Dr. Akimasa Hirata (Nagoya Institute of Technology), who chairs a new subcommittee (SC6) established to address dosimetry and induction model issues at low frequencies; and J Patrick Reilly as an "at large" member recognized internationally for his expertise in low-frequency bioeffects. Dr. B Jon Klauenberg replaced Dr. Michael Murphy as Membership Chair. Additional "at large" members are being sought, especially young scientists and engineers from outside the US.

2.2 AdCom Activities

AdCom members continue to explore paths toward international harmonization of standards for the safe use of electromagnetic energy. The increased international ICES membership, the DoD-funded IEEE Get Program, and the agreement with the NATO Standardization Agency (now the NATO Standardization Office, NSO) to provide a new civil standard to replace NATO standards adopted under Standards Agreement 2345 are providing greater influence within the international community. ICES representatives regularly participate and give presentations on the role of ICES in international standard setting at important international meetings, including meetings sponsored by, PIERS (Progress in Electromagnetics Research Symposium), ITU (International Telecommunication Union), IEC (International Electrotechnical Commission), the Bioelectromagnetics Society (BEMS), WHO EMF Project workshops, and workshops sponsored by the EU Presidency and the Commission on Worker Safety. 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 (deceased), was the main author of the WHO Model Legislation document, which included finding common ground where different opinions existed. ICES Chairman Bodemann represents ICES at the WHO International Advisory Committee meetings, TC34 Chairman Keshvari and TC95 member Klauenberg represent ICES at IEC TC106 and NATO Standardization Office meetings, respectively.

2.3 Highlights (2015 – 2016)

- During the past year, the Administrative Committee (AdCom) met in Plantation, FL, Ghent, BE (in conjunction with BioEM-2016), and several times by

teleconference. In addition to other duties, the ICES AdCom plans and arranges meetings of TC34 and TC95 and their subcommittees, and approves (or rejects) applications for membership on the ICES technical committees. ICES Chairman Dr. Ralf Bodemann (Siemens AG, Germany), TC95 Membership Chairman Dr. B Jon Klauenberg (US Air Force Research Laboratory), TC34 Chairman Dr. Jafar Keshvari (Aalto University School of Science), TC95 Chairman Dr. C-K Chou (Motorola Solutions –retired), and others have become ICES roving ambassadors to the EU member states and other countries. Each has given numerous presentations in support of ICES and the IEEE open consensus process at meetings throughout the world. During the past two years TC95 Chairman Dr. Chou, for example, has given presentations in Argentina, Bulgaria, China, India, Malaysia, Taiwan, Thailand, The Netherlands, Uruguay and the United States. Dr. Murphy, Past President of the Bioelectromagnetics Society (BEMS – the pre-eminent Society for the study of the interaction and effects related to the exposure of living systems to electric, magnetic and electromagnetic fields at frequencies below 300 GHz) and several other ICES members serve as ICES liaisons to the BEMS Board of Directors.

- In May 2009, the IEEE entered into a Technical Cooperation Agreement (TCA) with the NATO Standardization Agency (NSA) in order to share knowledge of each organization's standards development activities. The objective of the agreement is to avoid duplication of technical standards whenever possible. In addition, on 30 July 2009, ICES entered into a Specific Agreement with the NSA for the conversion of the standard covered by NATO STANAG 2345 Med. (Edition 3) into an IEEE Standard. A result of this agreement, IEEE C95.1™-2345-2014, "IEEE Standard for Military Workplaces—Force Health Protection Regarding Personnel Exposure to Electric, Magnetic and Electromagnetic Fields, 0 Hz to 300 GHz," was approved 16 May 2014 and published 30 May 2014.

  IEEE C95.1-2345™-2014 was officially adopted by NATO on 26 November 2015 with the promulgation of NATO Standardization Agreement (STANAG 2345 ed. 4. The primary purpose of updating STANAG 2345 was to provide assurances to NATO nations that all participants in NATO activities will not exceed the IEEE C95.1-2345™-2014 limits therein. STANAG 2345 is a minimal requirements standard designed to provide a safe maximum exposure limit that covers and includes (but not supersede) the various international, national, and military standards/guidance that have been adopted by NATO Nations, thereby ensuring interoperability. The commonality factor of interoperability was achieved by setting the military occupational safety and health EMF exposure limits at a reasonable safe level sufficient to cover most, if not all, of the nations' individual standards. This ensures that multinational operations can be conducted with the assurance that the levels and limits of the STANAG 2345 covered standard IEEE C95.1-2345™-2014 would not be exceeded. This ends a seven year IEEE process that included first establishing a Technical Cooperation Agreement between IEEE and NATO, which can be utilized for any and all IEEE standards; a five year revision of IEEE C95.1™-2005; and a yearlong NATO ratification process. The STANAG calls out the Get Program for access to the covered IEEE 2345™-2014 making the no cost availability of the standard a necessary component for several nations to continue to implement the STANAG.

- In the past, international recognition of the C95 standards was hindered somewhat by their cost, especially when compared with the competing International Commission on Non-Ionizing Radiation Protection (ICNIRP) guidelines, which are used throughout Europe and other parts of the world and are available at no cost. In accordance with a joint IEEE/DoD agreement, IEEE Standards C-95.1-2005, C95.1a-2010, C95.1-2345-2014, C95.3-2002, C95.3.1-2010, C95.6-2002 (R2008) C95.7-2005 and C95.7-2014 have been made publicly available for the past five years at no cost through the IEEE SA Get Program (funded by the Department of Defense). Mainly through the efforts of Dr. Klauenberg, funding for the next 5 years was obtained through Mr, Greg Saunders, Director of the Defense Standardization Program Office and chairman of a number of NATO working groups. A process for future funding is being explored, e.g., rotation between the services. A decision is expected well before the end of the new agreement period. It is important to note that the no cost access is a critical component of the NATO STANAG 2345 and has enhanced international recognition of C95 standards, ICES, and IEEE in general. During the months of January through November, 2016, 3138 copies of the standards have been downloaded, the majority by "Research Scientists" followed by "Students" and "Safety Risk Managers."

- TC34 submitted a PAR (on the December 2016 NesCom agenda) to establish a working group to develop a new standard, "Recommended Practice for Determining the Power Density of the Electromagnetic Field Associated with Human Exposure to Mobile Devices and Network Equipment Operating Between 6 GHz and 100 GHz." Note that this project also falls within the scope of IEC TC106. The intent is to move the project forward as an IEEE project and later submit it to IEC for consideration as a dual logo project. This is the process that was successfully followed for the four dual logo projects now under development by SCC39/TC34 (P62704-1, -2, -3, and -4).

- Following circulation of an IEC TC106 "Q" document titled "Establishment of joint IEC TC106 – IEEE SCC-39/TC34 projects on the evaluation of specific absorption rate (SAR) using numerical techniques," ICES TC34 submitted four draft standards to be jointly developed by IEC and IEEE and published as dual logo standards. The status of the four projects in the IEC process is as follows:

  — IEC/IEEE P62704-1 (general requirements for FDTD simulations of SAR) – (Now in IEEE SA Sponsor recirculation ballot)

  — IEC/IEEE P62704-2 (specific requirements for SAR from vehicular mounted antennas) – (Now in IEEE SA Sponsor comment resolution).

  — IEC/IEEE P62704-3 (specific requirements for SAR from mobile telephones) – (Now in IEEE SA Sponsor comment resolution)

  — IEC/IEEE P62704-4 (general requirements for FEM simulations for modeling vehicle-mounted antennas and personal wireless devices) – (WG draft under development).

- IEEE 1528-2013, 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 2013 SA Standards Board meeting and was published September 2013. Note that

IEEE 1528 and the IEC 62209-1 standards are developed by essentially the same working group. The intent is to eventually issue a single dual logo IEC/IEEE standard—a joint working group has been formed.

- ICES provided comments in response to a *Further Notice of Proposed Rule Making* (FNPRM) and *Notice of Inquiry (*NOI) issued by the Federal Communications Commission in the matter of Reassessment of FCC Radiofrequency Exposure Limits and Policies and Proposed Changes in the Commission's Rules Regarding Human Exposure to Radiofrequency Electromagnetic Fields (ET Dockets ET 13-84 and 03-137, respectively) and also responded to comments submitted by others in the same proceedings. In both cases, ICES encouraged the FCC to base any changes to their current exposure guidelines on IEEE C95.1™-2005 (frequencies above 3 kHz) and, should the FCC extend its scope, C95.6™-2002 (frequencies below 3 kHz).
- The World Health Organization (WHO) is preparing a large document entitled, "Radio Frequency fields: Environmental Health Criteria Monograph" and has invited individuals and organizations to submit comments and suggestions on the chapters that have already been written. The document was circulated to TC95 for comment; the comments were edited and circulated as a ballot for approval. The ballot was approved unanimously and the comments submitted to WHO.
- Over the years there has been pushback by ICNIRP in establishing a collaboration effort with ICES, presumably because ICES is associated with experts (stakeholders) from industry (which ICNIRP considered a commercial vested interest). In May 2016, there was a change of leadership and some members of ICNIRP. The new ICNIRP Chairman and one of the new members of the 14 member committee are also ICES members and ICNIRP is now willing to discuss harmonization of the exposure limits found in IEEE Stds C95.1™-2005 and C95.6™-2002 and the ICNIRP Guidelines. At a June 2016 Mobile Manufacturers Forum Workshop in Ghent, Belgium, the new ICNIRP Chairman, Dr. van Rongen, presented "ICNIRP's proposed HF guidelines" and extended an invitation to ICES to comment on the proposed guidelines. TC95 formed a 19 member task group to draft a document to comment on the ICNIRP proposed guidelines. The document was circulated to the TC95 membership for comment and a final document submitted to ICNIRP in time for discussion at the ICNIRP September meeting. ICES will maintain its collaborative relationship with ICNIRP with the goal of setting internationally harmonized safety limits for exposure to electromagnetic fields at frequencies below 300 GHz. This interaction with ICNIRP is considered a major step forward.

2.4 Policies and Procedures

The ICES Policies and Procedures were accepted by AudCom and the SASB at the December 2012 meetings. The Working Group P&Ps, based on the September 2012 Working Group Baseline, were found to be without issue by AudCom and the SASB at the August 2013 meetings.

2.5 Budget

2.51 TC34

TC 34 has no specific budget or operating expenses.

2.52 TC95

The operating expenses and budget for TC95 are found in 4.2.

2.6 Standards

Table 1 lists the SCC-39 published standards and their status:

Table 1(a)

SCC-39 Standards

Standard	Title
	TC34 Standards
1528-2013	IEEE Recommended Practice for Determining the Peak Spatial-Average Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques
1528a-2005	IEEE 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 Human Head Model (SAM Phantom)
	TC95 Standards
1460-1996	IEEE Guide for the Measurement of Quasi-Static Magnetic and Electric Fields
C95.1-2005	IEEE Standard for Safety Levels with Respect to Human Exposure to Radio Frequency Electromagnetic Fields, 3 kHz to 300 GHz
C95.1a-2010	IEEE Standard for Safety Levels with Respect to Human Exposure to Radio Frequency Electromagnetic Fields-Amend 1: Specifies Ceiling Limits for Induced & Contact Current
C95.1-2345-2014	IEEE Standard for Military Workplaces—Force Health Protection Regarding Personnel Exposure to Electric, Magnetic and Electromagnetic Fields, 0 Hz to 300 GHz
C95.2-1999	IEEE Standard for Radio-Frequency Energy and Current-Flow Symbols
C95.3-2002	IEEE Recommended Practice for Measurements and Computations of Radio Frequency Electromagnetic Fields With Respect to Human Exposure to Such Fields
C95.3.1-2010	IEEE Recommended Practice for Measurements and Computations of Electric, Magnetic and Electromagnetic Fields with Respect to Human Exposure to Such Fields, 0 Hz to 100 kHz
C95.4-2002	IEEE Recommended Practice for Determining Safe Distances From Radio Frequency Transmitting Antennas When Using Electric Blasting Caps During Explosive Operations
C95.6-2002	IEEE Standard for Safety Levels With Respect to Human Exposure to Electromagnetic Fields, 0—3 kHz
C95.7-2014	IEEE Recommended Practice for Radio Frequency Safety Programs, 3 kHz to 300 GHz

Table 1 (b)

SCC-39 Standards—Status

Standard	Year	Expiration Date	SASB Approval Date	ANSI Approval Date
1460	1996	12/31/2018	12/10/1996	06/05/1997
1528	2013	12/31/2023	06/14/2013	12/06/2013*
1528a	2005	12/31/2018	09/22/2005	12/29/2005
C95.1	2005	12/31/2018	10/03/2005	11/02/2006
C95.1a	2010	02/02/2020	02/02/2010	
C95.1-2345	2014	12/31/2024	05/16/2014	10/10/2014*
C95.2	1999	12/31/2018	09/16/1999	10/05/2005
C95.3	2002	12/31/2018	12/11/2002	04/18/2003
C95.3.1	2010	03/25/2020	03/25/2010	08/05/2010
C95.4	2002	12/31/2018	11/11/2002	02/05/2003
C95.6	2002	12/31/2018	09/12/2002	05/19/2008
C95.7	2014	12/31/2024	06/12/2014	10/10/2014*

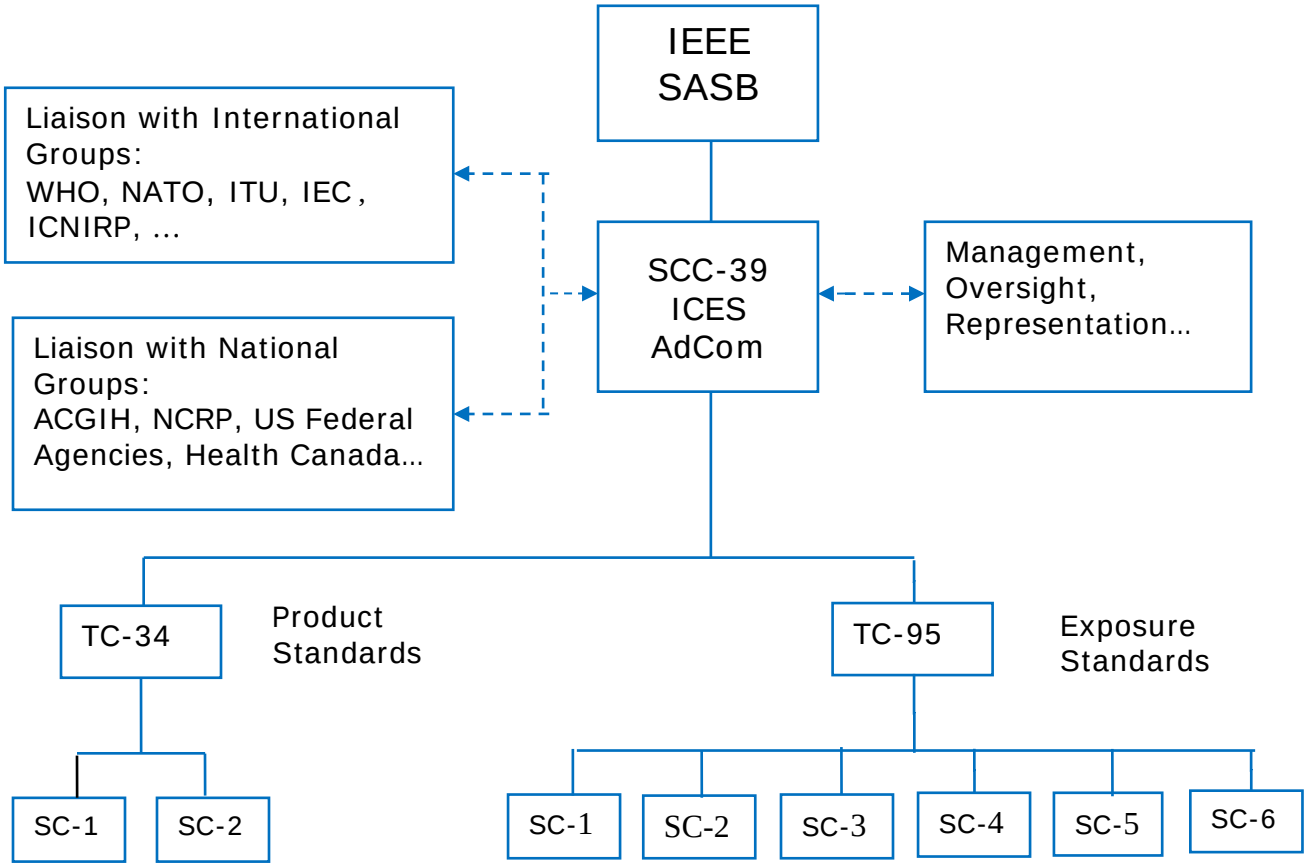
*ANSI BSR8/Public review start date.

2.7 ICES Websites

AdCom members continually provide material for the ICES website (http://www.ices-emfsafety.org/), which includes separate sections for TC34 and TC95 with both public and private pages for the main committees and the subcommittees (ICES owns the domain). The website is maintained by NEMA. File Transfer Protocol (FTP) services for subcommittee activities are included. In addition, TC34 maintains the following websites:

http://grouper.ieee.org/groups/scc34/sc2/ (public),
http://grouper.ieee.org/groups/scc34/sc2/private/moindex.html (private).

The website has been updated to present a more contemporary appearance.



TC-34

SC-1: Measurement Techniques
- WG-1: SAR-Handheld Devices

SC-2: Computational Techniques
- WG-1: General FDTD Requirements
- WG-2: Specific FDTD Requirements
- WG-3: FDTD Requirements for Modeling Devices
- WG-4: General FEM Requirements

TC-95

SC-1: Measurements and Calculations
SC-2: Warning Signs, Hazard Communications
SC-3: Low-frequency Exposure Values
SC-4: High-frequency Exposure Values
SC-5: Electro-explosive Devices
SC-6: EMF Modeling and Dosimetry

Figure 1—ICES Structure

Table 2—ICES AdCom

OFFICE	NAME	AFFILIATION	COUNTRY
Chair	Dr. Ralf Bodemann	Siemens AG	DE
Vice Chair	Kenneth Gettman	NEMA	US
Executive Secretary/Treasurer	Ronald C Petersen	R C Petersen Associates LLC	US
Chair, TC95 Membership	Dr. B Jon Klauenberg	US Air Force Research Laboratory	US
Chair, TC34 and TC34/SC2	Dr. Jafar Keshvari	Aalto University-School of Science	FI
Chair, TC34/SC1	Dr. Mark Douglas	IT'IS Foundation	CH
Chair, TC95	Dr. C-K. Chou	C-K Chou Consulting	US
Co-chair, TC95/SC1	Francis Colville	US Army PHC	US
Co-chair, TC95/SC1	Dr. Mark Douglas	IT'IS Foundation	CH
Chair, TC95/SC2	Richard Tell	Richard A Tell and Associates	US
Co-chair, TC95/SC3	Dr. Kevin Graf	Exponent	US
Co-chair, TC95/SC3	Dr. Rob Kavet	Kavet Consulting LLC	US
Co-chair, TC95/SC4	Dr. Art Thansandote	Health Canada (Retired)	CA
Co-chair, TC95/SC4	Dr. Marvin Ziskin	Temple University Medical School	US
Co-chair, TC95/SC5	Raymond Harmon	URS Corporation	US
Co-chair, TC95/SC5	Tamera Hay	Naval Surface Warfare Ctr.	US
Chair, TC95/SC6	Dr. Akimasa Hirata	Nagoya Institute of Technology	JP
Past Chair , ICES	Dr. John Osepchuk	Full Spectrum Consulting	US
Past Chair, TC34	Dr. Wolfgang Kainz	US FDA/CDRH	US
At Large Members			
	Dr. Sheila Johnston	Independent Consulting Neuroscientist	IE
	J. Patrick Reilly	Independent Consultant	US
IEEE Staff Liaison			
IEEE Staff Liaison	Soo Kim	IEEE Standards Department	US

3. Technical Committee-34

3.1 Scope

The scope of Technical Committee 34 (TC34) 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 organizations such as the IEEE International Committee on Electromagnetic Safety (ICES) and the International Commission on Non-Ionizing Radiation Protection (ICNIRP)." Included in the scope are standards, guides and recommended practices that describe measurement and computational protocols for determining compliance with the basic restrictions and the derived exposure values, e.g., maximum permissible exposure values (MPEs), exposure reference levels (ERLs) found in IEEE Stds C95.1 and C95.6 and in other relevant national and international standards and guidelines.

3.2 Structure of TC34

There are two subcommittees in TC34—SC1 (SAR evaluation—measurement techniques) and SC2 (SAR evaluation—numerical techniques). SC2 includes the following four working groups:

- WG-1 (General requirements for using the FDTD method for SAR calculations);
- WG-2 (Specific requirements for FDTD Modeling of vehicle mounted antenna configurations);
- WG-3 (Specific requirements for FDTD modeling of mobile phones/personal wireless devices);
- WG-4 (Requirements for using the finite-element method for SAR Calculations, specifically vehicle-mounted antennas and personal wireless devices).

The two subcommittees and their working groups are very active and hold face-to-face meetings and teleconferences several times per year. The face-to-face meetings are usually held in conjunction with IEC TC106/MT-1 and IEC TC106 PT 62209-3, each of which has a similar scope and with whom TC34 has a Category D Liaison.

3.3 Membership Roster

See Table TC34-2 (NOTE—All members listed are members of TC34, TC34/SC1 and TC34/SC2, i.e., the members of SC1 are also members of SC2 and also members of TC34, and vice versa.)

3.4 Meetings (2016-2017)

3.4.1 Past meetings (2016)

- Zurich, Switzerland, 24 May 2016
- Hangzhou, China, 1-2 November 2016

3.4.2 Future meetings

- Plantation, FL, 20-24 February 2017
- London, UK, 22-24 May, 2017

- Melbourne, AU, 16-19 October 2017

3.5 Subcommittee activities

3.5.1 Subcommittee 1 (SAR evaluation – measurement techniques)

- Joint meetings were held (and continue to be held) with IEC TC-106 MT1 to work on maintenance of IEC 62209 "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 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)." (IEC 62209-1 and 62209-2 were published in 2005 and 2010, respectively.) The SC1 activities are coordinated with IEC TC106 MT1 with the intent of publishing a single dual-logo international standard to replace IEEE 1528-2013, "IEEE Recommended Practice for Determining the Peak Spatial-Average Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques." In response to a formal ballot, the members of TC34 voted unanimously to move forward with the development of a dual logo standard (IEC 62209-1) to replace IEEE Std 1528-2013. A joint IEC TC106/IEEE SCC39/TC34 working group is has been formed.
- **P1528:** The revision of IEEE 1528 (which extends the frequency range of SAR measurement standards up to 6 GHz) was approved at the June 2013 SA Standards Board meeting. And published in September 2013. SC1 is collaborating with IEC MT-1 toward the development of standards for devices held within 20 cm of the body (including body-worn, hand-held and desktop devices), and addressing harmonization with IEC P62209-2 with the goal of developing a jointly developed international dual-logo standard.

3.5.2 Subcommittee 2 (SAR evaluation – numerical techniques)

Following approval of four IEEE projects as IEC/IEEE jointly developed standards projects, PARs P1528.1, P1528.2, P1528.3 and P1528.4 were withdrawn and new PARs with the assigned IEC project numbers were submitted and approved.

3.5.2.1 IEC P62704-1 (formerly P1528.1):

- The initial ballot for P62704-1 closed in November 2013 and meets all thresholds for approval by the IEEE SASB. All comments on the IEC draft have been resolved and the revised draft was circulated as an IEC CDV and is now in the FDIS editing stage. Reference and model files will be available for download on the IEC server.

3.5.2.2 IEC P62704-2 (formerly P1528.2):

- The initial ballot for P62704-2 closed in November 2013 and meets all thresholds for approval by the IEEE SASB. All comments on the IEC draft have been resolved and the revised draft circulated as an IEC CDV in Oct 2015 and is now in the IEC FDIS preparation stage.

3.5.2.3 P62704-3 (formerly P1528.3):

- The initial ballot closed in August 2013 and meets all thresholds for approval by the IEEE SASB. Comment resolution is still in process. Most of the comments

have been resolved but there still remains a question regarding the need for benchmarking. TC34 Chairman Keshvari contacted the Mobile Manufacturers Forum (MMF) as a source for CAD models for benchmarking. Although MMF did not agree to provide the CAD files, the relevant files were obtained from Microsoft Corporation based on the previous NDA. The CDV is scheduled for Dec 2016—IEC balloting is in preparation.

3.5.2.4 P62704-4 (formerly P1528.4):

- This project had been progressing more slowly than the other three in the series. A new Chair, Dr. Andreas Christ, has been nominated, which stimulated interest in this activity from a number of software developers. The CDV is in preparation.

3.6.1 SC1 PARs

(None)

3.6.2 SC2 PARs

3.6.2.1 P62704-1 (Approved March 2011)

Title: Standard for Determining the Peak Spatial Average Specific Absorption Rate (SAR) in the Human Body from Wireless Communications Devices, 30 MHz - 6 GHz. Part 1: General Requirements for using the Finite Difference Time Domain (FDTD) Method for SAR Calculations

Status: New Standard Project. (A one-year PAR extension request was submitted to NesCom for consideration at their December 2015 meeting.)

Project scope: This standard 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 and IEEE C95.1a.

Project purpose: Document will not contain a purpose clause.

3.6.2.2 P62704-2 (Approved March 2011)

Title: Standard for Determining the Peak Spatial Average Specific Absorption Rate (SAR) in the Human Body from Wireless Communications Devices, 30 MHz - 6 GHz. Part 2: Specific Requirements for Finite Difference Time Domain (FDTD) Modeling of Vehicle Mounted Antenna Configurations

Status: New Standard Project. (A one-year PAR extension request was submitted to NesCom for consideration at their December 2015 meeting.)

Project scope: This standard 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 are (but are 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™-2005 and IEEE C95.1a™-2010.

Project purpose: Document will not contain a purpose clause.

3.6.2.3 P62704-3 (Approved March 2011)

Title: Standard for Determining the Peak Spatial-Average Specific Absorption Rate (SAR) in the Human Body from Wireless Communications Devices, 30 MHz - 6 GHz. Part 3: Specific Requirements for Finite Difference Time Domain (FDTD) Modeling of Mobile Phones/Personal Wireless Devices

Status: New Standard Project. (A two-year PAR extension request was submitted to NesCom for consideration at their December 2015 meeting.)

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 does not recommend specific SAR values since these are found in other documents, e.g., IEEE C95.1 and IEEE C95.1a.

Project purpose: This standard will not contain a purpose clause

3.6.2.4 P62704-4 (Approved December 2011)

Title: Standard 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 Element Method (FEM) for SAR Calculations and Specific Requirements for Modeling Vehicle-Mounted Antennas and Personal Wireless Devices.

Status: New Standard Project. (A two-year PAR extension request was submitted to NesCom for consideration at their December 2015 meeting.)

Scope: This standard describes the concepts, techniques, models, validation procedures, uncertainties and limitations of the Finite-Element Method when used for determining the spatial-peak specific absorption rate (SAR) in standardized anatomical models exposed to wireless communication devices, including vehicle-mounted antennas and personal wireless devices, such as hand-held mobile phones. Guidance on modeling such devices and benchmark data for simulation is provided; model contents, meshing and test positions of the anatomical models are defined. This document does not recommend specific SAR values since these are found in other documents, e.g., IEEE C95.1™-2005 (IEEE Standard for Safety Levels with Respect to Human Exposure to Radio Frequency Electromagnetic Fields, 3 kHz to 300 GHz.)

Purpose: This document will not contain a purpose clause.

3.6.2.5 P1528.5[1]

Title: Recommended Practice for Determining the Power Density of the Electromagnetic Field Associated with Human Exposure to Mobile Devices and Network Equipment Operating Between 6 GHz and 100 GHz.

Status: (On December 2016 NesCom Agenda.)

Scope: Recommendations are made that specify measurement procedures for the free space power density relevant to human exposure compliance assessment for mobile devices or network equipment operating between 6 and 100 GHz. The recommendations provide a conservative estimate of the free space power density of the exposure of the head or body of a significant majority of persons during normal use of these devices.

Purpose: This document will not include a purpose clause.

3.7 Drafts

3.7.1 SC1 (None)

3.7.2 SC2 (Computational Techniques)

Drafts of P1528.1, P1528.2, 1528.3 and P1528.4 (now IEC/IEEE P62704-1, -2, -3 and -4) were approved as dual-logo standards projects. The first two documents are in IEC stage CDV and are in IEEE Sponsor ballot.

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

3.8.1 SC1 (Measurement techniques)

3.8.1.1 Objectives (2015)

- Continue to work with IEC TC106 to ensure harmonization of IEEE 1528-2013 and IEC P62209-2 (Met)

3.8.1.2 Objectives (2016)

- Continue following up on harmonization process with IEC P62209-2; seek jointly-developed dual-logo standards status with IEC.

3.8.2 SC2 (Numerical techniques)

3.8.2.1 Current levels of activity and milestones (2015)

- P62704-1 – prepare CDV for IEC ballot: (Met)
- P62704-2 – prepare CDV for IEC ballot: (Met)
- P62704-3 – prepare CDV for IEC ballot: (Not met)

[1] With the rapid development of new wireless technologies in the frequency range or 6 GHz to 100 GHz (e.g., 5G) there is a need to ensure that compliance assessment procedures are developed for human exposure to the fields from devices used in close proximity to the head and body, and for base stations and network equipment. Current compliance assessment standards only cover frequencies up to 6GHz. This project will fill this need. Also, during the last face to face meeting in Hangzhou-China, SC2 discussed the need to submit a PAR for numerical standards for compliance assessment of exposure to the fields from devices operating at frequencies above 6 GHz. The decision is to be made in Dec 2016.

- P62704-4 – prepare 1 CD for circulation: (Not met)

3.8.2.2 Objectives (2016)

- P62704-1 – prepare FDIS for IEC and IEEE ballot: Met
- P62704-2 – prepare FDIS for IEC and IEEE ballot: Partially met (FDIS in preparation)
- P62704-3 – prepare CDV for IEC and IEEE ballot: Met
- P62704-4 – prepare CD for IEC and IEEE ballot: Met

3.8.2.3 Objectives (2017)

- P62704-1 – complete IEC and IEEE balloting
- P62704-2 – complete IEC and IEEE balloting
- P62704-3 – prepare FDIS for IEC and IEEE ballot
- P62704-4 – prepare FDIS for IEC and IEEE ballot

3.9 Website

A website and reflector was set up several years ago for SC2 (now SC1 and SC2) and operates successfully. All meeting minutes, action items, motions, and drafts are posted on the web – SC balloting is carried out electronically. The site has recently been updated and reorganized. Public areas contain links to other sites important for subcommittee activities, e.g., the USAF Dosimetry Handbook, Tables of Dielectric Properties of Tissues (Gabriel), schedules for meetings. A private area contains draft sections of the practice, the results of measurements on canonical models, etc.

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

A reflector was also set up. The address is stds-ices-tc34@ieee.org

3.10 IEEE Staff support requirements

Originally, secretarial services for SC2 originally provided by the Cellular Telecommunications and Internet Association (CTIA) are now provided by volunteer committee members. Soo Kim, who replaced Tricia Gerdon, is the IEEE Staff Engineer for both TC34 and TC95—both of their engineering backgrounds and broad knowledge of IEEE procedures is invaluable to this committee.

3.11 Liaison with other committees

Liaison with other committees occurs via the circulation of drafts, common meetings and common membership on committees such as the European Committee for Electrotechnical Standardization (CENELEC), IEC, ITU (TC34 Chairman Keshvari was recently nominated as liaison between ITU-T SG5 and IEEE/ICES), the Association of Radio Industries and Businesses (ARIB) and other standards developing organizations, and through a “Category D” liaison with IEC TC106/MT-1. Coordination has also been established with IEEE societies, e.g., EMC-S via representation on the Standards and Advisory Coordination Committee (SACCom).

3.12 Issues: Joint IEC/IEEE development project: IEC 62209 and IEEE 1528

Because of the close cooperation and overlap of membership and the desire for a single international standard, TC34 continues to move forward to obtain IEC approval of IEEE 1528-2013 and IEC P62209-1 as a jointly developed IEC/IEEE standards project.

Rationale: IEC TC106/MT-1 (maintenance of IEC 62209) and IEEE TC34/SC1 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)," IEC 62209-2-2010 "Human exposure to radio frequency fields from hand-held and body-mounted wireless communication devices - Human models, instrumentation, and procedures - Part 2: Procedure to determine the specific absorption rate (SAR) for wireless communication devices used in close proximity to the human body (frequency range of 30 MHz to 6 GHz" and IEEE 1528-2013 "IEEE Recommended Practice for Determining the Peak Spatial-Average Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques." During the development of these standards a number of TC34 members also participated on the IEC PTs, sharing drafts to ensure harmonization. Thus the three existing standards were developed jointly by many of the same people but issued separately as three distinct IEC standards. During the past three years, TC34/SC1and MT-1 have held a number of face-to-face meetings and a number of joint teleconferences. While these exchanges are dedicated to P62209 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 for the wireless communications industry where harmonization is critical. Having a single dual logo standard is important for a variety of reasons and both 62209 Project Team Leader and the leadership of TC34/SC1 believe that IEC 62209 and IEEE 1528 are ideal candidates for such a project.

3.13 Membership

See Table TC34-2 for detailed membership information.

Table TC34-1
TC34 Leadership

OFFICE	NAME	AFFILIATION	COUNTRY
Chair	Dr. Jafar Keshvari	Aalto University-School of Science	FI
Vice- chair	Dr. Mark Douglas	IT'IS Foundation	CH
Chair – SC1 (SAR evaluation—measurement techniques)	Dr. Mark Douglas	IT'IS Foundation	CH
Chair – SC2 (SAR evaluation—numerical techniques)	Dr. Jafar Keshvari	Aalto University-School of Science	FI
Chair – WG-1 (IEC/IEEE P62704-1)	Dr. Andreas Christ	IT'IS Foundation	CH
Chair – WG-2 (IEC/IEEE P62704-2)	Dr. Giorgi Bit-Babik	Motorola Solutions, Inc.	US
Chair – WG-3 (IEC/IEEE P62704-3)	Vikass Monebhurrun	Supelec	FR
Chair – WG-4 (IEC/IEEE P62704-4)	Dr. Andreas Christ	IT'IS Foundation	CH

Table TC34-2
TC34 Membership (November 2015)

	LAST NAME	FIRST NAME	AFFILIATION	INTEREST CATEGORY	COUNTRY	IEEE SA MEMBER?
1.	Ablehamid	Hadjem	Orange – FT Group	U	FR	
2.	Almeida	Antonio	CPQD	S	BR	
3.	Alon	Leeor	NYU Med Center	A	US	
4.	Attayi	Daoud	RIM	P	CA	
5.	Balzano	Quirino	University of Maryland	A	US	Y
6.	Beard	Brian	US Food and Drug Administration	G	US	
7.	Bit-Babik	Giorgi	Motorola Solutions, Inc.	P	US	Y
8.	Bodemann	Ralf	Siemens	PI	DE	Y
9.	Case	David	Cisco	P	US	
10.	Chan	Kwok	US Federal Communications Commission	G	US	
11.	Chang	Isaac	US Food and Drug Administration	G	US	Y
12.	Chao	Justin	PC TEST	U	US	
13.	Chen	Ji	University of Houston	A	US	
14.	Choi	Dong-guen	KCC	G	KR	
15.	Choi	Hyung-Do	ETRI	P	KR	
16.	Chou	C-K.	C-K Chou Consulting	GI	US	Y
17.	Christ	Andreas	IT IS Foundation	A	CH	
18.	Davis	Chris	University of Maryland	A	US	
19.	Derat	Benoit	Field Imaging	P	FR	

	LAST NAME	FIRST NAME	AFFILIATION	INTEREST CATEGORY	COUNTRY	IEEE SA MEMBER?
20.	Dianyuan	Qi	CATR-MIIT	G	CN	
21.	Douglas	Mark	IT IS Foundation	A	CH	Y
22.	Faraone	Antonio	Motorola Solutions, Inc.	P	US	
23.	Forrester	John	Qualcomm	P	US	
24.	Foster	Ken	University of Pennsylvania	A	US	Y
25.	Francavilla	Mauro	Telecom Italia	P	IT	
26.	Gabriel	Sami	Vodafone	P	UK	
27.	Gouqing	Li	CATR	G	CN	
28.	Hamada	Lira	NICT	G	JP	
29.	Harrington	Tim	US Federal Communications Commission	G	US	Y
30.	Hauswirth	Steve	Motorola Mobility, Inc.	P	US	
31.	Heirman	Don	Consultant	P	US	Y
32.	Jeong	Chan-Ho	LG	U	KR	
33.	Joyner	Ken	Samsung	P	AU	Y
34.	Jun	Haeyoung	Samsung	P	KR	
35.	Kainz	Wolfgang	US Food and Drug Administration	G	US	Y
36.	Katsumi	Abe	Fujitsu	P	JP	
37.	Keshvari	Jafar	Aalto University-School of Science	P	FI	
38.	Kopp	Markus	ANSYS	G	US	Y
39.	Koslov	Mikhail	MPG	P	DE	
40.	Kuster	Niels	IT IS Foundation	A	CH	Y
41.	Lee	Ae-kyoung	ETRI	U	KR	

	LAST NAME	FIRST NAME	AFFILIATION	INTEREST CATEGORY	COUNTRY	IEEE SA MEMBER?
42.	Liu	Steve	PC TEST	U	US	Y
43.	Loader	Benjamin	National Physical Laboratories	G	UK	
44.	Lu	Lin	Qualcomm	P	US	
45.	Luc	Jerome	Satimo	P	FR	
46.	Magana	Luis	PC TEST	U	US	
47.	Manteuffel	Dirk	Uni-Kiel	A	DE	
48.	McIntosh	Robert	Telstra	U	AU	
49.	Meier	Matthias	Motorola	P	DE	Y
50.	Moller	Paul	Motorola	P	US	
51.	Monebhurrun	Vikass	Supelec	A	FR	
52.	Nappert	Hughes	Industry Canada	G	CA	Y
53.	Nesterova	Maryna	APREL	GI	CA	Y
54.	Nicol	Stuart	APREL	U	CA	Y
55.	Niskala	Kai	Nokia	P	FI	
56.	Onishi	Teruo	NTT DoCoMo	P	JP	
57.	Park	DS	Samsung	P	KR	
58.	Parmentier	Jack	Lenovo	P	US	
59.	Penney	Chris	Remcom	P	US	Y
60.	Picard	Stéphane	Industry Canada	G	CA	
61.	Petersen	Ron	Consultant	GI	US	Y
62.	Plicanic	Ramadan	Sony Ericsson Mobile Communications	U	SE	
63.	Poirier	Marcel	Industry Canada	G	CA	

	LAST NAME	FIRST NAME	AFFILIATION	INTEREST CATEGORY	COUNTRY	IEEE SA MEMBER?
64.	Pokovic	Katja	SPEAG	P	CH	
65.	Prokop	Alexander	CST	PM	DE	
66.	Proulx	Stephane	Industry Canada	G	CA	
67.	Roman	John	Intel	P	US	Y
68.	Schiavoni	Andrea	Telecom Italia	U	IT	
69.	Sen	Indranil	Apple	P	KR	
70.	Shah	Yogi	Medtronic	P	US	
71.	Simon	Winfried	IMST	P	DE	
72.	Thors	Björn	Ericsson	P	SE	
73.	Tanabe	Shinji	Mitsubishi	P	JP	Y
74.	Tornevik	Christer	Ericsson	P	SE	Y
75.	Toropainen	Anssi	Nokia	P	FI	
76.	Trinchero	Daniele	Polito	A	IT	
77.	Vannatta	Louis	Motorola	P	US	
78.	Wang	Ying	Sierra Wireless	GI	CA	
79.	Watanabe	Soichi	NICT	G	JP	
80.	Wiart	Joe	ORANGE	U	FR	
81.	Wittig	Tilmann	CST	P	DE	
82.	Ye	Qiubo	Communications Research Center	G	CA	Y
83.	Zilberti	Luca	RicMet	G	IT	

A = General Interest: Academic
G = General Interest: Government
GI = General Interest
P = Producer
N = IEEE/IEEE SA membership unknown
U = User

4. Technical Committee 95

4.1 Scope

The scope of ICES TC95 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 TC95." (The scope remains the same as the scope of SCC-28 before reorganization in March 2005.)

4.2 Budget

TC TC95 manages its funds through the IEEE Concentration Banking System and NetSuite. Funding, which is obtained through meeting registration fees, is used to cover meeting and other expenses, e.g., website maintenance. Opening balance 1 January 2016: $17,497.62; current balance (as of 1 November 2016): $22,160.45. Major expenses for the year include: $400 (website maintenance), $420 (maintenance of IEEE literature database), $1558 (January 2016 meeting – luncheons, refreshments, awards, badges, etc.), and $300 ($30/month ICES PayPal account, $103 (brochures for June meeting). Income: $4534 (registration fees January 2016 meeting), $2866 (registration fees June 2016 meeting). Funds for the June 2016 meeting – meeting rooms, luncheons, refreshments (approximately $5850), are in the process of being transferred.

4.3 TC95 Membership Roster

(See Tables TC95-2 through Table TC95-7.)

With the leadership of Dr. B Jon Klauenberg, TC95 Membership Chairman, the non-US membership of ICES continues to grow (now greater than 44% of the members are from outside the US). In terms of stakeholders, the membership continues to be well balanced. About 40% of the members of TC95 and its subcommittees are IEEE members, which is to be expected and defended in view of the interdisciplinary nature of our membership. TC95 is grateful for their voluntary contributions of talent and time under conditions where it would be an unreasonable imposition to require IEEE membership. (There may be more IEEE and IEEE SA members than indicated on Tables TC95-2 thru TC95-7.) TC95 recognizes the financial burden for travel and loss of income generating business opportunity already born by many volunteers during TC95 activities. However, IEEE SA membership is required of all TC95 leadership (e.g., Committee and Subcommittee Chairs, Co-Chairs) and is encouraged for all members.

4.4 Meetings (2015-2017)

4.4.1 Main Committee

4.4.1.1 Past Meetings

- June 13, 2015 – Pacific Grove, CA (in conjunction with BioEM 2015)
- January 12, 2016 –Plantation, FL
- June 4, 2016 – Ghent, Belgium (in conjunction with BioEM 2016)

4.4.1.2 Future Meetings

- January 12, 2017 – Plantation, FL

- Summer 2017 – Possibly Eureka Springs, AR. (Date and venue TBD.)

4.4.2 Subcommittee 1 (Measurements and Computation)

4.4.2.1 Past Meetings

- June 11, 2015 – Pacific Grove, CA (in conjunction with BioEM 2015)
- January 10, 2016 –Plantation, FL
- June 2, 2016 – Ghent, Belgium (in conjunction with BioEM 2016)

4.4.2.2 Future Meetings

- January 10, 2017 – Plantation, FL
- Summer 2017 – Possibly Eureka Springs, AR. (Date and venue TBD.)

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

4.4.3.1 Past Meetings

- June 11, 2015 – Pacific Grove, CA (in conjunction with BioEM 2015)
- January 10, 2016 –Plantation, FL
- June 2, 2016 – Ghent, Belgium (in conjunction with BioEM 2016)

4.4.3.2 Future Meetings

- January 10, 2017 – Plantation, FL
- Summer 2017 – Possibly Eureka Springs, AR. (Date and venue TBD.)

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

4.4.4.1 Past Meetings

- June 12, 2015 – Pacific Grove, CA (in conjunction with SC4 and BioEM 2015)
- January 11, 2016 – Plantation, FL
- June 3, 2016 – Ghent, Belgium (in conjunction with BioEM 2016)

4.4.4.2 Future Meetings

- January 11, 2017 – Plantation, FL (in conjunction with SC4)
- Summer 2017 – Possibly Eureka Springs, AR. (Date and venue TBD.)

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

4.4.5.1 Past Meetings

- June 12, 2015 – Pacific Grove, CA (in conjunction with BioEM 2015)
- January 11, 2016 – Plantation, FL
- June 3, 2016 – Ghent, Belgium (in conjunction with BioEM 2016)

4.4.5.2 Future Meetings

- January 11, 2017 – Plantation, FL
- Summer 2017 – Possibly Eureka Springs, AR. (Date and venue TBD.)

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

SC5 is responsible for IEEE Std C95.4, "IEEE Recommended Practice for Determining Safe Distances from Radio Frequency Transmitting Antennas When Using Electric Blasting Caps During Explosive Operations." This standard is stable and the sub-committee has not found it necessary to meet regularly face-to-face. The January 2016 meeting was the first time the subcommittee met since the June 2008 San Diego meeting. However, a PAR for the revision of the standard has been submitted and the subcommittee expects to meet regularly going forward.

4.4.6.1 Past Meetings

- January 11, 2016 – Plantation, FL

4.4.6.2 Future Meetings

- January 11, 2017 – Plantation, FL
- Summer 2017 – Possibly Eureka Springs, AR. (Date and venue TBD.)

4.4.7 Subcommittee 6 (EMF Modeling and Dosimetry)

(SC6 was established at the September 2014 meeting in Pismo Beach, CA.)

4.4.7.1 Past Meetings

- June 13, 2015 – Pacific Grove, CA (in conjunction with BioEM 2015)
- January 12, 2016 – Plantation, FL
- June 4. 2016 – Ghent, Belgium (in conjunction with BioEM 2016)

4.4.7.2 Future Meetings

- January 12, 2017 – Plantation, FL
- Summer 2017 – Possibly Eureka Springs, AR. (Date and venue TBD.)

4.5 Main Committee and Subcommittee Status

4.5.1 Main Committee

A major effort during the past several years has been to increase the membership of ICES, particularly non-U.S. members. TC95 now has members from Australia (4), Austria (1), Belgium (1), Bulgaria (1), Canada (7), China (1), Croatia (2), Czechoslovakia (1), France (3), Finland (1), Germany (1), Greece (4), Hungary (1), India (1), Ireland (3), Israel (3), Italy (3), Japan (5), Korea (4), Malaysia (3), the Netherlands (2), New Zealand (1), Poland (1), Slovenia (1), Switzerland (3), Thailand (1), Turkey (1), the United Kingdom (4) and the United States (79)—more than 44% of the main committee membership is from outside the US. The TC95 mailing list now approaches 350, including subcommittee members and observers.

All meeting minutes are posted on the ICES website (http://www.ices-emfsafety.org/), which contains both open and private pages for TC95 and its subcommittees and links to TC34 and its subcommittees. All agendas approved meeting minutes, white papers, RF research databases, draft standard documents, and many special reports are publicly available; certain proprietary or working documents are available only to members of the subcommittees on private sections of the site. The TC95/SC3/SC4 literature database, containing more than 6000 titles, is supported by ICES and appears on the ICES website at http://www.ieee-emf.com/. All publicly available papers (titles and abstracts only) are accessible to all; the complete papers are offered only to members of the TC95/SC3/SC4 literature evaluation working groups.

4.5.2 Subcommittee 1 (Measurement and Computation)

Subcommittee 1 (Techniques, Procedures and Instrumentation) has the responsibility for IEEE C95.3 “IEEE Recommended Practice for Measurements and Computations of Radio Frequency Electromagnetic Fields With Respect to Human Exposure to Such Fields, 100 kHz–300 GHz” and IEEE Std C95.3.1™-2010, “IEEE Recommended Practice for Measurements and Computations of Electric, Magnetic, and Electromagnetic Fields with Respect to Human Exposure to Such Fields, 0 Hz to 100 kHz” and IEEE Std

1460-1996 (R2002), "IEEE Guide for the Measurement of Quasi-Static Magnetic and Electric Fields."[2]

Work is continuing on the revision and merging of IEEE Stds C95.3 and C95.3.1 into a single standard covering the frequency range of 0 Hz to 300 GHz. A PAR extension request for the revision of C95.3-2002 was approved at the September 2016 NesCom meeting. The project is now active until 31 December 2018. An initial draft that combines existing IEEE Stds C95.3™-2002 (R2007) and C95.3.1™-2010 has been prepared and an SC1 balloting draft is now being prepared and approximately 50% complete—Sponsor balloting is expected to begin in early 2018. (Note that before Sponsor ballot, TC95 subcommittees go through a rigorous ballot process with essentially the same requirements as Sponsor ballot, e.g., ballot groups are formed, 75% response rate and 75% approval rate after ballot resolution is required before a draft standard is moved to IEEE Sponsor Ballot. This process speeds up Sponsor ballot in that many of the issues that would be identified during the Sponsor ballot more than likely would have already been addressed during the TC95 balloting process.)

The newly formed Spatial Averaging Working Group met twice during the past year. They continue to investigate issues related to field measurements for evaluating compliance with current exposure standards. The current standard, IEEE C95.1™-2005, "IEEE Standard for Safety Levels with Respect to Human Exposure to Radio Frequency Electromagnetic Fields, 3 kHz to 300 GHz" provides only minimal information on spatial averaging and C95.3™-2002, "IEEE Recommended Practice for Measurements and Computations of Radio Frequency Electromagnetic Fields with Respect to Human Exposure to Such Fields, 100 kHz–300 GHz" does not adequately address the proper methods and procedures necessary for performing these measurements. Some of the current issues under consideration are: 1) the lack of uniformity among users when attempting to demonstrate compliance with RF exposure standards and regulations, including those of the Federal Communications Committee (FCC), 2) the lack of proper methodology within the standards to produce accurate and replicable field intensity measurements, and 3) the effects of field perturbations on the accuracy of the field measurements. The Spatial Averaging Working Group is continuing to review the C95.1 and C95.3 standards to identify all areas needing revision. The working group also intends to either develop an annex to the current C95.3 standard or draft a recommended practice on field measurements for purposes of spatial averaging.

A short presentation "Random Thoughts about Measurement for Compliance for Consideration by IEEE SC-1" was presented at the January 2016 meeting. It was stated that of primary importance is the reliability of RF evaluations. Many RF evaluations currently being conducted contain an unmeasurable amount of uncertainty. In order to improve the RF reliability, the magnitude of this uncertainty is necessary. For example, in many cases calculations apply a ground reflection factor that is inappropriate. The goal of the ongoing discussions is to identify the issues and update those sections of the C95.3 that are affected.

[2] IEEE 1460 has been incorporated into C95.3.1 and will not be revised or reaffirmed.

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

Subcommittee 2 has responsibility for the following standards: IEEE C95.2™-1999, "IEEE Standard for Radio-Frequency Energy and Current-Flow Symbols" and IEEE C95.7, "IEEE Recommended Practice for Radio Frequency Safety Programs, 3 kHz to 300 GHz." A new PAR request for the revision of C95.2 was submitted for consideration at the December 2016 Standards Board Meeting. One comment received from the NesCom (New Standards Committee) related to the use of the term "guidance" in the scope of the project for a Recommended Practice. The Subcommittee 2 Chairman agreed that the term guidance should be replaced with "recommendations" in two instances: 5.3 (purpose) and 5.5 (need for project).

Most of the SC2 activity during the year was related to the issue of producing a document, tentatively titled "RF Minimal Awareness Guide" that would be deemed sufficient for providing adequate information to qualify individuals for access to controlled environments as defined in IEEE Std. C95.1™-2005. A draft "RF Safety Information Sheet" was reviewed by the committee but formal adoption of the document for use as part of an RF safety program has not yet been achieved.

A second topic of discussion during 2016 was the possible organization of an RF workshop that could provide attendees with practical guidance on implementing an RF safety program at locations where there exists potential exposure to RF fields that exceed the recommendations contained in IEEE Std C95.1™-2005. Potential financial support by the IEEE Broadcast Technology Society (BTS) was identified. Discussions continue within SC2 to define the exact purpose of such a workshop, who would be involved in its production, where it could be held and whether it should be presented at several different locations. It is expected that this issue will be resolved in 2017 with a possible presentation date of January 2018, possibly in concert with the winter TC-95 meetings.

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

There are no active PARs for new or existing projects. However, SC3 is working jointly with SC4 on the ongoing revision of C95.1-2005 (PC95.1), which will incorporate C95.6-2002, thereby extending the frequency range of C95.1 from 0 Hz to 300 GHz. Portions of C95.6 were incorporated into C95.1-2345™-2014, a civil standard considered as a replacement of STANAG 2345, the current NATO RF safety standard. In addition, members of SC3 are making progress in encouraging further research on improvement of induction models and synaptic effects thresholds, including magnetophosphenes in human volunteers, and on issues related to compatibility of medical implants. In order to address issues and inconsistencies in the models and dosimetry used to determine the induced fields in the body (and exposure limits), a new subcommittee (SC6) was recently established (see 4.5.7). Many members of SC3 are also members of the new subcommittee.

4.5.5 Subcommittee 4 (Safety Levels – 3 kHz-300 GHz)

Subcommittee 4 has responsibility for the C95.1 standard "IEEE Standard for Safety Levels with Respect to Human Exposure to Electromagnetic Fields, 3 kHz – 300 GHz." 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 1998, a combined edition published in 1999, and an amendment in 2004. The latest revision, C95.1™-2005

was approved October 3, 2005 and published April 19, 2006. The revision is the result of a major effort by SC4 to fully review and evaluate the relevant scientific literature. An amendment (C95.1a) that specifies ceiling values for induced and contact current, distinguishes between peak power density and localized exposure, and corrects other technical issues was published in March 2010.

The major effort by SC4 (and SC3) for the past three years was revising and combining C95.6™-2002, the low frequency (0 Hz – 3 kHz) safety standard, with C95.1™-2005, the RF safety standard (3 kHz to 300 GHz) into a single standard (C95.1-201X – 0 Hz – 300 GHz). Two major hurdles that were overcome: developing limits for contact currents; addressing differences in the approaches for defining adverse effect thresholds, i.e., effects associated with electrostimulation (low frequencies) and effects associated with tissue heating (high frequencies). Specifically, the question of whether the adverse effects level at high frequencies (a threshold model) should be determined using a probabilistic model (as for low frequencies). After much discussion, it was decided to keep the two different approaches.

The first combined standard covering frequencies from 0 Hz to 300 GHz, IEEE C95.1™-2345, "IEEE Standard for Military Workplaces – Force Health Protection Regarding Personnel Exposure to Electric, Magnetic and Electromagnetic Fields, 0 Hz to 300 GHz," was approved by the Standards Board on April 18, 2014, and published May 30, 2014. Having been promulgated by NATO on November 26, 2015, this standard will be used in NATO and military installations replacing NATO STANAG 2345 (Edition 3). The development and revision of the C95.1 standards is carried out by an editorial working group that meets about four times per year face-to-face and more frequently by teleconference. The working group, with members from both SC3 and SC4, prepares the drafts and addresses comments received by the subcommittees following circulation of each draft.

The exposure values and basic restrictions continue to be based on a critical review of the relevant scientific literature. RF literature surveillance is ongoing. Literature review has started with the selection of topic WG Chairs and members. The research selection of topics and proposed authors to initiate the creation of white papers summarizing the findings pertaining to health concerns is ongoing. Guidelines have been prepared on the procedure for developing a transparent systematic review of the literature in order to minimize "cherry picking" of the literature that could lead to biased conclusions. These guidelines will be used in the literature review and preparation of the white papers.

SC4 continues to pursue the investigation of relationships between localized tissue temperature increase and peak spatial-average SAR (100 kHz to 3 GHz) and power density (3 GHz to 300 GHz) as a basis for a decision on the need to revise the limits for localized exposure at frequencies from 100 kHz to 300 GHz. Although numerous studies that report effects at levels below those where thermal mechanisms would prevail, all reliable evidence indicates that established adverse effects are thermal in nature and, therefore, changes in temperature under localized exposure conditions is important with respect to devices that produce such exposures, e.g., mobile telephones. The results are being used to provide a scientifically sound basis for the current SAR limits for localized exposure or the basis for a change.

SC4 responded to a request from the Federal Communications Commission (FCC) for comment on their intended changes in electromagnetic exposure limits. SC4 also responded to a request from the World Health Organization (WHO) to review their

proposed document on "Radio Frequency Fields: Environmental Health Criteria." A 38 page document of detailed comments was provided to the WHO.

The International Commission on Non-Ionizing Radiation Protection (ICNIRP) presented its revised RF Guidelines at the BioEm2016 meeting in Ghent, Belgium. SC4 prepared a multipage commentary on the proposal and submitted it to ICNIRP on September 15, 2016. An ICNIRP response to SC4's comments was planned to be ready by the end of the year, but additional time was necessary for considering the detailed comments. The new 13 person ICNIRP Project Group (PG) on "HF guidelines (up to 300 GHz), which includes at least two members of ICES, including the PG Chairman, is now very willing to work with ICES to develop science based safety standards. This will enhance the possibility of harmonizing international RF safety standards.

As indicated above, SC4 has been able to procure funding to extend the no cost availability (through the Get Program) of several C95 standards for an additional five years. This important accomplishment will greatly enhance our ability to spread the utilization of the IEEE safety standards throughout the world.

An ad hoc committee has been established to address bio-effects at THz frequencies. This is the continuation of a joint effort between members of SC4 and ANSI ASC Z136 (laser safety) that began informally in 2000. While there was little data in 2000, there is a growing body of data that can be used to provide additional science-based support for reaffirming or revising the maximum permissible exposure values at 300 GHz (the upper frequency of IEEE C95.1 and the lower frequency of ANSI Z136.1). There is close coordination between ICES and ANSI ASC Z136 (ICES Secretary, Ron Petersen, chaired the Z136 committee from 2000 until 2009 and is a member of the Z136.1 AdCom).

4.5.5.1 Issues

4.5.5.1.1: Justification of the lower tier of exposure limits

Over the past few years there has been considerable discussion within SC3 and SC4 regarding the rationale and need for the lower tier of exposure limits for the general public. In order to stimulate discussion on the inherent conservatism built into the C95.1 standard, SC4 members John Bergeron and Ric Tell drafted a paper "IEEE Standard C95.1 on Radiofrequency Electromagnetic Safety: Considerations of Conservatism." The paper was circulated to the subcommittees for review and comment and posted on the ICES website. The authors believe that justification of a lower tier of exposure limits demands clarification in order to distinguish their basis from that used to justify the upper tier. Specifically, it is argued that the language of the standard must recognize the non-scientific basis for the lower tier limits, and whether a lower tier is necessary in future standards. The paper stimulated discussion at the 2014 ICES Pismo Beach, CA, meeting, which continued online and at the June 2015 meeting. Discussions on the desirability of the lower tier continue.

4.5.5.5.1.2: Literature review

In March 2016 the TC95 Literature Review task Group developed "Guidelines for the Systematic Review of Scientific Literature on Health and Electromagnetic Fields (0-300 GHz)," for use by the Literature Review WG during the revision of IEEE C95.1™-2005 Annex B (Identification of levels of RF exposure responsible for adverse effects: summary of the literature). The original intent was to wait for publication of the WHO literature review (WHO Environmental Health Criteria Monograph EHC), refer to the EHC document in Annex B, review any relevant papers

not included in the EHC review and papers published after the original EHC cutoff-date but before the revision of C95.1-2005 is complete. The publication date of the EHC Monograph has now been moved back to 2018, which means that the gap in the relevant literature published after publication of the EHC document but before the revision of C95.1-2005 is complete (2018) will no longer exist. Options being explored to address this issue include commissioning the Literature Review WG to update Annex B by summarizing expert reviews by independent international expert groups and health authorities (68 citations during 2010-2016 are listed in the Expert Review pages of the ICES website) and using the summary for the revision of C95.1-2005 in 2018. When the EHC Monograph becomes is available, the Literature Review WG can provide a summary of the EHC literature review, provide comments, and review any relevant papers missing in the EHC document. This can then be used to update Annex B and, if necessary, revise C95.1 (2018).

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

Subcommittee 5 is responsible for IEEE C95.4™-2002, "IEEE Recommended Practice for Determining Safe Distances from Radio Frequency Transmitting Antennas When Using Electric Blasting Caps during Explosive Operations." The standard was reaffirmed at the March 2008 SASB meeting. While the standard is considered stable, a PAR for a revision of the standard, possibly with a broadened scope, has been approved. The new Chairman, Ray Harmon, will resume SC5 activities to ensure harmonization with other international standards.

4.5.7 Subcommittee 6 (EMF Modeling and Dosimetry)

The aims of this new subcommittee (established September 2014) are: resolution of uncertainties in the dosimetric data used for the development of dosimetric reference limits and exposure reference levels (the bases of standards and guidelines for human exposure to electric, magnetic and electromagnetic fields); recommend analytical tools and data applicable to human exposure standards, follow and assess the recent literature on EMF dosimetry modeling, both for nerve stimulation effects caused by exposure to electric, magnetic and electromagnetic fields at frequencies below ~100 kHz, and for heating effects caused by RF energy absorption at frequencies above ~100 kHz. SC6 coordinates closely with the other subcommittees, especially with Subcommittee 3 and Subcommittee 4, both of which are currently working on the update and merger of IEEE Std C95.1™-2005 and IEEE-Std C95.6™-2002 (Reaffirmed 2007) into a single standard that covers the frequency range of 0 Hz to 300 GHz.

As a key activity, SC6 held an open workshop "The Current Status of Low Frequency Modeling" in Monterrey, California on June 14, 2015. Nine speakers covered three main topics: (1) Induction modeling; (2) Electrostimulation modeling; (3) Combined induction and electro-stimulation, including experimental verification. A panel discussion on future research topics was included at the end of the formal presentations. Eighty five attendees – many of whom were not IEEE/ICES members but were attending the BioEM2015 meetings – participated.

The results and conclusions of the workshop have been made freely available to interested parties via publication in a special section of *Physics in Medicine and Biology* (June 2016). The special section includes the research agenda for human safety from low-frequency fields, in which topics helpful for merging C95.1 and C95.6 are listed.

In addition to the original working group "Merging Computational and Experimental Approaches to Resolve Uncertainties Related to the Electrostimulation Threshold"

established in 2015, two new working groups were established; “Numerical Artifacts” and “Inter-comparison”.

4.6 PARs

The following TC95 PARS are currently active:

4.6.1 SC1 PARs

4.6.1.1 PC95.3 (Approved February 2012 – Extension Request Approved September 2016)

Title: Recommended Practice for Measurements and Computations of Electric, Magnetic and Electromagnetic Fields With Respect to Human Exposure to Such Fields, 0 Hz-300 GHz.

Status: Revision Project

Project Scope: This recommended practice describes methods for measuring and computing external electric, magnetic and electromagnetic fields to which persons may be exposed over the frequency range of 0 Hz to 300 GHz. Instrument characteristics and the methods of calibrating such instruments and methods for computation and the measurement of the resulting fields and currents that are induced in bodies of humans exposed to these fields are included.

4.6.2 SC2 PARs

4.6.2.1 PC95.2 (On December 2016 NesCom agenda)

Title: Standard for Radio-Frequency Energy and Current-Flow Symbols

Status: Revision Project

Project Scope: This standard provides a description of warning symbols for radio frequency radiation and radio frequency induced and contact currents in the frequency range of 3 kHz to 300 GHz.

Project Purpose: The purpose of this standard is to provide recommendations on the standardized design of warning symbols that may be used on alerting signs for informing individuals of the potential for exposure to electric, magnetic and electromagnetic fields and associated induced and contact currents and contact voltages.

4.6.3 SC3/4 PARs

4.6.3.1 PC95.1 (Approved June 2010 – Extension Request approved September 2016)

Title: Standard for Safety Levels with Respect to Human Exposure to Electric, Magnetic and Electromagnetic Fields, 0 Hz to 300 GHz

Status: Revision Project

Project scope: Recommendations are made to protect against established adverse health effects in humans resulting from exposure to electric, magnetic and electromagnetic fields in the frequency range of 0 Hz to 300 GHz. The recommendations are expressed in terms of exposure reference levels (ERLs) and dosimetric reference levels (DRLs). The DRLs are limits on in situ electric field strength, specific absorption rate (SAR), and incident power density; the ERLs, which are derived from the DRLs, are limits on external fields and induced and contact current. This standard is intended to apply to all human exposures except for exposure

of patients under medical supervision. The recommendations are not intended for the purpose of preventing interference with medical and other devices that may exhibit susceptibility to radio frequency (RF) fields. The recommendations at 300 GHz are consistent with existing recommendations for safe exposure in the infrared frequency range, which begins at 300 GHz, cf., ANSI Z136.1, and IEC 60825-1.

Project purpose: The purpose of this standard is to provide rational, science- based exposure values to protect against established adverse effects to human health induced by exposure to electric, magnetic, and electromagnetic fields over the frequency range of 0 Hz to 300 GHz.

4.6.4 SC5 PARs

4.6.4.1 PC95.4 (Approved September 2016)

Title: Recommended Practice for Determining Safe Distances From Radio Frequency Transmitting Antennas When Using Electric Blasting Caps During Explosive Operations

Status: Revision Project

Project scope: This project provides recommended practices for the prediction and practical determination of safe distances from radio and radar transmitting antennas when using electric initiators to remotely detonate an explosive charge. Specifically, this document includes mathematical formulas, tables, and charts that allow the user to determine safe distances from RF transmitters with spectrum bands from 0.5 MHz to 300 GHz, including VHF, UHF television antennas, FM, AM radio transmitting antennas, radar navigation beacons, and portable communication devices. This document excludes criteria for the use of electro-explosive devices (EEDs) within electrically conductive enclosures or weapons and does not include discussion of hazards deriving from electromagnetic fields generated by other sources of energy such as electrical storms, electromechanical equipment, electrical power plants or power transmission lines.

Project purpose: The purpose of this project is to provide recommendations for the prevention of the inadvertent detonation of electric initiators by radio-frequency electric and magnetic fields generated from transmitting antennas with spectrum bands from 0.5 MHz to 300 GHz. The intended users of this document may include, but are not limited to, the domestic international commercial demolition industries and the armed forces.

4.7 TC95 Objectives and Goals for 2015 and the TC's performance relative to meeting these goals and objectives.

- Initiate subcommittee balloting on PC95.3 (SC1 – 3rd Q 2015: Not met)
- Complete the establishment of the literature evaluation WG. (SC3/SC4 – 1st Q 2015: Partially met)
- Initiate Subcommittee balloting on PC95.1. (SC3/SC4 – 4th Q 2015): Not met
- Decide whether IEEE C95.4 should be updated and submit PAR if the decision is positive. (SC5 – 2nd Q 2015; Not met)

4.8 Objectives and Goals for 2016 with milestones indicated

- Initiate subcommittee balloting on PC95.3. (SC1 – 3rd Q 2016): Not met

- Complete the establishment of the literature evaluation WG. (SC3/SC4 – 1st Q 2016): Met
- Initiate Subcommittee balloting on PC95.1. (SC3/SC4 – 4th Q 2016): Not met
- Decide whether IEEE C95.4 should be updated and submit PAR if the decision is positive. (SC5 – 1st Q 2016): Met

4.9 Objectives and Goals for 2017 with milestones indicated

- Initiate subcommittee balloting on PC95.3. (SC1 – 2nd Q 2017)
- Initiate subcommittee balloting on PC95.1. (SC3/4 – 3rd Q 2017)
- Begin the revision of C95.4. (SC5 – 1st Q 2017)
- Initiate ICNIRP/ICES collaboration meeting through the WHO EHC group to discuss harmonization of exposure limits. (SC3/4 – 3rd Q 2017)

4.10 IEEE Staff

Support in setting up meetings at IEEE Piscataway has been required in the past and may be in the future; availability of the IEEE Staff Engineer at meetings held at IEEE is desirable. The engineering background and broad knowledge of IEEE procedures of Soo Kim, Staff Liaison for both TC34 and TC95, is invaluable to this committee.

4.11 Other Activities:

Members of ICES TC95 are continually involved in a wide spectrum of activities that relate to standard-setting including research, education, and drafting of regulations. Members participate in the governmental activities in many nations, as well. These include the FCC and FDA in the US, the EU/EC in Europe, and Standard setting bodies in China. TC95 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.

4.12 Issues

4.12.1 Recognition of C95 measurement standards by IEC TC106

ICES has twice submitted without success IEEE 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 that contain exposure limits (ICNIRP). It is unlikely that further attempts will succeed as C95.3 is being revised and expanded to include IEEE C95.3.1™-2010.

4.12.2 Interaction with ICNIRP

Members of ICES have tried unsuccessfully to coordinate harmonization 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 Hz – 3 kHz) and C95.1 (3 kHz – 300 GHz). The ICNIRP process for developing guidelines is closed and relies on claims of “no commercial vested interests” to maintain “credibility,” especially within the EU states. Since there is no stakeholder involvement, it is not clear how they will deal with “Consideration of Implementation in Practice” in their process. In the past, members of the ICES AdCom have met several times with members of ICNIRP (twice at ICNIRP’s request) to discuss methods of coordination but attempts at sharing documents are one-way only.

During the past few years there has been some softening in ICNIRP's position stemming from an issue in the EU whereby a European Commission (EC) Worker Safety Directive to implement ICNIRP-based guidance in the workplace was initially delayed because of impacts to several stakeholder groups, including MRI operators performing certain interventional procedures, would be exposed to low frequency magnetic fields in excess of the ICNIRP limits. The relevant ICNIRP limits are far more restrictive than those of IEEE C95.6 and the incorporation of extremely large safety factors in the ICNIRP limits has never been explained. TC95/SC6 was established to reconcile issues related to dosimetry and induction models in order to reconcile the differences. Additional stakeholder impacts included industry (welders and heat-sealer operators) and military (induced and contact current impacts on operations). The NATO Stakeholder to the EC Advisory Group that revised the proposed Directive 2004/40/EC on EMF exposure limits in the workplace obtained several derogations in the final Directive 2013/35/EU for militaries operating in the EU. The derogations allowed the EU NATO Nations to lawfully ratify and implement STANAG 2345-2015 which adopts IEEE C95.1-2345™-2014.

In May 2016, there was a change of leadership and members of ICNIRP. The new ICNIRP Chairman and one of the new members of the 13 member committee are also ICES members and ICNIRP is now willing to discuss harmonization of the exposure limits found in IEEE Stds C95.1™-2005 and C95.6™-2002 and the ICNIRP Guidelines. At a June 2016 Mobile Manufacturers Forum Workshop in Ghent, Belgium, the new ICNIRP Chairman, Dr. van Rongen, presented "ICNIRP's proposed HF guidelines" and extended an invitation to ICES to comment on their proposed limits. TC95 formed a 19 member task group to draft a document to comment on the ICNIRP proposed limits. The document was circulated to the TC95 membership for comments. A final document was submitted to ICNIRP in time to be discussed at the ICNIRP September meeting. ICES will maintain its collaborative relationship with ICNIRP with the goal of in setting internationally harmonized safety limits for exposure to electromagnetic fields at frequencies below 300 GHz. This interaction with ICNIRP is considered a major step forward.

ICES will continue to discuss the IEEE standards and process at major international fora to help recruit key scientists and engineers who have no other way of participating in setting safety standards. Indications are that there may be a closer relationship with ICNIRP in the future.

4.12.3 Responding to Advocacy Groups

A major ICES concern has been responding to advocacy groups that are gaining an increasing stronger foothold, particularly outside of North America. Most notable are the advocates of the *BioInitiative Report* (a non-peer reviewed selective, rather than comprehensive, review of the literature that mixes discussions on science with social issues). This group has gained momentum pushing for unrealistic restrictive standards and policies that must be continually rebutted. In 2009, the EMB-S Committee on Man and Radiation (COMAR – which is made up mostly of ICES members) published a peer reviewed article in *Health Physics* that spotlights errors and inconsistencies in the web published *BioInitiative Report*. IEEE/ICES experts need standards developmental organizational support in countering unscientific claims that would be catastrophic if implemented as law or regulation. In the 2012 revision of the *BioInitiative Report*, the authors of the final chapter (written by two individuals without consulting other authors

of the report) recommend a precautionary exposure limit of 0.3 nW/cm^2 for RF exposure, which would essentially shut down radio communications.

4.13 Membership

See Tables TC95-1 through Table TC95-7 for committee and subcommittee membership information.

Table TC95-1

TC95 Leadership

OFFICE	NAME	AFFILIATION	COUNTRY
Chairman	C-K Chou	C-K. Chou Consulting	US
Vice Chairman (Vac)			
Secretary/Treasurer	Ron Petersen	R C Petersen Associates LLC	US
Co-chairman, SC1	Francis Colville	US Army PHC	US
Co-chairman, SC1	Mark Douglas	IT'IS Foundation	CH
Chairman, SC2	Richard Tell	Richard A Tell Associates, Inc.	US
Co-chairman, SC3	Kevin Graf	Exponent	US
Co-chairman, SC3	Rob Kavet	Kavet Consulting LLC	US
Co-chairman, SC4	Art Thansandote	Health Canada (Retired)	CA
Co-chairman, SC4	Marvin Ziskin	Temple University Medical School	US
Co-chairman, SC5	Tamera Hay	Naval Surface Warfare Ctr.	US
Co-chairman, SC5	Ray Harmon	URS Corp.	US
Chairman, SC6	Akimasa Hirata	Nagoya Institute of Technology	JP

Table TC95-2

TC95 Membership: Main Committee (November 2016)

	LAST NAME	FIRST NAME	AFFILIATION	INTEREST CATEGORY	COUNTRY	IEEE MEMBER?
1.	Adhikari	Sam	Syssoft Corp.	GI	US	
2.	Alon	Leeor	NYU Medical Center	GI	US	
3.	Ammann	Max	Dublin Institute of Technology	A	IE	
4.	Anderson	Vitas	Swinburne University	A	AU	Y
5.	Attayi	Daoud	Research In Motion, Ltd	P	CA	
6.	Bailey	William	Exponent, Inc.	GI	US	Y
7.	Baron	David	AIHA Representative	GI	US	Y
8.	Bavin	John	Consumers Energy	U	US	
9.	Bellier	Pascale	Health Canada	G	CA	
10.	Bergeron	John	Independent Consultant	GI	US	
11.	Bodemann	Ralf	Siemens AG	P	DE	Y
12.	Bowman	Joseph	CDC NIOSH	G	US	
13.	Brewer	John	HCJB Global	U	US	
14.	Brooker	Ian	Tyco Fire and Security	P	IE	
15.	Bushberg	Jerrold	U. of California, Davis	A	US	
16.	Butcher	Matt	Sitesafe	U	US	Y
17.	Chiang	Huai	Zhejiang Medical University	A	CN	
18.	Chen	Jyun-cheng	Apple	GI	US	
19.	Chen	Xi Lin (Vick)	St Jude Medical Center	GI	US	
20.	Chou	C.K.	C-K. Chou Consulting	GI	US	Y
21.	Cifra	Michal	Czech Technical University	A	CZ	
22.	Cleveland	Robert	EMF Consulting	U	US	Y

	LAST NAME	FIRST NAME	AFFILIATION	INTEREST CATEGORY	COUNTRY	IEEE MEMBER?
23.	Colville	Frank	US Army PHC	G	US	
24.	Comlekci	Selcuk	Suleyman Demirel University	A	TR	
25.	Cotton	David	Sitesafe Inc	U	US	
26.	Cotts	Benjamin	Exponent	GI	US	
27.	Curtis	Robert	RF CHECK Incorporated	U	US	Y
28.	Cvetković	Mario	FESB University of Split	A	NR	
29.	D'Andrea	John	Naval Medical Research Unit (Ret)	G	US	Y
30.	De Santis	Valerio	University of L'Aquila	A	IT	
31.	DeFrank	John	US Army PHC	G	US	Y
32.	Delgato	Michael	Verizon Wireless	U	US	Y
33.	Dockzat	Martin	FCC-OET	G	US	
34.	Douglas	Mark	IT'IS Foundation	GI	CH	Y
35.	Dovan	Thanh	SP AusNet (Retired)	P	AU	Y
36.	Duvdevany	Amnon	IDF Medical Corps	G	IL	
37.	Elder	Joe	Independent Consultant	U	US	
38.	Erdreich	Linda	Exponent	GI	US	Y
39.	Faraone	Antonio	Motorola Solutions	GI	US	Y
40.	Farrer	Donald	Independent Consultant	U	US	
41.	Filippopoulos	George	Greek Atomic Energy Comm.	G	GR	
42.	Findlay	Richard	EMF Comp	GI	UK	
43.	Fink	Nir	Israel Defence Forces	G		
44.	Foster	Kenneth	Univ. of Pennsylvania	A	US	Y
45.	Futch	James	Florida Dept of Health	G	US	
46.	Gajsek	Peter	Institute of Public Health	U	SI	
47.	Geber	Kurt	Dynamac Corporation	P	US	
48.	George	David	Unisys Corp.	P	US	Y

	LAST NAME	FIRST NAME	AFFILIATION	INTEREST CATEGORY	COUNTRY	IEEE MEMBER?
49.	Gettman	Ken	NEMA	GI	US	Y
50.	Giaccone	Luca	Politecnico di Torino	A	IT	
51.	Gledhill	Martin	Monitoring and Adv. Serv. NZ, Ltd	U	NZ	
52.	Graf	Kevin	Exponent Failure Analysis Assc.	GI	US	Y
53.	Haes, Jr.	Donald	BAE Systems	P	US	Y
54.	Halkiotis	Konstantinos	Medical School of Athens	A	GR	
55.	Hare	Ed	American Radio Relay Leaque	GI	US	Y
56.	Harmon	Raymond	URS Corp.	U	US	Y
57.	Hatfield	James	Hatfield & Dawson	GI	US	Y
58.	Hay	Tamera	Naval Surface Warfare Center	U	US	Y
59.	Heirman	Donald	Don HEIRMAN Consultants	GI	US	Y
60.	Hill	Jonathin	ASSESSAFRICA, LLC	GI	US	
61.	Hirata	Akimasa	Nagoya Institute of Technology	A	JP	Y
62.	Ibey	Bennett	US Air Force Research Laboratory	U	US	
63.	Ikehata	Masateru	Railway Technical Research Inst	A	JP	
64.	Israel	Michel	National Centre of Hygiene	G	BL	
65.	Ivans	Veronica	Medtronic Inc. (Retired)	G	US	Y
66.	Jiang	Hai	Underwriters Lab	G	US	
67.	Jirjis	Michael	US Air Force Research Labs	G	US	
68.	Johnston	Sheila	Independent Consultant	GI	IE	
69.	Jones	Christine	Naval Surface Warfare Ctr.	G	US	
70.	Joyner	Ken	Samsung	P	AU	Y
71.	Kandel	Shaiela	Hebrew University of Jerusalem	A	IL	
72.	Karabetsos	Efthymios	Greek Atomic Energy Commission	G	GR	
73.	Karpowicz	Jolanta	Central Institute for Labor Protection	A	PL	
74.	Kavet	Robert	Kavet Consulting LLC	GI	US	Y

	LAST NAME	FIRST NAME	AFFILIATION	INTEREST CATEGORY	COUNTRY	IEEE MEMBER?
75.	Keshvari	Jafar	Aalto University-School of Science	P	FI	Y
76.	Kilian	David	Verizon	U	US	
77.	Kim	Byung Chan	ETRI, Korea	GI	KR	Y
78.	Kim	Nam	Chungbuk National University	A	KR	Y
79.	Klauenberg	B. Jon	US Air Force Research Laboratory	G	US	Y
80.	Koepfinger	Joseph	Consultant	G	US	Y
81.	Kuster	Niels	IT'IS Foundation	A	CH	Y
82.	Laakso	Ilkka	Nagoya Inst of Tech	A	JP	Y
83.	Lee	Ae-Kyoung	ETRI	GI	KR	
84.	Legros	Alexandre	Lawson Health Research Institute	A	CA	
85.	Lodwick	Jeffrey	US Department of Labor	G	US	
86.	Manatrakul	Nisakorn	Ministry of Public Health	G	TH	
87.	Mathur	Rajat	Hammett & Edison, Inc.	U	US	
88.	Mattsson	Mats-Olof	Austrian Institute of Technology	AT	A	
89.	McNamee	James	Health Canada	G	CA	
90.	Meltz	Martin	Retired	GI	US	Y
91.	Mezei	Gabor	Exponent Health Services	GI	US	
92.	Miyagi	Hiroaki	Japan NUS Co., Ltd	P	JP	
93.	Mueller	William	Boring	U	US	
94.	Mundy	Wesley	Altalink	U	US	Y
95.	Murphy	Michael	USAF Research Laboratory (Retired)	G	US	Y
96.	Muthuvelu	Pirunthavany	Ministry of Health	G	MY	
97.	Nappert	Hughes	CEM Industry Canada	G	CA	
98.	Ng	Kwan-Hoong	Dept of Radiation	G	MY	
99.	Osepchuk	John	Full Spectrum Consulting	U	US	Y
100.	Packer	Malcolm	Harris RF Communications	P	US	Y

	LAST NAME	FIRST NAME	AFFILIATION	INTEREST CATEGORY	COUNTRY	IEEE MEMBER?
101.	Pakhomov	Andrei	McKesson Bio Services	GI	US	
102.	Petersen	Ronald	R C Petersen Associates	GI	US	Y
103.	Poljak	Dragan	University of Split, Croatia	A	HR	
104.	Ramachandran	TV	Vodafone	U	IN	Y
105.	Ravazzani	Paolo	Italian Nat Res Council	G	IT	
106.	Reilly	J. Patrick	Metatec Associates	GI	US	Y
107.	Repacholi	Michael	World Health Organization (Retired)	GI	CH	
108.	Ryu	Chungsang	KR Com Radio Res Agency	G	KR	
109.	Samaras	Theodoros	Aristotle University of Thessaloniki	A	GR	Y
110.	Sayers	Andrew	Elbit Systems of Australia, Pty. Ltd	GI	AU	
111.	Scanlon	William	Queens University, Belfast	A	UK	Y
112.	Sen	Indranil	Apple	P	US	
113.	Shelton, Jr	Wesley	AT&T Mobility	G	US	
114.	Sheppard	Asher	Asher Sheppard Consulting	U	US	
115.	Sheppard	Christopher	Verizon Wireless	U	US	Y
116.	Shkolnikov	Yakov	Advanced Data Analytics	GI	US	
117.	Shrivastava	Devashish	University of Minnesota	A	US	
118.	Sindia	Suraj	Intel Corp	P	US	
119.	Sliney	David	Health Physics Society (Liaison)	GI	US	
120.	Swicord	Mays	Mays Swicord Consulting	U	US	Y
121.	Tanghe	Emmeric	Ghent University	A	BE	
122.	Tattersall	John	DSTL	G	UK	
123.	Tell	Richard	Richard Tell Assoc. Inc.	U	US	Y
124.	Testagrossa	Paul	Independent Consultant	GI	US	Y
125.	Thansandote	Art	Health Canada (Retired)	G	CA	Y
126.	Thuroczy	Gyorgy	Nat Res Inst for Radiobiology	G	HU	

	LAST NAME	FIRST NAME	AFFILIATION	INTEREST CATEGORY	COUNTRY	IEEE MEMBER?
127.	Umbdenstock	Donald	Tyco/Sensormatic	P	US	Y
128.	Valberg	Peter	Gradient Corporation	GI	US	
129.	van Rongen	Eric	Health Council of the Netherlands	G	NL	
130.	Varanelli	Arthur	Independent Consultant	U	US	Y
131.	Vijayalaxmi	"Vijay"	University of Texas	GI	US	
132.	Visser	Auke	Royal Netherlands Navy	G	NL	
133.	Wan Nor Liza	Mahadi	Mahadi. Institute: University Malaya	A	MY	
134.	Wessel	Marvin	Global RF Solutions	U	US	Y
135.	Wiart	Joe	France Telecom Orange Labs R&D	U	FR	Y
136.	Williams, Jr.	Louis	Louis A. Williams Jr. & Associates	U	US	Y
137.	Yamazaki	Kenichi	Central Res Inst Elec Power Ind	G	JP	
138.	Zhadobov	Maxim	IETR	GI	FR	
139.	Zipse	Donald	Electrical Forensics, LLC	GI	US	Y
140.	Ziskin, MD	Marvin	Temple Univ. Medical School	A	US	Y
141.	Zollman	Peter	Peter Zollman Consultancy	GI	UK	

A = General Interest: Academic G = General Interest: Government GI = General Interest P = Producer U = User

Table TC95-3

TC95 Membership: SC1 (Techniques, Procedures, Instrumentation and Computation)

	LAST NAME	FIRST NAME	AFFILIATION	INTEREST CATEGORY	COUNTRY	IEEE MEMBER?
1.	Alon	Leeor	NYU Medical Center	A	US	Y
2.	Baron	David	AIHA Representative	GI	US	
3.	Bodemann	Ralf	Siemens AG	P	DE	Y
4.	Bowman	Joe	NIOSH	G	US	
5.	Brooker	Ian	Tyco Fire and Security	P	IE	
6.	Butcher	Matthew	Sitesafe	U	US	Y
7.	Choi	Dong-guen	Radio Research Agency	P	KR	
8.	Chou	C.K.	C-K. Chou Consulting	P	US	Y
9.	Cleveland	Robert	EMF Consulting	U	US	Y
10.	Colville	Frank	US Army PHC	G	US	
11.	Cotton	David	Sitesafe Inc	U	US	
12.	DeFrank	John	US Army PHC	G	US	Y
13.	Dockzat	Martin	FCC OET	G	US	
14.	Douglas	Mark	IT'IS Foundation	GI	CH	Y
15.	Faraone	Antonio	Motorola Solutions, Inc	P	US	Y
16.	Friedrich	Gerd	Deutche Telekom	U	DE	
17.	Gettman	Ken	NEMA	GI	US	Y
18.	Harrington	Tim	FCC	G	US	Y
19.	Kainz	Wolfgang	UCFDA/CDRH	G	US	Y
20.	Klauenberg	B. Jon	USAF Research Laboratory	G	US	Y
21.	Kong	Sungsik	Radio Research Agency	G	KR	Y

	LAST NAME	FIRST NAME	AFFILIATION	INTEREST CATEGORY	COUNTRY	IEEE MEMBER?
22.	Mantiply	Ed	FCC/OET	G	US	
23.	McKenzie	Ray	Telstra, Australia	P	AU	Y
24.	Menard	Francois	Industry Canada	G	CA	
25.	Petersen	Ronald	R C Petersen Associates	GI	US	Y
26.	Reilly	J Patrick	Metatec Associates	GI	US	Y
27.	Tell	Richard	Richard Tell Assoc. Inc.	GI	US	Y
28.	Testagrossa	Paul	Independent Consultant	GI	US	Y
29.	Thansandote	Art	Health Canada (Retired)	G	CA	Y
30.	Umbdenstock	Donald	Tyco/Sensormatic	P	US	Y
31.	Wessel	Marvin	Global Solutions	U	US	Y
32.	Ziskin	Marvin	Temple Univ Med School	A	US	Y

A = General Interest: Academic
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Table TC95-4

TC95 Membership: SC2: (Terminology, Units of Measurements and Hazard Communication)

	LAST NAME	FIRST NAME	AFFILIATION	INTEREST CATEGORY	COUNTRY	IEEE MEMBER?
1.	Alon	Leeor	NYU Medical Center	A	US	
2.	Anderson	Vitas	Swinburne University	A	AU	Y
3.	Bailey	William	Exponent	GI	US	Y
4.	Baron	David	AIHA Representative	GI	US	Y
5.	Bellier	Pascale	Health Canada	G	CA	
6.	Biby	Richard	Crown Castle International	U	US	Y
7.	Bodemann	Ralf	Siemens AG	P	DE	Y
8.	Bowman	Joe	CDC NIOSH	GI	US	
9.	Boyer	Jim	Lawrence Livermore National Labs	G	US	
10.	Brecher	Aviva	DOT/RSPA Volpe Ctr.	G	US	Y
11.	Bushberg	Jerrold	U. of California, Davis	A	US	
12.	Chou	C.K.	C-K. Chou Consulting	P	US	Y
13.	Cleveland	Robert	EMF Consulting	GI	US	Y
14.	Curtis	Robert	Curtis Engineering and Management	U	US	Y
15.	D'Andrea	John	Naval Medical Research Unit	G	US	Y
16.	DeFrank	John	US Army PHC	G	US	Y
17.	Erdreich	Linda	Exponent	GI	US	Y
18.	Everist	Donald	Cohen, Dipell and Everist	GI	US	Y
19.	Gajda	Greg	Health Canada	GI	CA	
20.	Gettman	Ken	NEMA	GI	US	Y
21.	Haes, Jr.	Donald	BAE Systems	P	US	Y

	LAST NAME	FIRST NAME	AFFILIATION	INTEREST CATEGORY	COUNTRY	IEEE MEMBER?
22.	Hatfield	James	Hatfield & Dawson	U	US	Y
23.	Hubbard	Roy	Technology Services International	U	ZA	Y
24.	Johnson	Robert	L-3 Microwave NARDA	U	US	
25.	Joyner	Ken	Samsung	P	AU	Y
26.	Kantner	Kimberly	AT&T	U	US	Y
27.	Khalil	Kathy	SPAWARSYSCEN Charleston	U	US	
28.	Kierl	Bill	Motorola, Inc	P	US	
29.	Klauenberg	B. Jon	USAF Research Laboratory	G	US	Y
30.	Kumbier	Werner	Narda Safety Test Solutions	P	DE	
31.	Kuster	Niels	IT'IS Foundation	GI	CH	Y
32.	Mantiply	Ed	FCC/OET	G	US	
33.	Meltz	Martin	U of Texas (Retired)	GI	US	Y
34.	Mercer	Christopher	Vodacom Group, Pty Ltd	U	ZA	
35.	Nappert	Hughes	CEM Industry Canada	G	CA	
36.	Norman	Larry	Pike Electric	P	US	
37.	Osepchuk	John	Full Spectrum Consulting	U	US	Y
38.	Persson	Bertil	Lund University	A	SE	
39.	Petersen	Ronald	R C Petersen Associates	GI	US	Y
40.	Rogers	Walt	Veridian Eng/RFR Branch	GI	US	Y
41.	Rowley	Jack	Telstra Research Labs	GI	AU	
42.	Scanlon	William	Queens University, Belfast	A	UK	Y
43.	Seabury	David	Chase Systems Inc.	U	US	Y
44.	Smith	Matthew	Dade Moeller & Associates	GI	US	

	LAST NAME	FIRST NAME	AFFILIATION	INTEREST CATEGORY	COUNTRY	IEEE MEMBER?
45.	Strickland	Richard	RF Safety Solutions	U	US	Y
46.	Tell	Richard	Richard Tell Assoc. Inc.	GI	US	Y
47.	Testagrossa	Paul	Independent Consultant	GI	US	Y
48.	Thansandote	Art	Health Canada (Retired)	G	CA	Y
49.	Ulcek	Jerry	FCC	G	US	
50.	Varanelli	Arthur	Independent Consultant	GI	US	Y
51.	Ziskin, MD	Marvin	Temple Univ. Medical School	GI	US	Y

A = General Interest: Academic
G = General Interest: Government
GI = General Interest
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U =User

Table TC95-5
TC95 Membership: SC3 (Safety Levels with Respect to Human Exposure, 0-3 kHz)

	LAST NAME	FIRST NAME	AFFILIATION	INTEREST CATEGORY	COUNTRY	IEEE MEMBER?
1.	Alon	Leeor	NYU Medical Center	A	US	
2.	Ammann	Max	Dublin Institute of Technology	A	IE	
3.	Anderson	Vitas	Swinburne University	A	AU	Y
4.	Attayi	Daoud	Research In Motion, Ltd	P	CA	
5.	Bailey	William	Exponent Inc.	GI	US	Y
6.	Barker	J. Richard	General Cable	P	US	Y
7.	Baron	David	AIHA Representative	GI	US	Y
8.	Bavin	John	Consumers Energy	P	US	
9.	Bellier	Pascale	Health Canada	G	CA	
10.	Bergeron	John	Independent Consultant	GI	US	
11.	Bodemann	Ralf	Siemens AG	P	DE	Y
12.	Boeggeman	Charles	PECO Energy Co.	P	US	Y
13.	Bowman	Joseph	CDC NIOSH	G	US	
14.	Brecher	Aviva	DOT/RSPA Volpe Ctr.	G	US	Y
15.	Brewer	John	HCJB Global	U	US	
16.	Brooker	Ian	Tyco Fire and Security	P	IE	
17.	Butcher	Matthew	Sitesafe	U	US	Y
18.	Carberry	Robert	Northeast Utilities	P	US	Y
19.	Cassata	Jim	Navy Medical NIR Branch	G	US	
20.	Comlekci	Selcuk	Suleyman Demirel University	A	TR	
21.	Cotton	David	Sitesafe Inc	U	US	

	LAST NAME	FIRST NAME	AFFILIATION	INTEREST CATEGORY	COUNTRY	IEEE MEMBER?
22.	Cotts	Benjamin	Exponent	GI	US	
23.	Croft	Rodney	Department of Psychology	A	AU	
24.	Dale	Steiner	ABB Power T&D Company	U	US	Y
25.	Doczkat	Martin	Federal Communications Commission	G	US	
26.	Dovan	Thanh	SP AusNet (Retired)	P	AU	Y
27.	Duvdevany	Amnon	IDF Medical Corps	G	IL	
28.	Erdreich	Linda	Exponent	GI	US	Y
29.	Farrer	Donald	Independent Consultant	GI	US	
30.	Filippopoulos	George	Greek Atomic Energy Comm.	G	GR	
31.	Geber	Kurt	Dynamac Corporation	P	US	
32.	George	David	Unisys Corp.	P	US	Y
33.	Gettman	Ken	NEMA	GI	US	Y
34.	Goulet	Daniel	Hydro-Quebec	U	CA	
35.	Graf	Kevin	Exponent	GI	Y	
36.	Haes, Jr.	Donald	BAE Systems	P	US	Y
37.	Harmon	Raymond	URS Corp.	GI	US	Y
38.	Hernandez	Martin	Florida Power & Light Co.	P	US	Y
39.	Herz	Michael	Pacific Gas & Electric Co.	P	US	Y
40.	Hicks	Danny	South Carolina Electric & Gas Co.	P	US	Y
41.	Hirata	Akimasa	Nagoya Institute of Technology	A	JP	
42.	Holley	Jeff	Florida Power and Light	U	US	
43.	Hongbin	Jin	China Mobile	U	CN	
44.	Hubbard	Roy	Technology Services International	GI	ZA	Y
45.	Ibey	Bennett	US Air Force Research Laboratory	G		

	LAST NAME	FIRST NAME	AFFILIATION	INTEREST CATEGORY	COUNTRY	IEEE MEMBER?
46.	Ikehata	Masateru	Railway Technical Research Institute	A	JP	
47.	Jaffa	Kent	Retired	GI	US	Y
48.	Jiang	Hai	UL Labs	GI	US	Y
49.	Karabetsos	Efthymios	Greek Atomic Energy Commission	G	GR	
50.	Kautz	Richard	Ford	P	US	
51.	Kavet	Robert	Kavet Consulting LLC	GI	US	Y
52.	Klauenberg	B. Jon	US Air Force Research Laboratory	G	US	Y
53.	Kim	Byung Chan	ETRI, Korea	GI	KR	Y
54.	Kim	Nam	Chungbuk National University	A	KR	Y
55.	Koepfinger	Joseph	Consultant	GI	US	Y
56.	Kuster	Niels	IT'IS Foundation	GI	CH	Y
57.	Kaalso	Ilkka	Nagoya Institute of Technology	A	JP	Y
58.	Lee	Ae-Kyoung	ETRI	GI	KR	
59.	Link	Richard	Radiation Safety Institute of Canada	A	CA	
60.	Lodwick	Jeffrey	US Department of Labor	G	US	
61.	Mair	Peter	Fronius International GMBH	P	DE	
62.	Manatrakul	Nisakorn	Ministry of Public Health	G	TH	
63.	Mathur	Rajat	Hammett & Edison, Inc.	U	US	
64.	McNamee	James	Health Canada	G	CA	
65.	Miyagi	Hiroaki	Japan NUS Co., Ltd	U	JP	
66.	Muthuvelu	Pirunthavany	Ministry of Health	G	MY	
67.	Nappert	Hughes	CEM Industry Canada	G	CA	
68.	Nelson	David	Michigan Technical University	A	US	

	LAST NAME	FIRST NAME	AFFILIATION	INTEREST CATEGORY	COUNTRY	IEEE MEMBER?
69.	Ng	Kwan-Hoong	Dept of Radiation	G	MY	
70.	O'Connor	Roger	Dept of Comm, Marine and Nat Res	G	IE	
71.	Osepchuk	John	Full Spectrum Consulting	GI	US	Y
72.	Petersen	Ronald	R C Petersen Associates	GI	US	Y
73.	Pittman	Steve	Potlach Pulp and Paperboard	P	US	Y
74.	Podhrasky	Robert	Garrett Metal Detectors	P	US	
75.	Ravazzani	Paolo	Italian Nat Res Council	G	IT	
76.	Reilly	J. Patrick	Metatec Associates	GI	US	Y
77.	Ryu	Chungsang	KR Com Radio Res Agency	G	KR	
78.	Sahl	Jack	J. Sahl Associates	GI	US	
79.	Samaras	Theodoros	Aristotle University of Thessaloniki	A	GR	Y
80.	Sawdon	Dave	IBM Global Services	P	UK	
81.	Sheppard	Asher	Asher Sheppard Consulting	GI	US	
82.	Shkolnikov	Yakov	Exponent	GI	US	
83.	Shrivastava	Devashish	University of Minnesota	A	US	
84.	Swicord	Mays	Mays Swicord Consulting	GI	US	Y
85.	Tell	Richard	Richard Tell Assoc. Inc.	U	US	Y
86.	Thansandote	Art	Health Canada (Retired)	G	CA	Y
87.	Thuroczy	Gyorgy	Nat Res Inst for Radiobiology	A	HU	
88.	Umbdenstock	Donald	Tyco/Sensormatic	P	US	Y
89.	van Rongen	Eric	Health Council of the Netherlands	G	NL	
90.	Varanelli	Arthur	Independent Consultant	GI	US	Y
91.	Vijayalaxmi		Univ. Texas Health Science Ctr.	A	US	

	LAST NAME	FIRST NAME	AFFILIATION	INTEREST CATEGORY	COUNTRY	IEEE MEMBER?
92.	Wan Nor Liza	Mahadi	Mahadi. Institute: University Malaya	A	MY	
93.	Wiart	Joe	France Telecom Orange Labs R&D	GI	FR	Y
94.	Woods	Richard	Sensormatic Electronics	P	US	Y
95.	Yamazaki	Kenichi	Central Res Inst Elec Power Ind	P	JP	
96.	Yandek	Edward	GE Lighting	P	US	Y
97.	Zhadobov	Maxim	IETR	GI	FR	
98.	Zipse	Donald	Electrical Forensics, LLC	GI	US	Y
99.	Ziskin, MD	Marvin	Temple Univ. Medical School	GI	US	Y

A = General Interest: Academic
G = General Interest: Government
GI = General Interest
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Table TC95-6
TC95 Membership: SC4 (Safety Levels with Respect to Human Exposure, 3 kHz – 300 GHz)

	LAST NAME	FIRST NAME	AFFILIATION	INTEREST CATEGORY	COUNTRY	IEEE MEMBER?
1.	Abd Rahman	Nazaruddin	Universiti Tenaga Nasional	A	MY	
2.	Alon	Leeor	NYU Medical Center	A	US	
3.	Ammann	Max	Dublin Institute of Technology	A	IE	
4.	Anderson	Vitas	Swinburne University	A	AU	Y
5.	Attayi	Daoud	Research In Motion, Ltd	P	US	
6.	Bailey	William	Exponent Inc.	GI	US	Y
7.	Baron	David	AIHA Representative	GI	US	Y
8.	Bellier	Pascale	Health Canada	G	US	
9.	Bergeron	John	Independent Consultant	GI	NZ	
10.	Bodemann	Ralf	Siemens AG	P	US	Y
11.	Bowman	Joseph	CDC NIOSH	G	US	
12.	Brecher	Aviva	DOT/RSPA Volpe Ctr. (Retired)	G	US	Y
13.	Brewer	John	HCJB Global	P	IE	
14.	Brooker	Ian	Tyco Fire and Security	P	US	
15.	Bushberg	Jerrold	UC Davis	A	US	
16.	Butcher	Matthew	Sitesafe, Inc.	U	US	Y
17.	Cassata	Jim	Navy Medical NIR Branch	G	UK	
18.	Chiang	Huai	Zhejiang Medical University	A	US	
19.	Chou	C.K.	C-K. Chou Consulting	GI	US	Y
20.	Cleveland	Robert	EMF Consulting	GI	UK	Y

	LAST NAME	FIRST NAME	AFFILIATION	INTEREST CATEGORY	COUNTRY	IEEE MEMBER?
21.	Colville	Frank	US Army PHC	G	US	
22.	Comlekci	Selcuk	Suleyman Demirel University	A	TR	
23.	Cotton	David	Sitesafe Inc	U	US	
24.	Cotts	Benjamin	Exponent	GI	US	Y
25.	Croft	Rodney	Department of Psychology	A	AU	
26.	Curtis	Robert	Curtis Engineering and Management	U	US	Y
27.	D'Andrea	John	Naval Med. Research NIR Unit (Retired)	G	US	Y
28.	DeFrank	John	US Army PHC	G	US	Y
29.	Delgato	Michael	Verizon Wireless	U	US	Y
30.	Dini	David	UL	U	US	
31.	Doczkat	Martin	Federal Communications Commission	G	IT	
32.	Dovan	Thanh	SP AusNet (Retired)	GI	AU	Y
33.	Duvdevany	Amnon	IDF Medical Corps	G	ZA	
34.	Elder	Joe	Independent Consultant	G	IL	
35.	Erdreich	Linda	Exponent	GI	US	Y
36.	Faraone	Antonio	Motorola Solutions, Inc.	P	US	Y
37.	Farrer	Donald	Independent Consultant	GI	US	
38.	Filippopoulos	George	Greek Atomic Energy Comm.	G	US	
39.	Foster	Kenneth	Univ. of Pennsylvania	A	US	Y
40.	Futch	James	Florida Department of Health	U	US	
41.	Gajsek	Peter	Institute of Public Health	G	GR	
42.	Geber	Kurt	Dynamac Corporation	P	SI	

	LAST NAME	FIRST NAME	AFFILIATION	INTEREST CATEGORY	COUNTRY	IEEE MEMBER?
43.	Gettman	Ken	NEMA	A	US	Y
44.	Gledhill	Martin	Monitoring and Advis. Serv. NZ, Ltd.	U	NZ	
45.	Graf	Kevin	Exponent	GI	US	Y
46.	Haes, Jr.	Donald	BAE Systems	P	UK	Y
47.	Halkiotis	Konstantinos	Medical School of Athens	A	US	
48.	Hatfield	James	Hatfield & Dawson	U	US	Y
49.	Hay	Tamera	Naval Surface Warfare Center	G	CH	
50.	Heirman	Donald	Don HEIRMAN Consultants	U	US	Y
51.	Hirata	Akimasa	Nagoya Institute of Technology	A	GR	
52.	Hongbin	Jin	China Mobile	U	IE	
53.	Hubbard	Roy	Technology Services International	GI	US	Y
54.	Ibey	Bennett	US Air Force Research Laboratory	G	US	
55.	Ikehata	Masateru	Railway Technical Research Institute	A	CA	
56.	Israel	Michel	National Centre of Hygiene	G	US	
57.	Jiang	Hai	Underwriters Labs	U	US	
58.	Johnson	Robert	L-3 Microwave-NARDA	US	GI	Y
59.	Johnston	Sheila	Independent Consultant	GI	BL	
60.	Jones	Christine	Naval Surface Warfare Ctr.	U	US	
61.	Joyner	Ken	Samsung	P	US	Y
62.	Kandel	Shaiela	Hebrew University of Jerusalem	A	IE	
63.	Kantner	Kimberly	AT&T	U	AU	Y
64.	Karabetsos	Efthymios	Greek Atomic Energy Commission	G	IL	
65.	Kavet	Robert	Kavet Consulting LLC	GI	US	Y
66.	Keshvari	Jafar	Aalto University-School of Science	GI	FI	Y

	LAST NAME	FIRST NAME	AFFILIATION	INTEREST CATEGORY	COUNTRY	IEEE MEMBER?
67.	Kim	Nam	Chungbuk National University	A	KR	Y
68.	Kim	Byung Chan	ETRI, Korea	GI	KR	Y
69.	Klauenberg	B. Jon	US Air Force Research Laboratory	G	US	Y
70.	Koepfinger	Joseph	Consultant	U	US	Y
71.	Kwee	Sianette	University of Aarhus	A	US	
72.	Laakso	Ilkka	Nagoya Institute of Technology	A	JP	Y
73.	Lee	Ae-Kyoung	ETRI	GI	FI	
74.	Link	Richard	Radiation Safety Institute of Canada	A	US	
75.	Lodwick	Jeffrey	US Department of Labor	G	CA	
76.	Manatrakul	Nisakorn	Ministry of Public Health	G	US	
77.	Mantiply	Ed	FCC/OET	G	TH	
78.	Mathur	Rajat	Hammett & Edison, Inc.	U	US	
79.	McKenzie	Ray	Telstra Chief Technology Office	P	US	
80.	McNamee	James	Health Canada	G	AU	
81.	Meltz	Martin	Retired	GI	CA	Y
82.	Miyagi	Hiroaki	Japan NUS Co., Ltd	P	US	
83.	Mundy	Wesley	Altalink	U	US	
84.	Muthuvelu	Pirunthavany	Ministry of Health	G	US	
85.	Nappert	Hughes	CEM Industry Canada	G	US	
86.	Nelson	David	Michigan Technical University	A	US	
87.	Ng	Kwan-Hoong	Dept of Radiation	G	MY	
88.	Osepchuk	John	Full Spectrum Consulting	GI	CA	Y
89.	Packer	Malcolm	Harris RF Communications	P	US	Y

	LAST NAME	FIRST NAME	AFFILIATION	INTEREST CATEGORY	COUNTRY	IEEE MEMBER?
90.	Pakhomov	Andrei	McKesson Bio Services	GI	US	
91.	Persson	Bertil	Lund University	A	MY	
92.	Petersen	Ronald	R C Petersen Associates	GI	US	Y
93.	Ramachandran	TV	Vodafone	IN	GI	Y
94.	Ravazzani	Paolo	Italian Nat Res Council	G	SE	
95.	Reilly	J. Patrick	Metatec Associates	GI	US	Y
96.	Rogers	Walt	Veridian Eng/RFR Branch	GI	US	Y
97.	Rybak	Terence	General Motors Proving Grnd.	GI	IT	Y
98.	Ryu	Chungsang	KR Com Radio Res Agency	G	US	
99.	Samaras	Theodoros	Aristotle University of Thessaloniki	A	US	Y
100.	Scanlon	William	Queens University, Belfast	A	US	Y
101.	Shelton	Wesley	AT&T Mobility	U	US	Y
102.	Sheppard	Asher	Asher Sheppard Consulting	GI	US	Y
103.	Sheppard	Christopher	Verizon Wireless	GI	US	Y
104.	Shkolnikov	Yakov	Exponent	GI	FI	
105.	Shrivastava	Devashish	University of Minnesota	A	UK	
106.	Swicord	Mays	Mays Swicord Consulting	GI	PL	Y
107.	Tattersall	John	DSTL	G	US	
108.	Tell	Richard	Richard Tell Assoc. Inc.	U	US	Y
109.	Testagrossa	Paul	Independent Consultant	U	CA	Y
110.	Thansandote	Art	Health Canada (Retired)	G	US	Y
111.	Thuroczy	Gyorgy	Nat Res Inst for Radiobiology	G	IT	
112.	Umbdenstock	Donald	Tyco/Sensormatic	P	NL	Y
113.	van Rongen	Eric	Health Council of the Netherlands	G	US	

	LAST NAME	FIRST NAME	AFFILIATION	INTEREST CATEGORY	COUNTRY	IEEE MEMBER?
114.	Varanelli	Arthur	Independent Consultant	GI	MY	Y
115.	Wan Nor Liza	Mahadi	Mahadi. Institute: University Malaya	A	US	
116.	Weller	Robert	National Broadcasting Association	G	US	Y
117.	Wiart	Joe	France Telecom Orange Labs R&D	P	FR	Y
118.	Woods	Richard	Sensormatic Electronics	P	KR	Y
119.	Yamazaki	Kenichi	Central Res Inst Elec Power Ind	P	JP	
120.	Zhadobov	Maxim	IETR	GI	FR	
121.	Zipse	Donald	Electrical Forensics, LLC	GI	US	Y
122.	Ziskin, MD	Marvin	Temple Univ. Medical School	GI	US	Y

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G = General Interest: Government
GI = General Interest
P = Producer
U = User

Table TC95-7
TC95 Membership: SC5 (Safety Levels with Respect to Electro-Explosive Devices)

	LAST NAME	FIRST NAME	AFFILIATION	INTEREST CATEGORY	COUNTRY	IEEE MEMBER?
1.	Balzano	Quirino	University of MD	A	US	Y
2.	Bean	John	Naval Surface Warfare Center	G	US	
3.	Colville	Frank	US Army PHC	G	US	
4.	Comlekci	Selcuk	Suleyman Demirel University	A	TR	
5.	DeFrank	John	US Army PHC	G	US	Y
6.	Doczkat	Martin	Federal Communications Commission	G	US	
7.	Duvdevany	Amnon	IDF Medical Corps	G	IL	
8.	Harmon	Ray	EG&G	P	US	
9.	Hatfield	James	Hatfield & Dawson	U	US	Y
10.	Hay	Tamera	Naval Surface Warfare Center	G	US	
11.	Joyner	Ken	Samsung	P	AU	Y
12.	Leidel	David	Halliburton Energy Services	U	US	
13.	Nappert	Hughes	CEM Industry Canada	G	CA	
14.	Petersen	Ronald	R C Petersen Associates	GI	US	Y
15.	Stuart	James	Franklin Applied Physics	GI	US	
16.	Thompson	Ramie	Franklin Applied Physics	GI	US	

A = General Interest: Academic
G = General Interest: Government
U = User
GI = General Interest
P = Producer

Table TC95-8
TC95 Membership: SC6 (EMF Dosimetry Modeling)

	LAST NAME	FIRST NAME	AFFILIATION	INTEREST CATEGORY	COUNTRY	IEEE MEMBER?
1.	Alon	Leeor	New York University	G	US	
2.	Angelone	Leonardo	FDA/CDRH	G	US	
3.	Bikson	Marom	City College of New York	A	US	
4.	Bodemann	Ralf	Siemens	P	DE	Y
5.	Cassara	Antonio	IT'IS Foundation	G	CH	
6.	Chen	Xi Lin	St. Jude Medical Center	P	US	
7.	Daga	Andrew	Momentum Dynamics	P	US	
8.	De Santis	Valerio	University of L'Aquila	A	IT	Y
9.	Diamant	Alan	Diamant Engineering	G	US	
10.	Dovan	Thanh	Retired	P	AU	
11.	Findlay	Richard	EMFcomp	GI	UK	
12.	Gomez-Tames	Jose David	Nagoya Inst Tech	A	JP	
13.	Hikage	Takashi	Hokkaido University	A	JP	Y
14.	Hirata	Akimasa	Nagoya Institute of Technology	A	JP	Y
15.	Iacono	Maria	FDA/CDRH	G	US	
16.	Israel	Michel	Medical University, Blevin	A	BG	
17.	Jeffreys	John	University of Oxford	A	UK	
18.	Kainz	Wolfgang	FDA/CDRH	G	US	Y
19.	Kamimura	Yoshitsugu	Utsunomiya University	A	JP	Y
20.	Kashiwa	Tatsuya	Kitami Inst Tech	A	JP	Y

	LAST NAME	FIRST NAME	AFFILIATION	INTEREST CATEGORY	COUNTRY	IEEE MEMBER?
21.	Kavet	Robert	Kavet Consulting LLC	GI	US	Y
22.	Krauthamer	Victor	FDA/CDRH	G	US	
23.	Kuster	Niels	IT'IS Foundation	G	CH	Y
24.	Laakso	Ilkka	Aalto University	A	FI	Y
25.	Lazzi	Gianlucca	University of Utah	A	US	Y
26.	Legros	Alexandre	Lawson Health Research Institute	A	CA	
27.	Lee	Ae-Kyoung	ETRI	A	KR	
28.	Leung	Sai Wing	City University of Hong Kong	A	HK	Y
29.	Matsumoto	Hideyuki	Japanese Red Cross Medical Center	GI	JP	
30.	McIntyre	Cameron	Case Western Reserve University	A	US	
31.	Neufeld	Esra	IT'IS Foundation	G	CH	Y
32.	Poljak	Dragan	University of Split	A	HR	Y
33.	Reilly	J. Patrick	Metatec Associates	GI	US	Y
34.	Samaras	Theodros	Aristotle U. of Thessaloniki	A	GR	Y
35.	Sasaki	Kensuke	NICT	GI	JP	Y
36.	Sarolic	Antonio	University of Split	A	HR	
37.	Schmid	Gernot	Seibersdorf Lab.	GI	AT	
38.	Sindia	Suraj	Intel Corp, Corp Quality Network	P	US	
39.	Sweeney	James D.	FL Gulf Coast U.	A	US	Y
40.	Takei	Amane	Miyazaki University	A	JP	
41.	Taguchi	Kenji	Kitami Inst Tech.	A	JP	Y
42.	Tarao	Hiroo	Kagawa National College of Tech.	A	JP	
43.	Wake	Kanako	NICT	GI	JP	Y

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45.	Wout	Joseph	University of Ghent	A	BE	Y
46.	Wu	Tongning	China Acad. of Telecomm. Research	GI	CN	Y
47.	Yamazaki	Kenichi	CRIEPI	U	JP	Y
48.	Yilmaz	Ali E.	University of Texas at Austin	A	US	Y

A = General Interest: Academic
G = General Interest: Government
U = User
GI = General Interest
P = Producer