



INTERNATIONAL
COMMITTEE *on*
ELECTROMAGNETIC
SAFETY

Approved Meeting Minutes

ICES/IEEE SCC-28 Meeting

**Novotel Hotel
6, rue du Fort Niedergrunewald
BP 512
2015, Luxembourg
December 1 - 2, 2001**

1. Call to Order

Chairman Adair opened the meeting (see Attachment 1 for tentative agenda) and welcomed the attendees.

2. Introduction of those Present.

Chairman Adair called for a round of personal introductions (see Attachment 2 for the list of attendees).

3. Tribute to Ulf Berquist

Dr. Tom McManus presented a tribute to the late Dr. Ulf Berquist, who died of a heart attack on Sept. 11, 2001. Ulf was a founding member of ICNIRP in 1992. He joined ICES immediately following the Munich meeting in 2000. He was the author of many papers and co-authored two recent books, one on VDU's and one on hypersensitivity. Tom's last memory of Ulf was at a planning meeting of the COST 281 program in Stockholm.

Ulf had the deepest affection for his wife and son and he loved his home in Stockholm – so much so that he tolerated a 400 km daily commute to the National Institute of Occupational Health at Umea. Personal memories are strengthened by photos of Ulf at the 1996 ICNIRP workshop (taking time to visit some Greek ruins), at the 1994 Sicily meeting and the 2000 BEMS meeting.

4. Subcommittee Reports (Dr. Michael Murphy – Chairman)

4.1 SC-1: Techniques, procedures, instrumentation and computation

Ron Petersen presented the report for SC-1. He first showed the organization chart for ICES, showing the five Subcommittees, ICES (SCC-28) – the parent

administrative committee and the Executive Committee (EXCOM) with special Chairmen for Membership and International Liaison (see [Attachment 3](#)). He described some of the administrative functions, especially that of the “Interpretations” process. He showed the scope of SC-1, which addresses measurement and computational techniques related to exposure assessment. The history of SC-1 documents includes C95.3-1973, C95.5-1981, C95.3-1991, 1460-1996 (guide for the measurement of quasi-static fields), and C95.3-200x – now being balloted. The latter document addresses the frequency range of 100 kHz to 300 GHz. He noted that the lower boundary is chosen to match the recognized transition frequency where bioeffects shift from domination by electrostimulation to domination by heating.

Petersen then reviewed the outline of C95.3, especially Section 5 [now Section 6] on the measurement of potentially hazardous fields. That section reviews probe techniques to measure SAR and discusses how to deal with exposure of the pinna and other thin regions of the body. The goal is to have the standard approved by the Standards Board in June 2002.

In the future SC-1 will develop a recommended practice that covers the 0 to 100 kHz frequency range.

4.2 SC-2: Terminology, units of measurements and hazard communication

This report was given by John Osepchuk for Ric Tell, Chairman of SC-2. He reviewed past work including the impressive standard on warning symbols, IEEE C95.2-2000. He pointed out that an initiative, which began in SC-2, resulted in an SCC-28 “Statement on Cautionary Policies” that was sent to a federal interagency committee preparing a report at the end of the RAPID program in the US. The Statement said that cautionary policies should be discretionary or optional and a matter suitable for a “Guide” but not higher in authority level.

The Subcommittee is now hard at work developing a Recommended Practice on the basis for Work Safety Programs.

Osepchuk noted that a veteran member of SC-2 is the prime author of an extensive 2-volume report assessing new transportation such as MAGLEV associated with EMF exposure.

4.3 SC-3: Safety levels with respect to human exposure, 0-3 kHz

Dr. Veronica Ivans presented a report in lieu of Kent Jaffa, Chairman of SC-3. She reviewed the new draft exposure standard for the 0 to 3 kHz region. She said the work reflects a big contrast between the MPEs in this standard and the reference levels in the ICNIRP’98 Guideline. Osepchuk pointed out that the difference largely is in the magnitude of safety factors, which in the ICNIRP guideline is > 100 in field strength levels (or approaching 50 dB) at 1 kHz. She credited J. P. Reilly for key work in deriving scientifically sound thresholds for the various type of electrostimulation.

Dr. Ivans invited attendees to follow the work of SC-3 or SC-4 at Internet site:

<http://grouper.ieee.org/groups/scc28/>

Ron Petersen also invited attendees to follow the work of SCC-34 (product standards) at Internet site:

<http://grouper.ieee.org/groups/scc34/>

4.4 SC-4: Safety levels with respect to human exposure, 3 kHz-300 GHz

Dr. C. K. Chou presented the report (see [Attachment 4](#)). He reviewed the extensive work and history including the literature-review process. There are currently more than 1550 papers under review (Version 24). He also discussed activities of the Risk Assessment WG – chaired by Ric Tell and the Mechanisms WG – chaired by Asher Sheppard.

Dr. Chou then reviewed the content of the C95.1 revision. The intent is to publish “White Papers” on key issues in a peer-reviewed journal. It is an ultimate goal to move toward international harmonization and, therefore, close interchange with ICNIRP has been underway. An official draft of the C95.1 revision will be sent to ICNIRP for review and comment.

Dr. Chou reported that on November 9 a 7-hour teleconference was held with 27 participants reviewing the various issues and tasks. They are hoping that some useful output will result from a planned WHO workshop on thermal effects in the most sensitive tissues. He pointed out the concern over the 10 W/kg peak spatial average SAR limit. McManus suggested using mW/g instead of W/kg but Santomaa pointed out that the IEEE requires use of MKS units.

Chou stated his goal was to have a complete draft for discussion at the June 2002 meetings of ICES in Quebec City. He invited all to participate.

Dr. Adair announced the schedule for the next ICES meeting in January, at the Sheraton Gunter Hotel in San Antonio, Texas.

January 17: SC-5 in the evening

January 18: SC-1 in the AM, SC-3 in the PM and SC-2 in the evening.

January 19: SC-4 all day and COMAR in the evening

January 20: ICES (SCC-28) in the AM

Adair reported that Dr. David Black of New Zealand is contributing much to the work of SC-4. Dr. Murphy reported the possible relevance of a workshop on pulsed effects to be held in Dresden, Germany on December 17-19, particularly regarding microdosimetry.

Dr. Peter Gajšek urged SC-4 to address possible synergistic effects and Drs. Goldberg and van Rongen suggested a more complete discussion of the determination of in-situ fields, i.e., internal exposure measures.

4.5 SC-5: Safety levels with respect to electro-explosive devices

Ron Petersen gave the report for Cochairman Drew Koban and John DeFrank (see [Attachment 5](#)). Murphy asked if SC-5 deals with hazardous RFI – Petersen said not per se but experts like Veronica Ivans helps ICES factor this subject into deliberations.

Dr. Halkiotis urged SC-5 to address hazards to flammable fuels and cited the relevant British standard on the subject.

Petersen reported that the draft Recommended Practice on safe distances from RF sources during blasting operations is in its 3rd final draft for a recirculation ballot. The recirculation ballot is expected to occur early in 2002.

The session closed with an open discussion on the rationale for the numbering of C95 documents, e.g., C95.6 for the 0-3 kHz Standard, C95.2 for the SC-2 work practices document, etc. Petersen explained that the IEEE assigns the numbers in sequence and retired numbers cannot be re-used.

5. Issues in ICES Standards-Setting (Dr. Eleanor Adair – Chairman)

5.1 One vs. two tiers:

Dr. C. K. Chou reviewed this topic borrowing heavily from a paper authored by Linda Erdreich and Deborah Sena (see [Attachment 6](#)). He expressed the view that a valid one-tier standard could be developed.

Dick Steinmetz commented on the differing views on “tiers” that leads to confusion. ICES uses “controlled” vs. “uncontrolled” environments with the latter having an extra safety factor – i.e. tightening of the limits. ICNIRP’98 has similar tiers but expressed in terms of “occupational” vs. “general public.” In the new draft SC-3 standard there is a primary MPE that is relaxed to provide a higher tier for certain situations that are occupational (similar to BGV-11). The discussion then drifted to how product standards can interface with exposure standards. Steinmetz emphasized the need for harmonized standards to ease global trade.

Bodemann agreed that the array of tiers could be complicated as in BGV11, where he could discern 4 tiers. Somebody voiced the opinion that public perception is better with the existing tiers. It was noted, however, that ICES and ICNIRP differ over the applicable frequency range for 2 tiers. McManus stated that it might be better to see one basic safety level with relaxation under certain circumstances.

5.2 Partial-body exposures:

Osepchuk reviewed the history of this subject in IEEE standards work with emphasis on the caveat on exposure of eyes and testes in the relaxation of MPEs for partial body exposure. No rationale was in the record for this but in the early nineties the only rationale was proffered by Richard Olsen, viz. that the averaging

times around 10-20 GHz were too high compared with the laser MPEs at infrared frequencies and would approach burn thresholds for short exposures, i.e., of the order of seconds. In the late nineties, after two AF workshops on the mm-wave/laser interface, K. Foster developed expressions for thermal time constants based on thermal modeling. The best-fit result was used to develop a two-step ramp, which lowered the time constant substantially around 10-20 GHz. The proposed ramp has been submitted to SC-4 for incorporation into the revision of C95.1-1991.

5.3 Non-thermal effects:

A long discussion was held on this subject. D'Andrea reported that experiments with eye exposure in the mm-wave range suggested some "eye resonance" phenomena. Osepchuk suggested that since the exposures were done in the very-near field, eye close to an open waveguide, possible artifacts must be examined, including the presence of temporal harmonics. Dr. Blick briefly reviewed the history of the controversial calcium efflux studies that are frequently used as an example of a non-thermal effect.

Considerable discussion took place over reports like the Hyland report and the rebuttal by COST 281. It was pointed out that Hyland is involved in the field of protective devices for mobile-phone users. McManus noted the COST 281 website:

www.COST281.org

5.4 Internal harmonization: ELF/RF (Presented Sunday AM)

Dr. Osepchuk presented a talk on "Internal harmonization: ELF/RF". He reported on intense discussions within ICES on how to match the low- and high-frequency standards, with a preference for 100 kHz as the transition region (instead of 3 kHz). He said that this is the long-range goal with significant technical and scientific problems, e.g., how to mathematically express averaging time around the transition region and how to write rules for "mixed" exposures, i.e., some low frequency and some high frequency exposures. He also reported that an important meeting of EXCOM representatives with IEEE-SA leaders would be held early in 2002 to review major issues like fund-raising.

5.5 Peak power limits (Presented Sunday AM)

Dr. Murphy then addressed the issue of peak-power limits (see [Attachment 7](#)). He said that his concern is about the great disparity between the ICES and ICNIRP peak limits noting that ICNIRP specifies a peak SA/pulse of 10/2 mJ/kg in the head. There is also the question of a ceiling limit on mm-wave power density. The ICNIRP position derives from a consideration that the microwave auditory effect is a hazard. The ICES limit on E field is 100 kV/m as compared with ~3000 kV/m for air breakdown.

Murphy then reported on some work at Brooks AFB that suggests a possible eye aversion effect. Averaging time formulas should be devised to prohibit exposures above the threshold for this effect. He said that ICNIRP allows spatial averaging over a 20 cm² area but limits the spatial peak to 20 times the averaged reference level.

6. Issues Related to World Harmonization of Standards (Dr. Tom McManus – Chairman)

Dr. McManus announced that before the panel discussion on this subject there would first be two presentations – one by Dr. Georges Goldberg on IEC/CENELEC and one by Dr. Ralf Bodemann on the Precautionary Principle.

Dr. Goldberg presented an extensive review of IEC and European standards relative to products with the aim of aiding the free trade of products. He discussed the coordination agreement between CENELEC and IEC TC106, where CENELEC would transfer ongoing work to IEC TC-106 if TC-106 has a similar project. He noted that CENELEC TC-211 has been renumbered as TC-106X. Some important features are CENELEC standards refer to ICNIRP – the IEC documents are more generic and do not refer to specific exposure criteria. It is expected that long rationales for exposure standards will be contained in documents like those of the IEEE/ICES. The EC has issued a strong recommendation that member states use the ICNIRP'98 Guidelines as a basis for their national regulations.

Dr. Goldberg listed classes of standards as:

- Generic standards
- Product family standards
- Product standards

He described the scope of the IEC TC-106 committee as the development of standards for the assessment of electric, magnetic and electromagnetic fields associated with human exposure. The TC106 working groups are:

- WG-1: Basic standards; low frequency
- WG-2: Product standards; low frequency
- WG-3: Basic standards; high frequency
- WG-4: Product standards; high frequency
- WG-5: Generic standards

He said that CENELEC TC-106X has a scope similar to IEC TC-106, i.e., the assessment of human exposure to EM fields, and noted that WG-2 of CENELEC TC-106X is chaired by Mr. Ian Brooker. TC-106X has developed several standards including EN 50360 on the assessment of SAR from mobile phones.

Dr. Bodemann related how the Precautionary Principle (PP) was developed, in particular for issues of possible catastrophic nature like global warming or the British mad-cow disease. He said that the EU/EC issued a recommendation on PP to clarify

when it should be applied. The following three conditions have been formulated by C. Shieble:

1. PP is justified if the potential hazard is catastrophic.
2. PP requires first a comprehensive risk assessment. Absence of scientific knowledge by itself does not justify PP – some science is needed.
3. PP is not justified in every case.

Criteria to be applied to PP:

1. Proportional
2. Nondiscriminatory
3. Consistent with similar applications of the PP
4. Capable of producing better scientific evidence for better risk assessment

Dr. McManus then convened the Panel – the first speaker was Richard Steinmetz. He stated that the concern of TABD (Transatlantic Business Dialogue) is how to deal with the differing EMF standards in the US and in the EU. He represents the US side of TABD and Dr. Ralf Bodemann represents the EU side.

Steinmetz said that there is a need for a globally-unified standard on EMF exposure. He looks to ICNIRP and ICES to work with each other towards this goal, but the TABD can't wait forever. They seek some certainty – the quicker the better. Another issue is the concern within the EU of differing exposure standards in member states, i.e., some states adopting limits more conservative than ICNIRP. He observed that ICES, when meeting with ICNIRP, should try to eliminate the confusion on the reasons for differences between the MPEs of the two organizations. Is it just a safety factor or are there more serious issues relative to uncertainties? Is it possible that ICES can compromise with ICNIRP? He also wondered if ICES could work more closely with WHO in their harmonization project.

Dr. Murphy gave a short history of how the IEEE (ICES) has been finally accepted in certain international dialogues. In 1995 there was opposition to allowing IEEE to speak at WHO meetings because of an alleged vested commercial interest. WHO accepted IEEE into its meetings in 1997. Later in China, WHO permitted IEEE to give a report and IEEE has been represented at the last three meetings.

Dr. Bodemann said that he has been working since the Munich meeting (2000) to improve the ICES strategy – e.g., by establishing contact with other organizations such as the IEC and CENELEC. He sees the principal problem as how to harmonize without losing our scientific convictions.

Dr. van Rongen expressed an eagerness to see improvements in all standards – he is not satisfied with the ICNIRP Guidelines. He feels the rationale in the document from the Health Council of the Netherlands is presented more clearly than in the ICNIRP document. He hopes the differences between ICES and ICNIRP will lead to a more critical and incisive review of the literature. In the end, he believes the essential differences between ICES and ICNIRP will be small compared with the

differences between these groups and the organizations in the former communist countries of Eastern Europe and China.

Dr. Goldberg again emphasized the difference between product standards and scientific standards – ICNIRP'98 is in the latter category. He said that IEEE standards are perceived as US documents. He expressed dismay that Switzerland, Italy and Belgium promote standards that are more conservative than the EU/EC recommendation.

Dr. Halkiotis pointed out that Italy did not adopt the EC recommendation because of pressure from the “greens.” He said that Dr. Vecchia believes this may change, however.

Dick Steinmetz reiterated that ICNIRP/ICES interaction is the highest priority. Problems in member states in Europe may lead to pressures for regulatory reform by the business communities. It was pointed out that NATO follows the ICES standard, but Dr. Goldberg believes the NATO standard is irrelevant (terrible) compared with the EU/EC low-voltage directive and the ETSI documents. Dr. Murphy reiterated the importance of the military as one of the prime users of equipment and devices associated with exposure to EM energy and the NATO countries apply the NATO standard during peacetime operations. In Italy there is the threat of shutdown of transmitters because of the very conservative limits promulgated by the government. There also is a dispute about standards in the US relative to a controversy on the PAVE PAWS radar in Massachusetts.

Dr. Murphy also reported that at recent WHO meetings he noted is some sign of movement in China towards the ICNIRP limits, perhaps first going to about ¼ of the ICNIRP MPEs. He said that there is no clear authority in Russia and the custom of hazard pay for those occupationally exposed to microwaves is an incentive to keep their low limits.

Dr. McManus reported that the EC would have a major meeting in June/July of 2002 to hear reports on how member states have responded to the EC recommendation on EMF. Then a WG will be set up to revise the EU/EC recommendation, perhaps waiting to see the anticipated WHO criteria document. ICNIRP has a strong voice in these groups. He noted that ICNIRP is meeting in Vancouver next summer and hoped that ICES could arrange a joint meeting there to discuss differences/harmonization. The EU will continue to utilize the ICNIRP documents.

Veli Santomaa proposed that ICNIRP adopt the low-frequency limits from ICES and ICES adopt the high frequency limits from ICNIRP. There was no voiced immediate support of this idea. Olin Giles, of the US, inquired of Dr. van Rongen on his assessment of the ICNIRP guidelines. He stated that the Health Council of the Netherlands carried out its own review of the literature and developed its own standard. One key feature is the limit of 50 W/m² in the Netherlands document vs. 10 W/m² in the ICNIRP document. It makes sense to him to have only one tier at 300 GHz. In the end, however, the Dutch government decided to harmonize with the ICNIRP guideline but also to pressure EU to have ICNIRP correct some deficiencies like this issue. They issued guidelines for RF in 1997 only and in 2000 guidelines for low frequency were issued. He said that there is uncertainty in The Netherlands

about how to deal with occupational vs. public exposures and now the mention of the PP clouds what may happen. Ian Brooker opined that CENELEC will follow EU/EC but some countries may apply the PP. Olin Giles reminded the group that, despite progress in scientific circles, the media battle is being lost.

Dr. Bodemann pointed out that harmonization has already occurred between SCC-34 and CENELEC – Goldberg said that IEC is key in these matters. Bodemann believes ICES should stay in contact with ICNIRP and CENELEC and make an effort to become known to government people in Europe – a self-marketing campaign is needed.

Dr. Murphy reminded all to participate in the WHO harmonization framework project and van Rongen emphasized the need for a strong scientific approach that can be used as an input to ICNIRP deliberations.

Dr. Murphy then reviewed upcoming meetings in Maastricht, Moscow, Rhodes, Thailand, St. Petersburg and southern China – plus the WHO meeting in Geneva in June 2002 (see [Attachment 8](#)).

Dr. Adair adjourned the meeting at the end of the afternoon.

Sunday, December 2, 2001 – Special ICES/SCC-28 Meeting

Dr. Adair convened the meeting at 9:30 A.M.

Dr. Bodeman presented a review of a recent SSK document on limit values and precautionary measures to protect the public against EM exposures. He said that the new chairman of SSK is an epidemiologist and that the German environmental ministry must approve the documents of SSK. The SSK has come up with three levels of concern on EM effects – (I) is merely indications of something, (S) is for suspicion based on some evidence, and (E) is for real concern based on hard evidence. The environmental ministry had leaned towards precautionary measures but the SSK report concludes:

- no evidence of invalidity of ICNIRP limits
- adequate for public exposures
- any precautionary measures would undercut limits for new technology

He said that SSK suspects that product standards already use up the leeway (i.e. budget) beneath limits and that SSK is concerned about hazardous RFI and effects on implants.

7. Issues Concerning Public Support of Standards (R. C. Petersen – Chairman)

Petersen opened the session with a few overheads that list some of the issues that go to credibility and acceptability of standards by the public (see [Attachment 9](#)).

7.1 Poor quality of the scientific literature

Dr. Adair reviewed the general scientific quality problem. Some of the causes are absence of peer review, shallow or incompetent peer review, poor scientific work and scientific misconduct.

Dr. D'Andrea addressed the review of specific literature in the field, as is being done within ICES. He reviewed basic assessment criteria, which was long ago stated by Sol Michaelson:

- effects are not equivalent to hazards, per se
- details of experiments must be reported to enable replication
- techniques must be adequate including sensitivity of sensors.
- one must guard against investigator bias
- controls must be appropriate

Intensity “windows” and similar concepts make science difficult to comprehend and accept as plausible vs. an interpretation of the data as merely random events. The hallmark of good science is replicability. D'Andrea reviewed the criteria used in the ICES literature review. He pointed out that old papers should not be discarded, since some of them stand the test of time.

7.2 Media issues: Effects of recent terrorism events:

Osephchuk reviewed the recent media coverage in the US of wireless phones. Since 9-11, it has been mostly positive emphasizing the need for increased reliability of wireless phones because of terrorism threats and emergencies, in general. Now people may approach limits for weapons detectors using magnetic fields emphasizing reliability and not extra precautions against possible (“might” type) hazards.

He also reported on recent work in NIOSH to utilize devices that expose workers to EM fields to prevent deaths and injuries from electrocution and contact with mechanical chipper/shredder equipment. Clearly more perceived risk of EM exposure is well justified by saving of lives.

He concluded by comparing philosophically two types of perceived events or hazards – those that “could” occur like the terrorism attack, which has actually occurred, and those that “might” occur if the speculations of some scientist are correct. He gave as an example of the latter speculations that “steep wavefronts” are dangerous as in the PAVE PAWS radar. It is important to distinguish between these two classes of “possibilities”.

8. Impact and Implications of ERA Meeting

Approved ICES Meeting Minutes – December 2001 Meeting

The ERA meeting held on November 30th was discussed briefly (see [Attachment 10](#) for program – in French). The overall conclusion was that it was more of a policy meeting with little scientific substance. Both Dr. Adair's and Richard Steinmetz's presentations at the ERA meeting provided good publicity for ICES.

There being no further business the meeting was adjourned by Chairman Adair at 1230 h.

Attachments

**ICES Meeting
Novotel Hotel
6, rue du Fort Niedergrunewald
BP 512
2015, Luxembourg
December 1-2, 2001**

1. Tentative Agenda
2. List of Attendees
3. SC-1 Report
4. SC-4 Report
5. SC-5 Report
6. One vs Two Tiers
7. Peak Power Issues
8. Upcoming Meetings
9. Standards – Public Credibility Issues
10. Program of the ERA Conference



INTERNATIONAL
COMMITTEE *on*
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ATTACHMENT 1

ICES Meeting — Tentative Agenda

**Novotel Hotel
6, rue du Fort Niedergrunewald
BP 512
2015, LUXEMBOURG
December 1-2, 2001**

All meeting rooms will be at the Novotel Hotel – the meeting room will be announced later.

0900-1030 h

1. Welcome and Introductory Remarks (Adair)
2. Personal Introductions
3. Ulf Bergqvist – an Appreciation (McManus)
4. The ICES Subcommittees, Their Work Programs and Issues Addressed (Murphy – Chair)
 - 4.1 SC-1 Techniques, procedures and hazard instrumentation (Petersen)
 - 4.2 SC-2 Terminology, measurements, and hazard communication (Osepchuk)
 - 4.3 SC-3 Human exposures in the 0 - 3 kHz frequency range (Ivans)
 - 4.4 SC-4 Human exposures in the 3 kHz – 300 GHz frequency range (C-K Chou)
 - 4.5 SC-5 Safety with respect to electro-explosive devices (Petersen)

1030-1045 h – Coffee Break

5. Issues on ICES Standards-Setting (Adair – Chair)
 - 5.1 One vs two tiers (C-K Chou)
 - 5.2 Partial body exposures (Osepchuk)
 - 5.3 Non-thermal effects? (Blick)
 - 5.4 Internal harmonization: ELF/RF (Osepchuk)
 - 5.5 Peak power limits (Murphy)

1230-1430 h – Lunch

5. Panel: Issues Related to World Harmonization of Standards (McManus – Moderator; Bodemann, van Rongen, Murphy, Goldberg, Steinmetz)

1600-1615 h – Coffee Break

- 7. Issues Concerning Public Support of Standards**
- 7.1 Poor quality of the scientific literature**
- 7.2 Media issues: Effects of recent terrorist events**
- 7.3 Precautionary principle**

(Petersen – Chair)
(Adair, D’Andrea)
(Osepchuk)
(Anderson?)

1730 h – Meeting Close

Sunday, 2 December 2001 0915 - 1230 h

- 8. Special ICES/SCC28 Meeting**
- 9. Impact and Implications of ERA Meeting**

1230 - 1430 h Lunch

1500 h ICES ExCom Meeting

ATTACHMENT 2

Attendance List

IEEE SCC-28 Meeting

Novotel Hotel
6, rue du Fort Niedergrunewald
BP 512
2015, Luxembourg
December 1-2, 2001

| | Last Name | First Name | Affiliation | Country | E-mail Address |
|-----|--------------|--------------|---------------------------------|---------|-------------------------------|
| 1. | Adair | Eleanor | Independent Consultant | US | eleanor.adair@ieee.org |
| 2. | Blick | Dennis | AFRL/HEDR | US | dennis.blick@brooks.af.mil |
| 3. | Bodemann | Ralf | Siemens | DE | ralf.bodemann@mchp.siemens.de |
| 4. | Brooker | Ian | Sensormatic | IE | ibrooker@tycoint.com |
| 5. | Chou | C.K. | Motorola | US | ck.chou@motorola.com |
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| 7. | D'Andrea | John | Naval Health Res Cntr | US | john.daandrea@brooks.ak.mil |
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| 10. | Gajšek | Peter | Institute of Public Health | SI | peter.gajsek@ivz-rs.si |
| 11. | Giles | Olin | Independent Consultant | US | o_giles@rtmc.net |
| 12. | Goldberg | Georges | Independment Consultant | CH | gegegezurich@swissonline.ch |
| 13. | Werner | Helmut | European Parliament | LX? | hwerner@europarl.eu.int |
| 14. | Ivans | Veronica | Medtronics | US | veronica.ivans@medtronics.com |
| 15. | Halkiotis | Konstantinos | Cosmote Mobile Comm. | GR | kchalkiot@cosmote.gr |
| 16. | Llanos | Carlos | Red Electrica de España | ES | cllanos@ree.es |
| 17. | Marinko | Janez | Swedish Work Env Authority | SE | janez.marinko@au.se |
| 18. | McManus | Tom | Dept of Public Enterprise | IE | Tommcmamus@dpe.ie |
| 19. | Murphy | Michael | USAF/AFRL | US | michael.murphy@brooks.af.mil |
| 20. | Osepchuk | John | Full Spectrum Consulting | US | jmosepchuk@cs.com |
| 21. | Petersen | Ron | Independent Consultant | US | r.c.petersen@ieee.org |
| 22. | Santomaa | Veli | Independent Consultant | FI | veli.santomaa@kolumbus.fi |
| 23. | Steinmetz | Dick | Rockwell Automation | US | rcsteinmetz@ra.rockwell.com |
| 24. | van Rongen | Eric | Hlth Council of the Netherlands | NL | e.van.rongen@gr.nl |

Parent Committee

Scientific/Technical Subcommittees

SC-1 Measurements/Computations

SC-2 Warning Symbols/Hazard Comm.

SC-3 Safety Levels 0 - 3 kHz

SC-4 Safety Levels 3 kHz - 300 GHz

SC-5 Electroexplosive Devices

Administrative Subcommittees

Executive Committee

Membership

International Liaison

Interpretations



ICES Subcommittee Activities: SC-1

Title of Subcommittee:

Techniques, Procedures, Instrumentation and Computation

Scope of Subcommittee:

Provide recommendations for the preferred methods for measuring and computing external radiofrequency electromagnetic fields to which persons may be exposed and for measurement and computation of the resulting fields and currents that are induced in bodies of humans exposed to these fields over the frequency range of 100 kHz to 300 GHz.

ICES Subcommittee Activities: SC-1

Publications:

The following standards, recommended practices and guides were developed by SC-1:

- American National Standard Techniques and Instrumentation for the Measurement of Potentially Hazardous Electromagnetic Radiation at Microwave Frequencies, ANSI C95.3-1973
- American National Standard Recommended Practice for the Measurement of Hazardous Electromagnetic Fields - RF and Microwave, ANSI C95.5-1981

ICES Subcommittee Activities: SC-1

Publications (Continued)

- IEEE Recommended Practice for the Measurement of Potentially Hazardous Electromagnetic Fields - RF and Microwave, IEEE C95.3-1991
- IEEE Guide for the Measurement of Quasi-Static Magnetic and Electric Fields, IEEE P1460-1996
- IEEE Recommended Practice for Measurements and Computations with Respect to Human Exposure to Radio Frequency Electromagnetic Fields, 100 kHz to 300 GHz, IEEE C95.3-200X (**In Ballot**)

IEEE C95.3-200X

Title: IEEE Recommended Practice for Measurements and Computations with Respect to Human Exposure to Radio Frequency Electromagnetic Fields, 100 kHz to 300 GHz, IEEE C95.3-200X

Scope: Provide information on the application of new instruments, measurement techniques, and sophisticated computational methods that have become available since the publication of IEEE Std C95.3-1991. Recommend techniques to ascertain compliance with the provisions of IEEE C95.1

IEEE C95.3-200X - Outline

1. Scope and Purpose

2. Definitions

3. Measurement Problems

- Discusses parameters determined by the source, secondary radiators, time and spatial averaging, instrument limitations, interference, SAR measurement issues and limitations, induced current measurement and limitations



IEEE C95.3-200X - Outline

4. Instrumentation

- Discusses near-field instrument types and performance, electrical and physical requirements, shaped frequency response, personal monitors, calibration methods, practical measurement accuracy, instruments for measuring induced current, implantible E-field and temperature probes

IEEE C95.3-200X - Outline

5. Measurement of Potentially Hazardous Exposure Fields
- Discusses source and propagation characteristics, estimates of expected field strength, determination of type of instrument required, safety precautions, measurement procedures (near-field, far-field, etc.), procedures for measuring induced and contact current, SAR measurement, estimation of SAR from external exposure-field measurement data

IEEE C95.3-200X - Outline

6. Theoretical Calculations

- Discusses factors affecting the internal fields, low-frequency internal fields, methods of calculation (FDTD, GMT, impedance method, etc.), considerations for estimating RF coupling and SAR associated with reactive near-field exposure

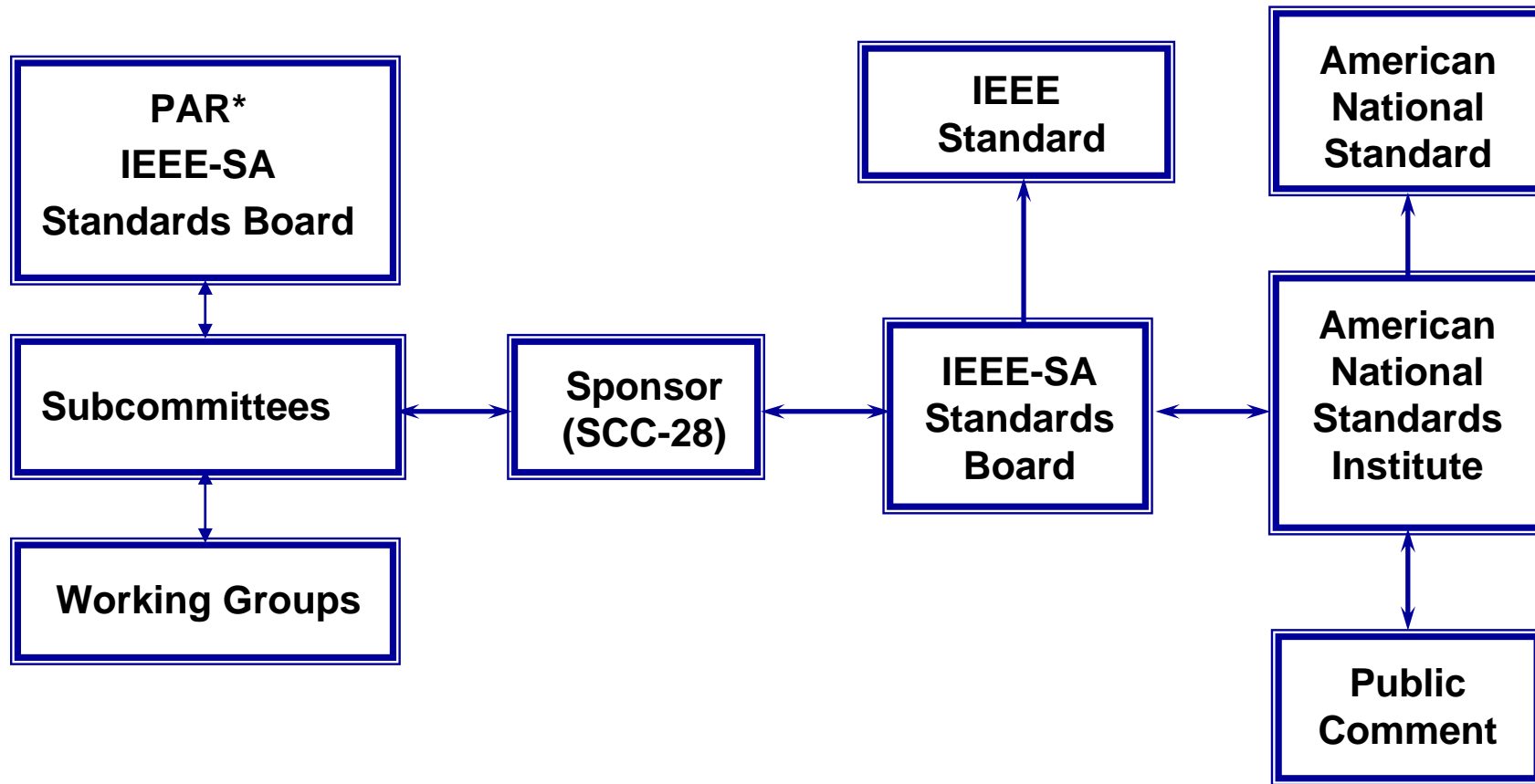
IEEE C95.3-200X - Outline

Annexes (A - G)

- Discuss instrument calibration techniques, source characteristics (antennas), thermography, body current measurement, fabrication of simulated tissues, finite difference time domain (FDTD) method, peak spatial-average SAR (averaging volume, spatial averaging in thin regions of the body, e.g., fingers, the pinna), peak spatial average SAR in the body and in the extremities



ICES Standard-Setting Process



*Project Authorization Request

International Committee on Electromagnetic Safety
IEEE Standards Coordinating Committee 28



IEEE Sponsor Balloting Requirements

Approval of an IEEE Standard Requires: *

- balance of interests on committees
- 75% return of ballots (including abstentions)
- approval of 75% of returned ballots (excluding abstentions)
- attempts made to reconcile all negative ballots
- circulation of non-reconciled ballots to allow voters to reaffirm, comment or change their vote
- coordination with other societies and organizations

* Also required by ICES at subcommittee level

IEEE C95.3-200X - Status

- Draft (150+ pages) unanimously approved by SC-1 after 1 recirculation (June 2001)
- Draft edited to conform with new *IEEE Style Manual* (October 2001)
- Draft sent to IEEE SC14 for editorial review (October 2001)
- Invitations to ballot sent (December 2001)
- Balloting Group will be notified of posting of draft and ballot (January 2002)
- Ballot closes (February 2002)
- If negative ballots are not received, draft will be sent to IEEE RevCom for consideration at the June 2002 Standards Board Meeting

ICES Subcommittee 1 - Future Activities

An SC-1 working group will be established to develop a recommended practice for the measurement of low-frequency (0-100 kHz) electric and magnetic fields and induced currents

Revision of RF Safety Standard IEEE C95.1 -1991

Institute of Electrical and Electronics Engineers
International Committee on Electromagnetic Safety
Standards Coordinating Committee 28
Subcommittee 4

IEEE SCC-28 International Committee

Australia

Bulgaria

Canada

China

Finland

Germany

Hungary

Ireland

Israel

Italy

Japan

Netherlands

New Zealand

Poland

Russia

South Africa

Sweden

Switzerland

United Kingdom

United States

IEEE Standard for Safety Levels with Respect to Human Exposure to Radio Frequency Electromagnetic Fields, 3 kHz to 300 GHz, C95.1

Membership: Affiliations - SCC28/SC4 (2000)

| | | |
|---|-------------------|----------------------|
| Research: | 65 | (45%) |
| ▪ university | 24 | (17%) |
| ▪ nonprofit | 7 | (5%) |
| ▪ military | 21 | (14%) |
| ▪ non-military government | 13 | (9%) |
| Industry | 33 | (23%) |
| Industry - Consulting | 8 | (6%) |
| Government - Administration | 18 | (12%) |
| General Public & Independent Consultants | 20 | (14%) |
| <u>Total</u> | <u>144</u> | <u>(100%)</u> |

IEEE SCC28/SC4

- **Governmental Agencies (USA)**
- **Federal Communication Commission (FCC)**
- **National Institute for Occupational Safety and Health**
- **Food and Drug Administration/Center for Devices and Radiological Health (FDA/CDRH)**
- **Occupational Safety and Health and Administration**
- **National Institute for Environmental Health Sciences**
- **Department of Defense**
- **Department of Transportation**
- **Department of Commerce**
- **Environmental Protection Agency (EPA) (limited participation)**

IEEE SCC28/SC4

Governmental Agencies (International)

- Health Canada
- National Radiation Protection Board, Department of Health, Ministry of Defense (UK)
- Health Council (Netherlands)
- Institute for Radiation Hygiene (Germany)
- Department of Public Enterprise (Ireland)
- Radiation and Nuclear Safety Authority (Finland)
- Federal Office for Communications, National Institute of Occupational Health, Radiation Protection Institute (Sweden)
- National Institute of Public Health (Japan)
- Institute of Occupational and Environmental Medicine (New Zealand)
- World Health Organization

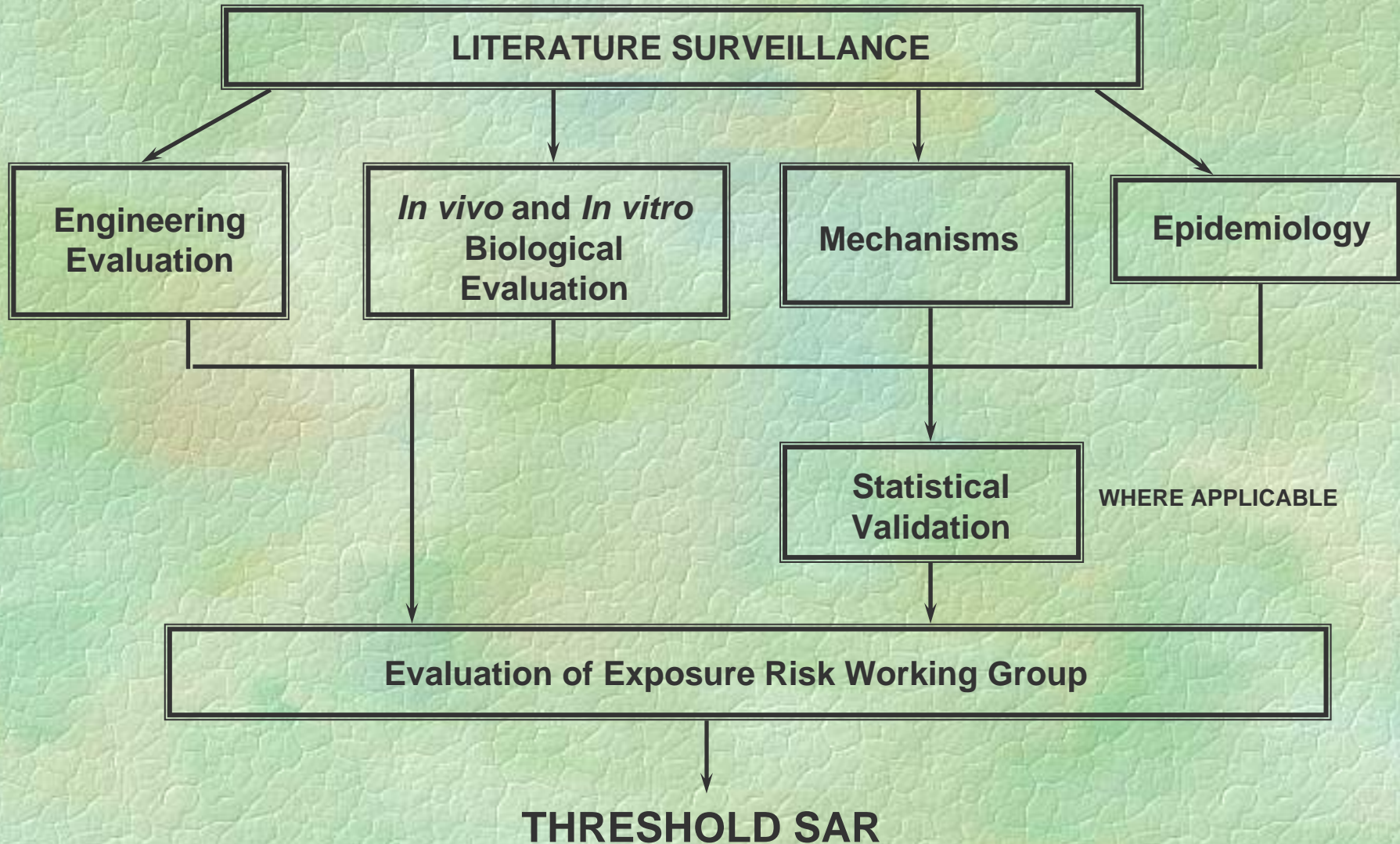
History of RF/Microwave Exposure Standards in the US (ANSI/IEEE)

- 1953 10 mW/cm² recommended to the US Navy
- 1959 USASI C95 Committee/Project chartered
- 1966 ANSI C95.1-1966 approved
- 1974 ANSI C95.1-1974 approved
- 1982 ANSI C95.1-1982 approved
- 1988 ASC (ANSI) C95 Committee becomes IEEE SCC-28
- 1991 IEEE C95.1-1991 approved
- 1992 ANSI adopted C95.1-1991
- 1999 IEEE C95.1-1999 Edition
- 2000 Developing a new standard

Revision of ANSI/IEEE C95.1-1992

- The exposure limits in C95.1-1991 were based mainly on scientific information published before 1986
- A few revisions of definitions and technical details were incorporated in the standard, and a new edition was published in April 1999
- It is time for a full revision.

IEEE SCC-28 - Subcommittee 4 Literature Evaluation Process



Database (started in 1991)

- Peer reviewed articles (majority)
- Reports
- Book chapters
- Published letters
- Total 1550 references (version 24)
- <http://grouper.ieee.org/groups/scc28/>

Literature Evaluation Working Groups

- In Vitro
- In Vivo
- Epidemiology
- Engineering

Review Priority Topics

- mutation
- cancer
- teratogenesis and reproductive effects
- effects on sensory organs, neurological system and behavior
- effects on immune, hematopoietic, cardiovascular or glandular system
- All other in vivo physiological effects or in vitro bioeffects

Literature Evaluation Process

- Working Group Chairs send papers to two randomly selected reviewers from the group
- The reviewers score the papers 1 to 5
- If two scores differ by more than 2, the paper is sent to a third reviewer
- Average Score higher than 3 is considered acceptable

Risk Assessment Working Group

- Determines action guidelines based on
 - tissue and body heating
 - induced and contact currents
 - non-thermal biological interactionscan be related to **adverse** human health effects
- Set Maximum Permissible Exposure limits
- How does uncertainty inherent in our present knowledge base influence the soon to be revised exposure limits?

Mechanism Working Group

- works in parallel with the RAWG
- evaluates possible mechanisms of interaction between electromagnetic fields and biological entities
- determines whether there is any scientific basis for reports of the existence of effects at levels well below the lowest threshold SAR
- develops guidelines for the use of mechanisms in setting quantitative standards
- identifies mechanisms of interaction
- evaluates their impact on standards

Editorial Committee

- 15 members with 5 members each from academia, government, and industry
- will work with the RAWG and MWG, and take recommendations from the Revision Working Group and SC4 members to complete the revision task

General Outline for Revision of C95.1-1999

NORMATIVE SECTIONS OF STANDARD

- **Introduction**
- **Participants**
- **Contents**
 - 1. Overview**
 - 1.1 Scope**
 - 1.2 Purpose**
 - 2. References**
 - 3. Definitions**
 - 4. Recommendations**
 - 4.1 Maximum permissible exposure (MPE) limit**
 - 4.2 Exclusions**
 - 4.3 Measurements**
 - 4.4 Relaxation of MPE limits for partial body exposures**

White papers to form the basis for the standard

- Cancer [Heynick, Meltz]
- Organ toxicity [Black, Elder]
- Teratogenesis [Heynick]
- CNS effects [D'Andrea]
- Adverse effects on physiological functions [Adair, Black]
- Thermoregulation [Adair]
- Behavior [D'Andrea, DeLorge]
- Longevity [Elder]
- Low level effects [Hynick]
- One vs. two tier [Erdriech]

General Outline for Revision of C95.1-1999

INFORMATIVE SECTIONS OF STANDARD

- Annex A: Approach to standard revision
- Annex B: Selecting an adverse effect - summary of the literature evaluation results
- Annex C: Explanation of maximum permissible exposure limits
- Annex D: Technical similarities and differences of this standard and other protection guides
- Annex E: Tables and Figures
- Annex F: Papers subjected to review
- Annex G: Papers identified as applicable to the development of the standard
- Annex H: Examples of application of the standard

Topics under discussion by SC4:

- a) Spark discharge and induced current
- b) Thermoregulation
- c) Non-thermal effects
- d) Selection of an Adverse Effect Level
- e) Whole body SAR limit
- f) Biological Basis for Local SAR Limit
- g) Spatial averaging, averaging volume
- h) Single vs. two tier
- i) Peak power limits
- j) Low power device exclusion, measurement distance
- k) Averaging time 6 GHz to 300 GHz
- l) Replication/Validation
 - **Harmonization with ICNIRP**

1st Revision Working Group Meeting

March 30-31, 2000

Fort Lauderdale, Florida

2nd Revision Working Group Meeting

September 7-8, 2000

Washington DC

3rd Revision Working Group Meeting

March 1-2, 2001

Scottsdale, Arizona

Revision Working Group Telephone Conference

November 9, 2001

Discussed basics of RF standard setting

Telephone conference summary (1)

- 1) The IEEE RF safety standard should be science based. Socio-political considerations should be considered via a separate process.
- 2) The safety standard should be derived from peer-reviewed publications.
- 3) Both MPE and SAR limits of RF safety standard should be based on established adverse health effects as summarized in the white papers.
- 4) All uncertainties should be included in the safety factor.
- 5) The applicable safety factor is to be decided upon later in consideration of whether a value smaller than 10 is warranted because there are more and better data from human beings and chronically exposed animals than were available for the 1986 database, or if a value higher than 10 is advisable because the data indicated more uncertainty than before.
- 6) Non-thermal effects, except nerve stimulation, have not been established (no independently repeatable non-thermal effect) and none of them are proven adverse to health.

Telephone conference summary (2)

- 7) All agreed that in the RF range the thermal-based effects are the only established adverse effects directly related to an electromagnetic field.
- 8) SAR should still be the basic quantity defining restrictions, not temperature.
- 9) The microwave hearing effect is not adverse to health.
- 10) Microwave hearing should not be used for setting limits for pulsed fields.
- 11) Synergistic action with other factors, such as environmental conditions, drugs, etc. should be considered as long as they are in peer-reviewed publications, but most of these will be incorporated in the safety factor.
- 12) The working group agreed to propose a standard that can protect all members of the population, including children, the sick and the elderly. Time averaging and a safety program (being developed by SC2 and to be included in this standard) will allow occupational group exposures to higher level fields for a shorter time.

Telephone conference summary (3)

- 13) Damage to the most sensitive tissue will be used to set the local SAR limit.
- 14) In favor of using 10 g average instead of 1 g.
- 15) The MPE level in the first draft standard needs some fine tuning.
- 16) The 10 W/kg peak SAR limit caused concerns. After extended discussion, no evidence was offered to show that 10 W/kg averaged over 10 g, which is the occupational exposure limit of ICNIRP, is adverse. The local SAR limit should be set based on health effects.
- 17) The 14 issues raised by the Federal Government RF Interagency Working Group will be covered in the revision.
- 18) SCC28 Chair will write to EPA to invite their participation. The question was raised of treatment of exposures to children and possible safety considerations based on for active neurological development throughout childhood. Harmonization with ICNIRP was discussed.

SCC28/SC4 Future Meetings

- **4th Revision Working Group meeting**
January 10-11, 2002 at Fort Lauderdale, Florida
- **SCC28/SC4 meeting**
January 19, 2002 at San Antonio, Texas
- **5th Revision Working Group meeting**
To be determined
- **SCC28/SC4 meeting**
June 21-22, 2002 at Quebec, Canada

SCC28/SC4 Goal

A draft for
SC4 discussion
in June 2002

IEEE SCC28/SC4

Please Participate

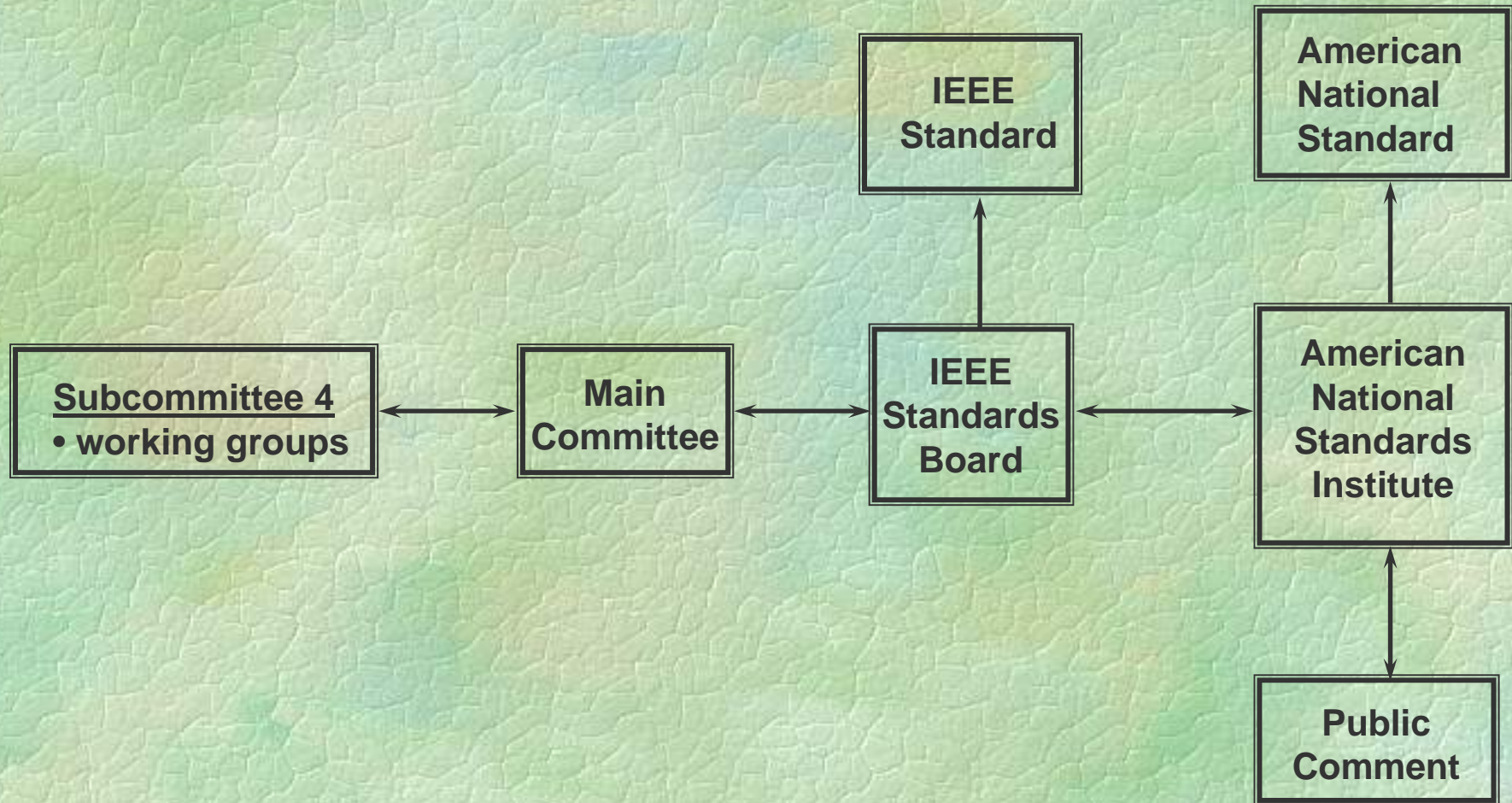
SCC28 Subcommittees

- **SC-1 Techniques, Procedures, and Instrumentation**
- **SC-2 Terminology and Units of Measurements**
- **SC-3 Safety Levels w.r.t. Human Exposure,
0-3 kHz**
- **SC-4 Safety Levels w.r.t. Human Exposure,
3 kHz-300 GHz**
- **SC-5 Safety Levels w.r.t Electro-Explosive Devices**

IEEE SCC-28 Procedures

- **Approval of an IEEE Standard Requires:***
- **balance of interests on committees**
- **75% return of ballots (including abstentions)**
- **approval of 75% of returned ballots (excluding abstentions)**
- **attempts made to reconcile all negative ballots**
- **circulation of unreconciled ballots to allow voters to reaffirm, comment or change their vote**
- **coordination with other societies and organizations**
- ***Required at the subcommittee level *and* at the main committee level**

IEEE SCC28 Standard-Setting Process



1st Revision Working Group Meeting

- March 30-31, 2000 in Fort Lauderdale, Florida
 - 19 attendees (no representatives from regulatory agencies)
 - adopted the normative and informative outlines
 - refined the objective of presenting unified limits applicable for particular frequencies based on electrostimulation effects below 100 kHz (with possible extensions for pulsed fields up to 3 MHz), whole-body and partial-body thermal and/or other effects (100 kHz to 6 GHz), and surface heating above 6 GHz.
 - Any other bases for a revision of the exposure criteria must be identified by the RAWG and its relation to human health assessed
 - A single tier approach was favored.

2nd Revision Working Group Meeting

September 7-8, 2000 in Washington DC

- 35 attendees including representatives from FDA, FCC, NIOSH, OSHA, and NTIA
- A Literature Review Task Group was formed. 556 Important papers of in vitro, in vivo and epidemiology were selected from the 1426 references. The task group will organize the literature review by topic, exposure parameters and scores before the March 2001 meeting.
- Since there is support in the scientific literature reviewed to date for adverse effects related to electrostimulation and thermal mechanisms, as a working hypothesis SC4 should draft a standard based on these mechanisms, while continuing to evaluate the literature on other effects.
- Reaffirmed the objective of presenting unified limits. Protection against RF burns from spark discharges will be included in the revised standard.
- The number of tiers in the standard is still under discussion. A task group is preparing a draft white paper to be completed and distributed to SC4 by November 10, 2000.

ICES Subcommittee Activities: SC-5

ATTACHMENT 5

Title of Subcommittee:

Safety Levels with Respect to Electro-Explosive Devices

Scope of Committee:

To provide methods 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.

ICES Subcommittee Activities: SC-5

Publications:

The following recommended practices and guides were developed by SC-5:

- American National Standard Safety Guide for the Prevention of Radio-Frequency Radiation Hazards in the Use of Electric Blasting Caps, ANSI C95.4-1978
- IEEE Recommended Practice for Determining Safe Distances From Radio Frequency Transmitting Antennas When Using Electric Blasting Caps During Explosive Operations, IEEE C95.4-200X (**In Ballot**)

IEEE C95.4-200X

Title: IEEE Recommended Practice for Determining Safe Distances From Radio Frequency Transmitting Antennas When Using Electric Blasting Caps During Explosive Operations, IEEE C95.4-200X

Scope: To provide develop 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.



IEEE C95.4-200X - Outline

1. Overview
 - Scope
 - Responsibility for Safety
2. References
3. Definitions

IEEE C95.4-200X - Outline

4. General

- Hazard Zones
- Contributing Factors
- Hazard Level
- Measurements

5. Safety Precautions when Using Blasting caps



IEEE C95.4-200X - Outline

6. Practical Hazards Identification and Elimination

- Hazard Origin
- Hazard Levels
- Assessment of Hazard Levels
- Safety in Transit
- Safe Distances
 - Assumptions
 - Tables of Recommended Distances
- Basic Area Hazard Assessment

IEEE C95.4-200X - Outline

7. Electromagnetic Radiated Fields

- Nature of the Radiation Field
- Hazard from Multiple Frequency Superposed Fields

8. Extraction of Energy from the Radiated Field

- General
- Antenna Characteristics of Electric Blasting Wiring
- Antenna Models (of Blasting Wires)



IEEE C95.4-200X - Status

- Draft (35 pages) unanimously approved by SC-5 and submitted to IEEE for ballot by main committee (February 2000)
- Three negative ballots received
- Negative ballots resolved - Revised draft recirculated to main committee (April 2001)

IEEE Sponsor Balloting Requirements

Approval of an IEEE Standard Requires: *

- balance of interests on committees
- 75% return of ballots (including abstentions)
- approval of 75% of returned ballots (excluding abstentions)
- attempts made to reconcile all negative ballots
- circulation of non-reconciled ballots to allow voters to reaffirm, comment or change their vote
- coordination with other societies and organizations

* Also required by ICES at the subcommittee level

IEEE C95.4-200X - Status

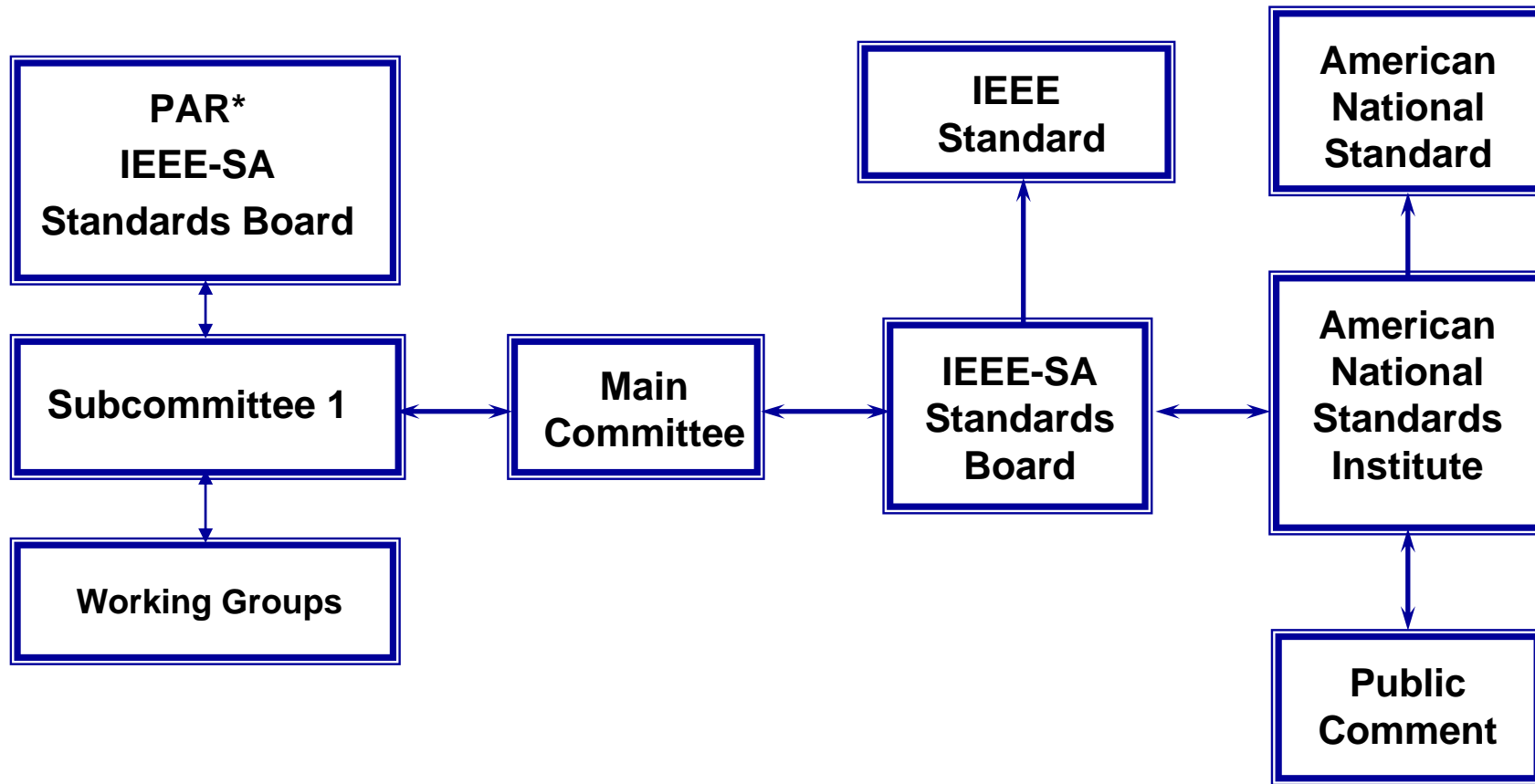
- 1st recirculation closed (May 2001) - Substantive comments received from coordinating organization (no negative ballots)
- Comments addressed - Revised draft recirculated to main committee (October 2001)
- 2nd recirculation closed (November 2001)
- Further comments received from coordinating organization and IEEE Editorial Review Committee (no negative ballots)



IEEE C95.4-200X - Status

- Comments being resolved - draft being revised.
- 3rd (final) recirculation (**January 2002**). Draft should be sent to IEEE RevCom for consideration at the June 2002 Standards Board Meeting

ICES Standard-Setting Process



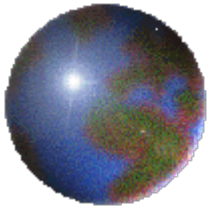
*Project Authorization Request

International Committee on Electromagnetic Safety
IEEE Standards Coordinating Committee 28



One Tier or Two Tiers?

Scientific and Practical Issues



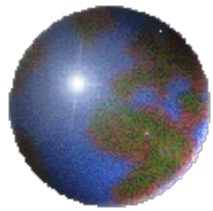
Prepared by

Linda S. Erdreich

Deborah Sena

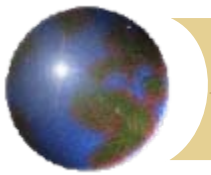
Presented at IEEE SC4 meeting in St. Paul, MN

June 2001



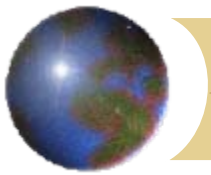
Working toward Consensus

This “white paper” reflects information shared among members of SC4 through interesting discussions, over several years. This report is designed to reflect those thoughtful contributions.



Standards in General – One tier or two?

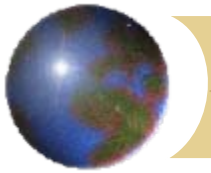
- Many standards for the general public are one tier
 - To protect all, the 'general population', lifelong exposure
 - e.g., drinking water concentrations; ambient air
Health Canada WHO/IPCS, USEPA
- Many standards for workers are one tier
 - To protect nearly all workers from adverse effect
 - Examples: Threshold Limit Values, Occupational Exposure Limits; OSHA



Practical Issues

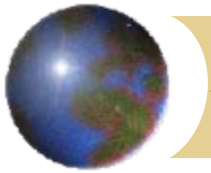
- Different exposure guidance for workers and the general public is common practice, and accepted
- Most RF standards are two-tiered - NRPB is one tier for whole body exposure, two-tiered for contact currents

NOTE: Two sets of exposure guidance exist for many agents. These are determined by different authorities, in different 'standards' [e.g., inhaled chemicals, noise]



Scientific validity - one tier

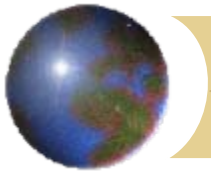
- A valid one- tiered standard can be developed. It needs to:
 - ▣ Identify the population it is designed to protect
 - ▣ Consider the possibility of a range of response values (i.e., inter-individual variability, range of sensitivity)
 - ▣ Protect 'nearly everyone' (95, 99 % ?) in the defined population, under the defined circumstances of exposure



Drawbacks of One Tier for RF

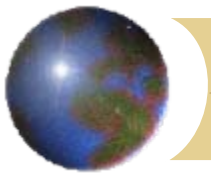
Impractical for covering both work situations, and protecting 'nearly everyone'

- May not provide options for working in areas where levels are higher
- Or, may not protect people who have decreased ability to adapt to an increased heat load include old age, obesity, and hypertension ...and various drugs
- Precedent (common practice) is two tiers



Is there a need for Two Standards or Two Tiers in the Standard?

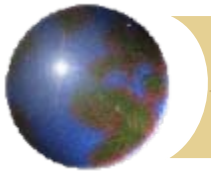
- General public exposure may be more uniform, on average, than worker
- Higher levels may occur in the work environment, including areas where workers function
- To work safely in these areas requires administrative controls



Moving toward Consensus.

The standard(s) should.....

- provide guidance under most reasonable exposure scenarios
- specify who is being protected, and for what duration of exposure (e.g., lifelong, regular exposure, limited access environment)
- communicate clearly to the non-scientist, and avoid using words that can be misinterpreted
e.g., uncontrolled



Revision Working Group approach

The working group agreed to propose a standard that can protect all members of the population, including children, the sick and the elderly. Time averaging and a safety program (being developed by SC2 and to be included in this standard) will allow occupational group exposures to higher level fields for a shorter time.

Discussion on Peak Power Limits

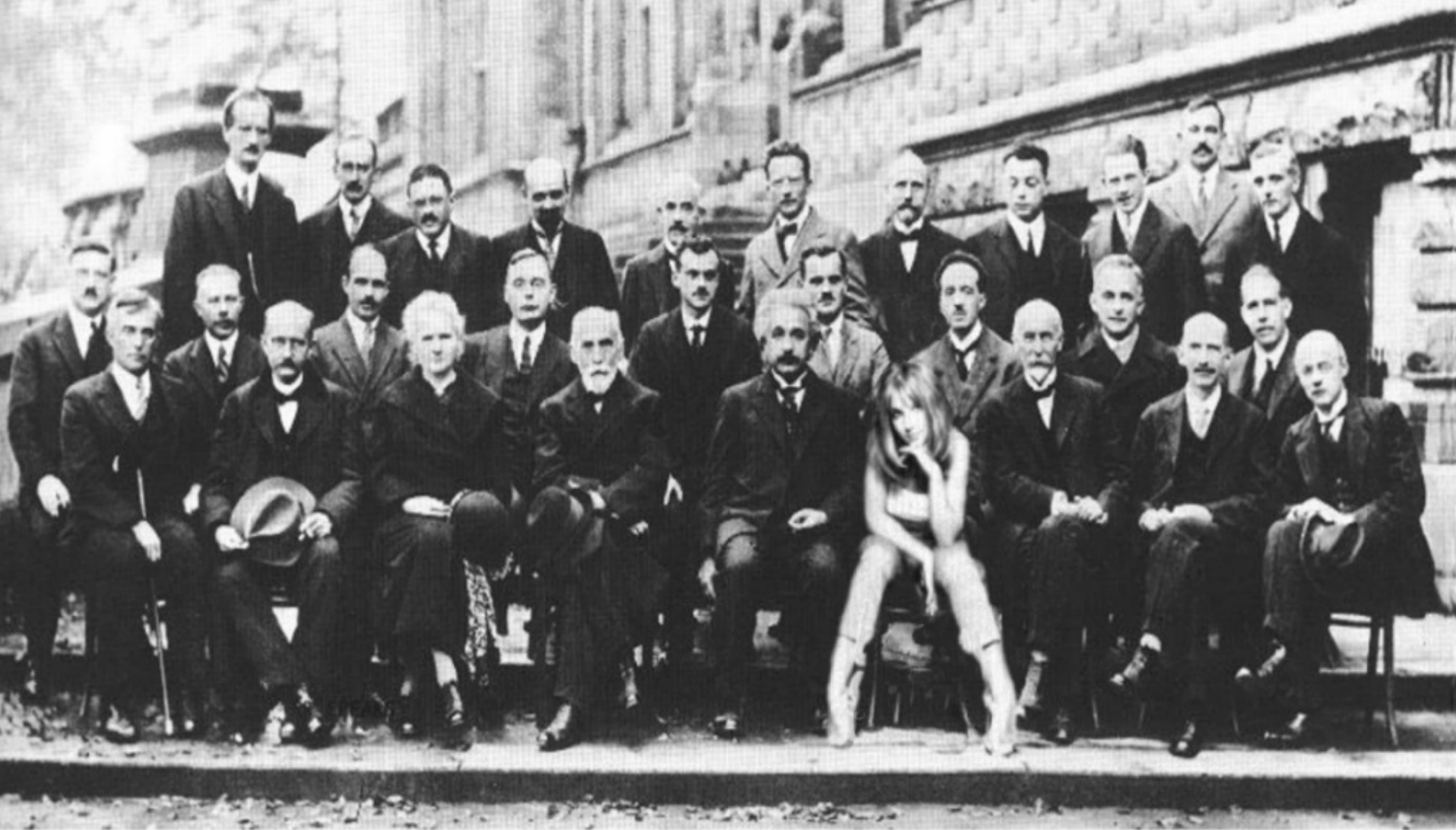
1-2 Dec 2001 – Luxembourg

ICES 2001



Michael R. Murphy, PhD
Chief, RFR Branch
Human Effectiveness Directorate
Air Force Research Laboratory

Peak Limits?



A. PICCARD E. HENRIOT P. EHRENFEST Ed. HERZEN Th. DE DONDER E. SCHRÖDINGER É. VERSCHAFFELT W. PAULI W. HEISENBERG R.H. FOWLER L. BRILLOUIN
P. DEBYE M. KNILSEN W.L. BRAGG H.A. KRAMERS P.A.M. DIRAC A.H. COMPTON L. de BROGLIE M. BORN N. BOHR
I. LANGMUIR M. PLANCK Mme CURIE H.A. LORENTZ A. EINSTEIN B. SPEARS Ch.E. GUYE C.T.R. WILSON O.W. RICHARDSON



Peak Power Limits (microwaves & millimeter waves)



- **Peak SA per Pulse**

- IEEE: 144 J/kg for pulses > 500 ms; based on .4 & .08 W/kg
28.8 J/kg for pulses < 100 ms; limit energy in short pulses
- ICNIRP: 10/2 mJ/kg worker/public to prevent MW hearing
 - head only; averaged over 10 g tissue

- **Peak e- field for pulses**

- IEEE: 100 kV/m (2.65 kW/cm²)
- ICNIRP: none specified in basic restrictions

- **Peak Power Density or Energy Density for mmWaves – needed?**

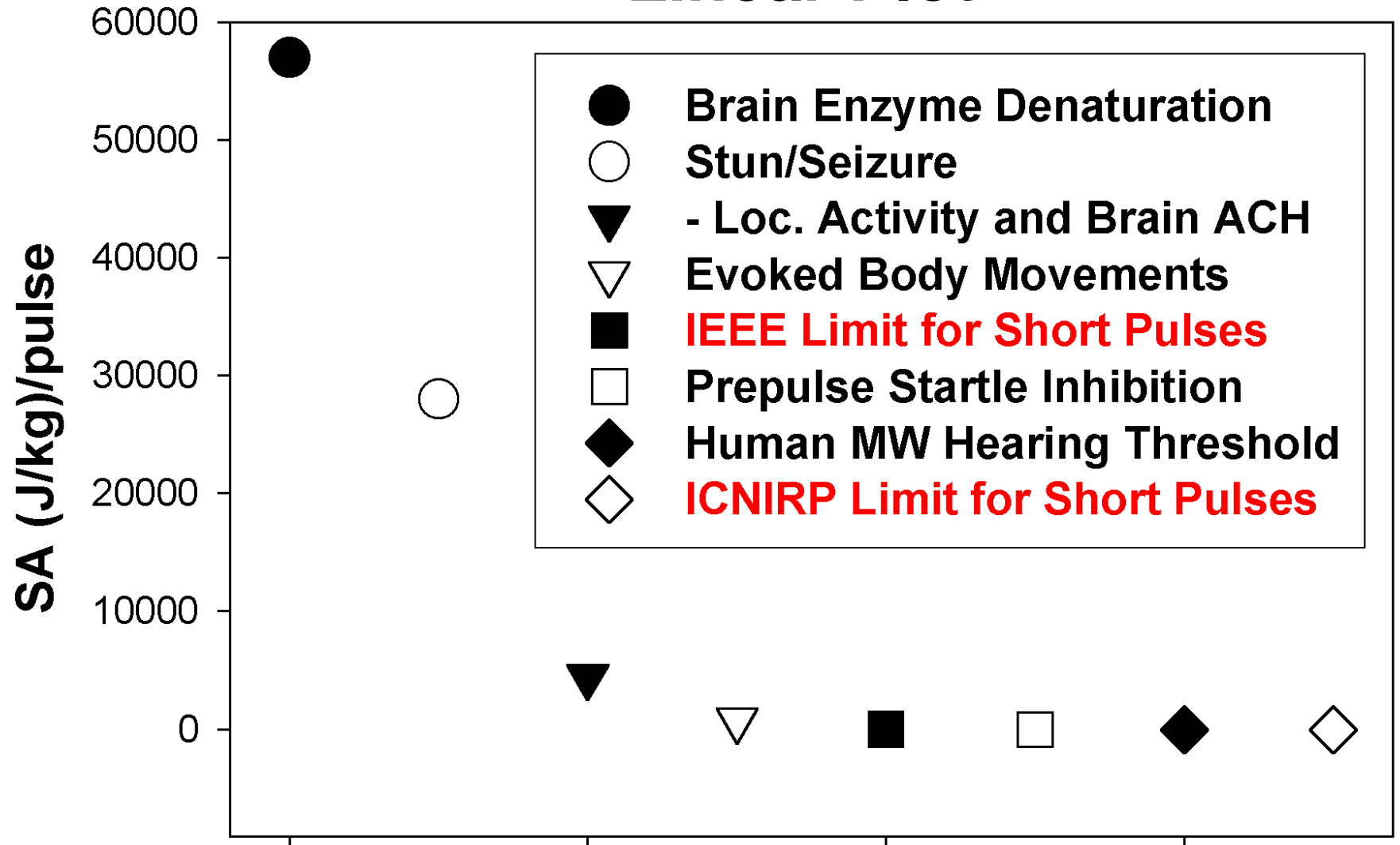
- IEEE: none (all based on time averages for whole or partial body)
- ICNIRP: none (all based on time & spatial averages)
- New IEEE: Discussing moving toward ICNIRP approach but with a peak power density provision added



Biological Effects & Exposure Standards Related to Specific Absorption from 1 Pulse



Linear Plot

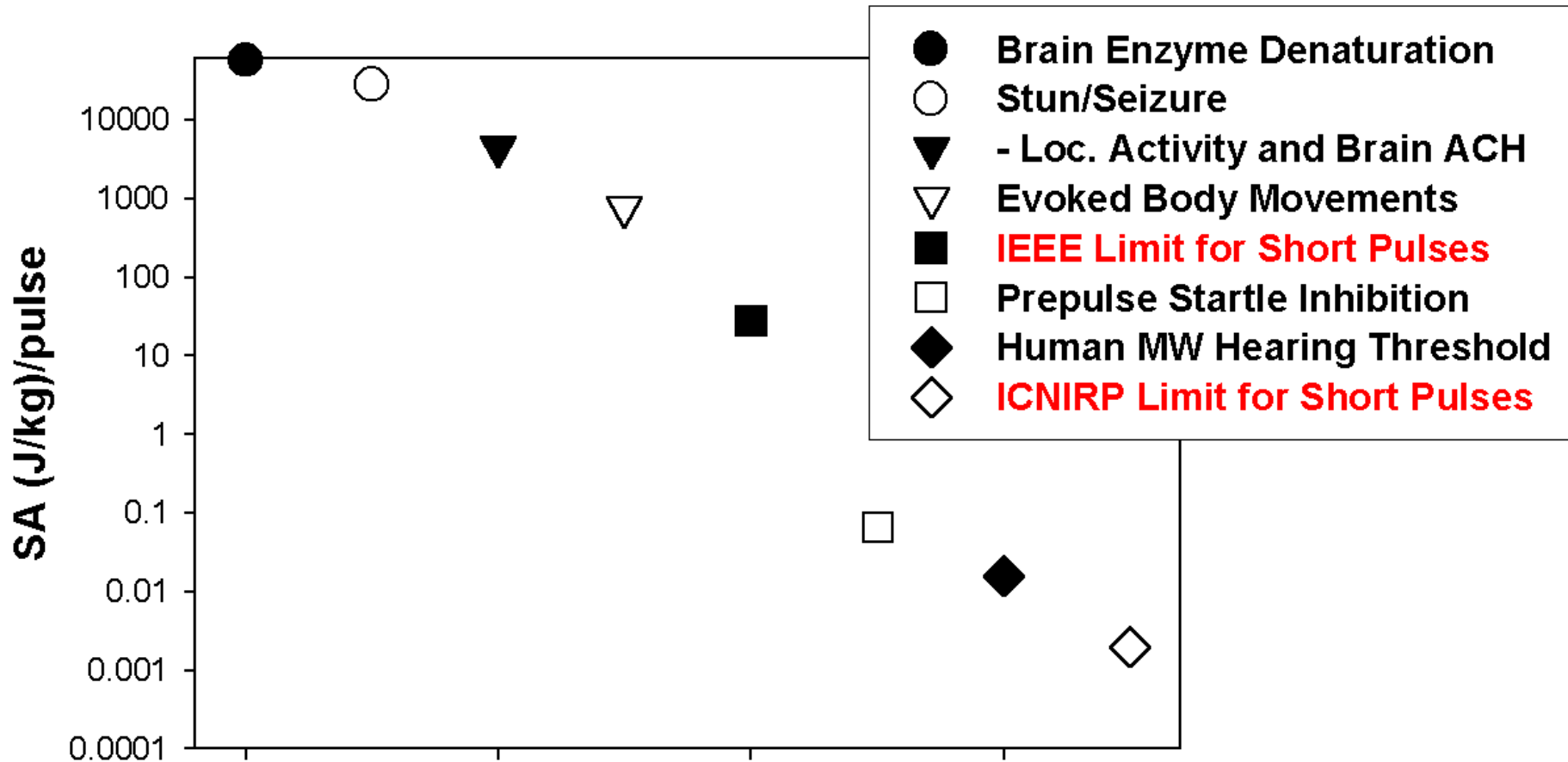




Biological Effects & Exposure Standards Related to Specific Absorption from 1 Pulse



Log Plot

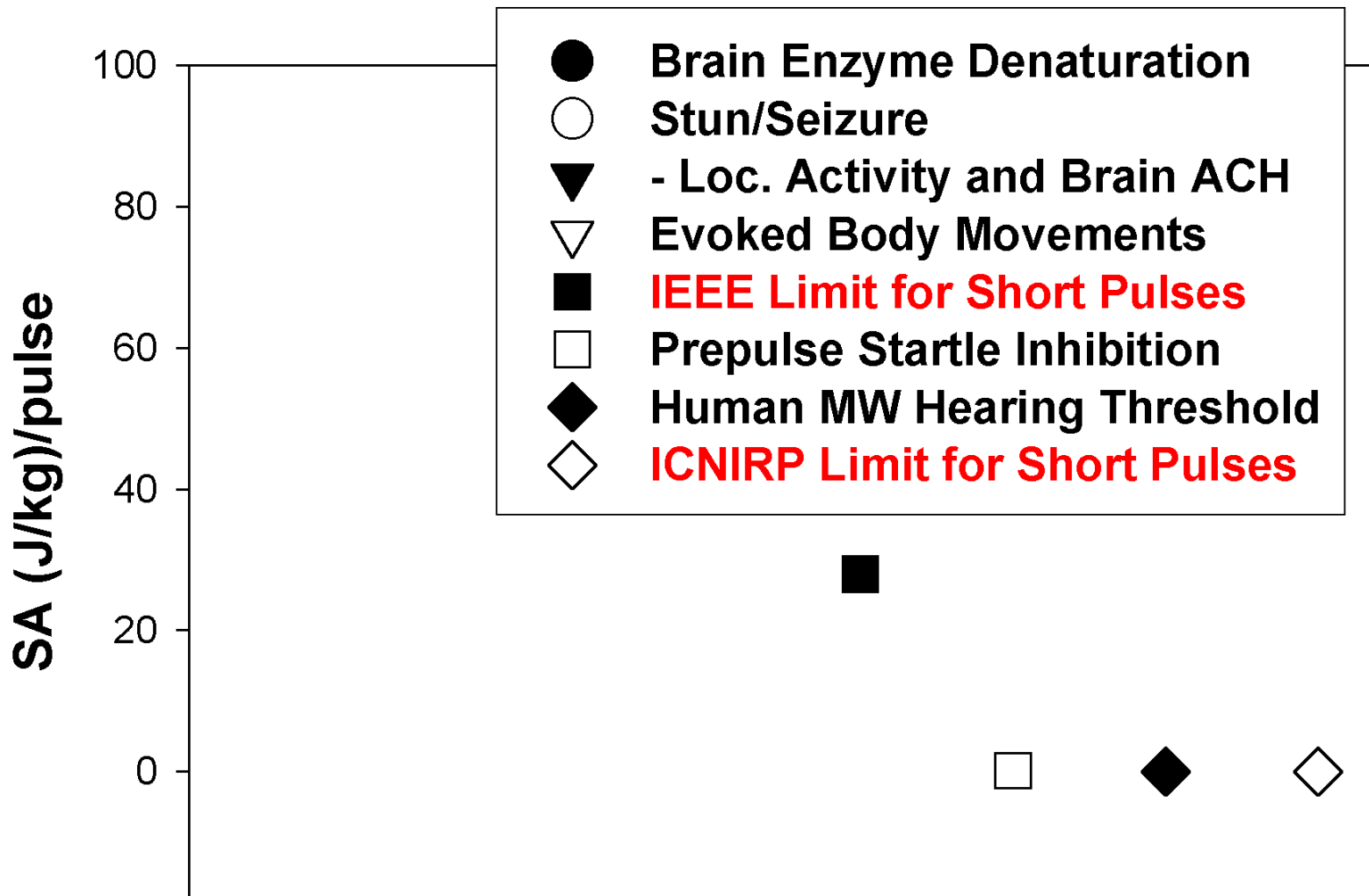




Biological Effects & Exposure Standards Related to Specific Absorption from 1 Pulse



Linear Plot



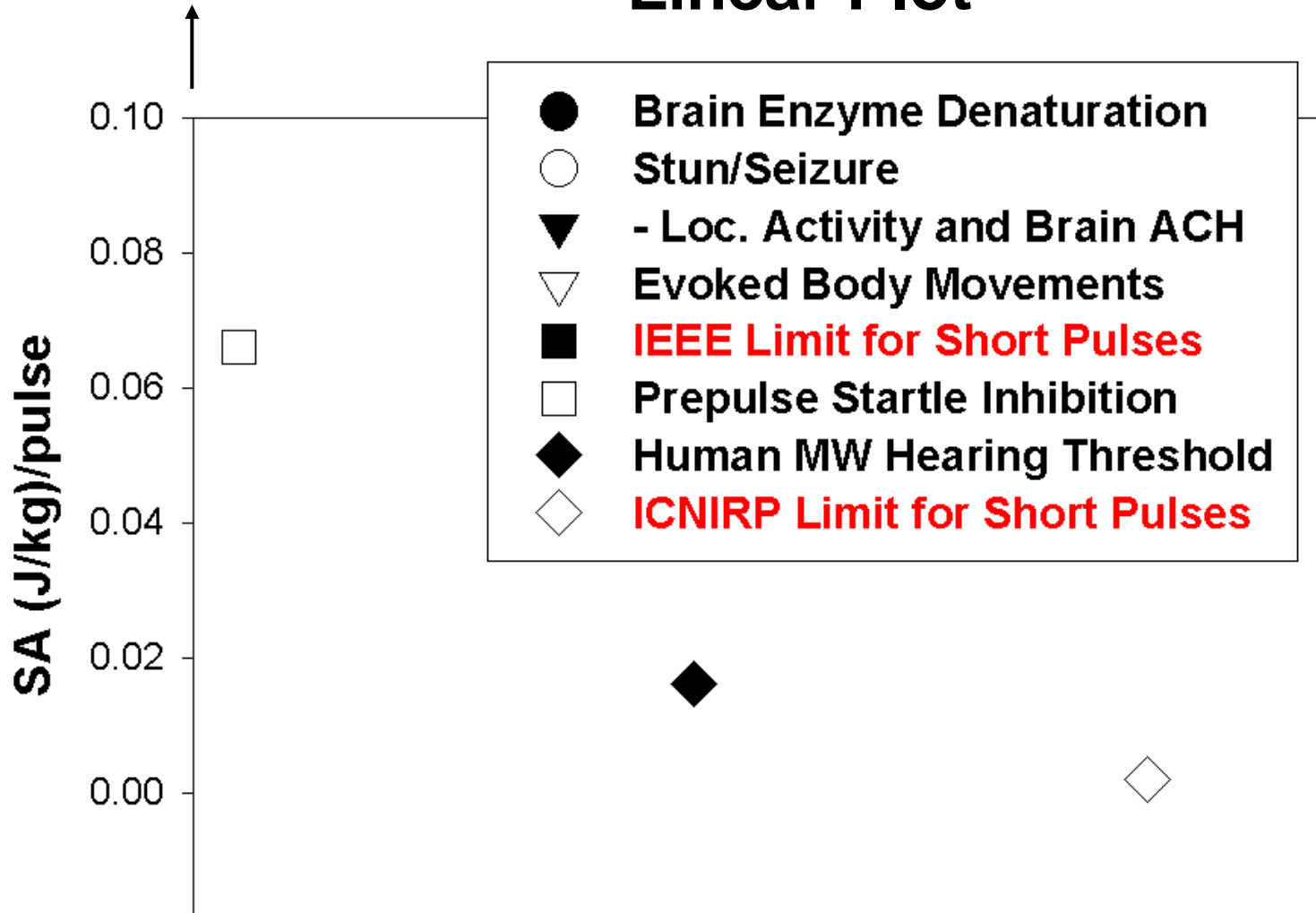


Biological Effects & Exposure Standards Related to Specific Absorption from 1 Pulse



IEEE @ 28.8

Linear Plot





Limits Based on Peak SA & Peak E-field Rational from IEEE Standard



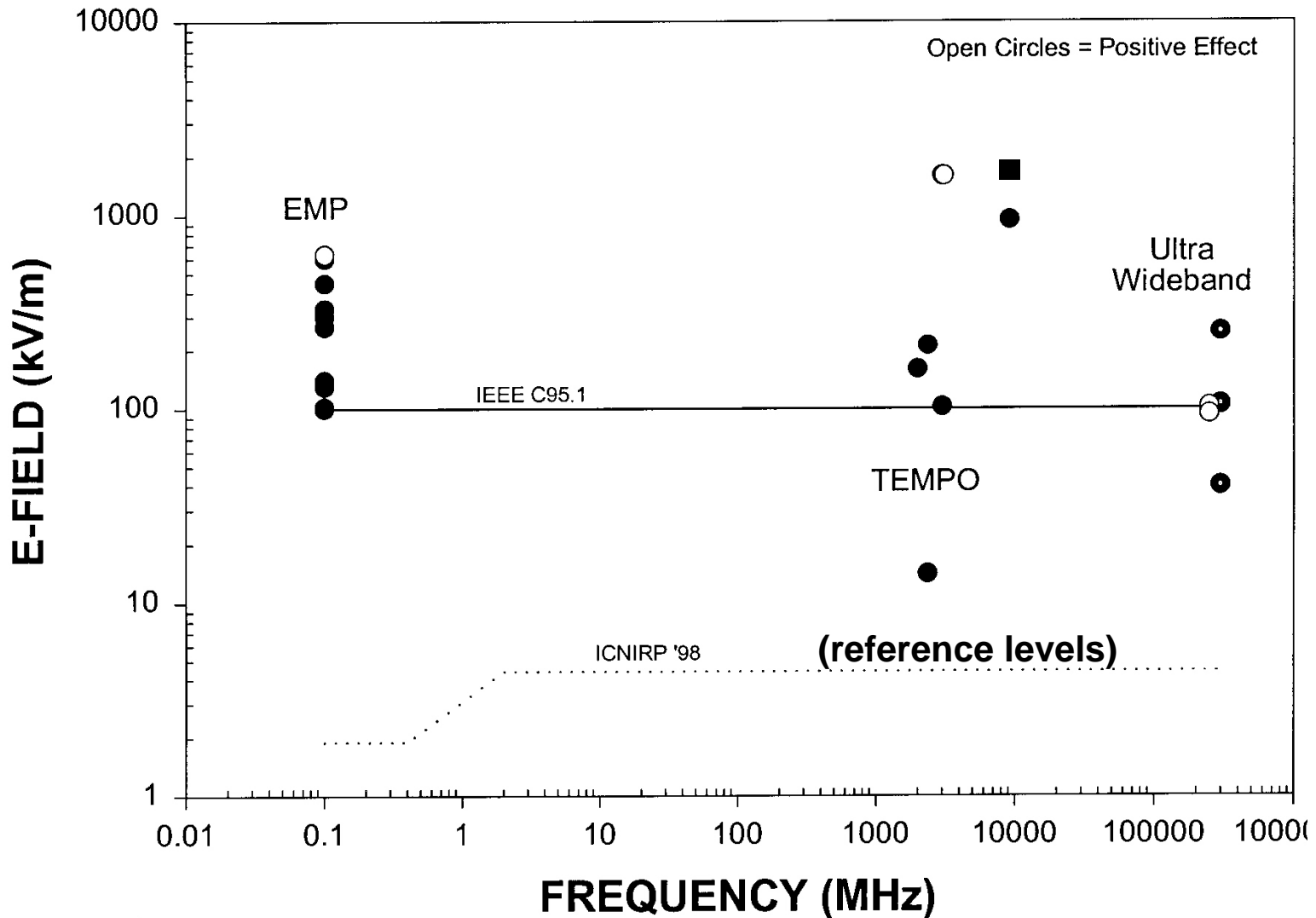
- Preclude high SA for decreasingly short widths of RF pulses
 - Considers the a well- established scientific base of data that includes the auditory effect in humans & RF energy-induced unconsciousness in rats
 - The limit on SA is conservative relative to RF-induced unconsciousness and is well above the threshold for **auditory effect**
 - **The latter (auditory effect) is clearly not deleterious**
- The recommendation for a peak E-field limit of 100 kV/m
 - Based on the necessity to cap the allowable field **below levels at which air breakdown or spark discharges occur**
 - The level chosen is **ultraconservative** in this regard
 - This conservatism is prudent in light of the relative sparseness of studies for very short high-intensity exposures
 - Such studies as do exist are reassuring that this level is indeed far below the threshold or adverse effect.



Limits Based on Peak e-field Biological Data (30 studies)



Plotted without regard to SA, SAR, PRF, duration of exposure, or nature of effect.

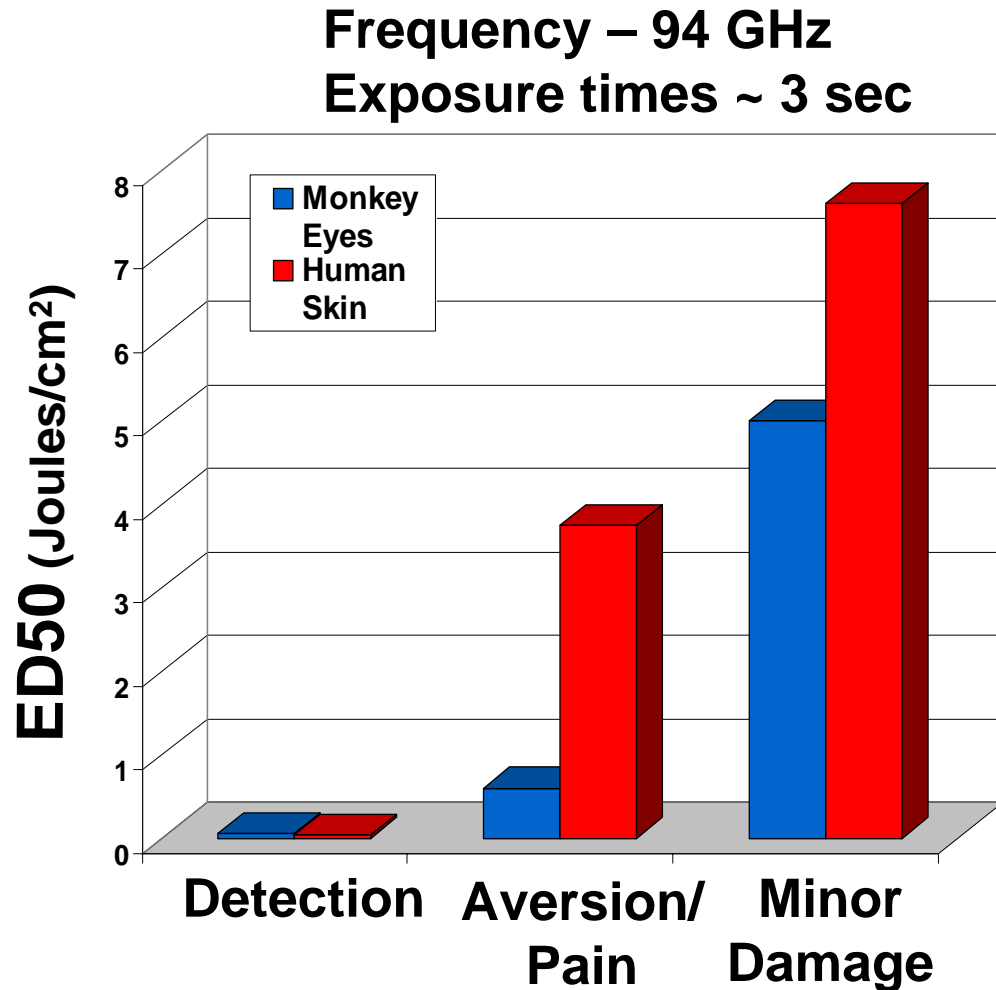




Recent Data on Skin & Eye Response Thresholds to mmWaves



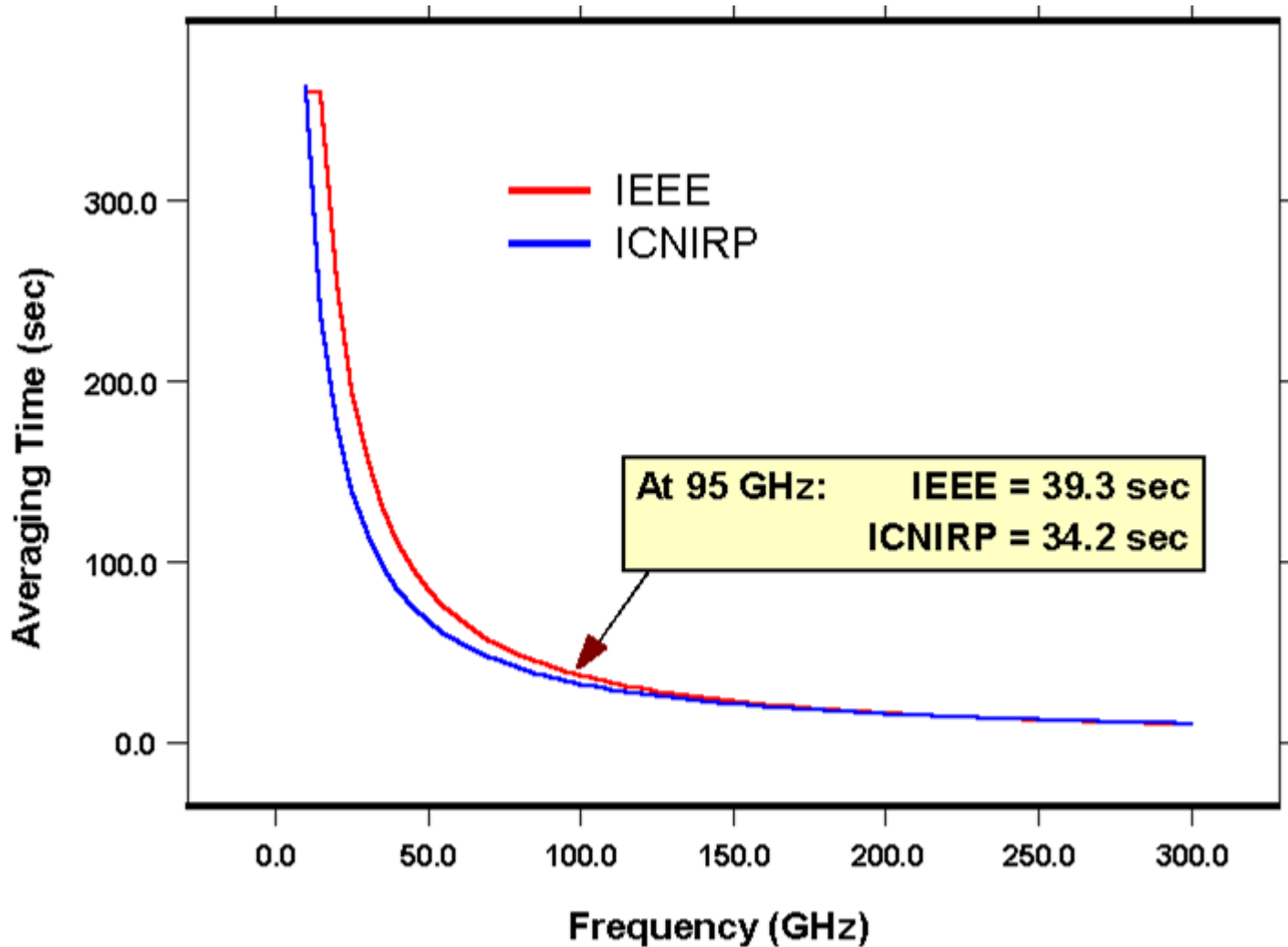
- Mostly based on the research of Blick (skin) & D'Andrea (eyes)
- Detection levels are very low
 - Within IEEE standard
 - Within ICNIRP standard
- Current protection against Aversion/pain
 - Current IEEE – yes
 - ICNIRP - ?
 - New IEEE - ? (needs peak limit?)





ICNIRP & IEEE

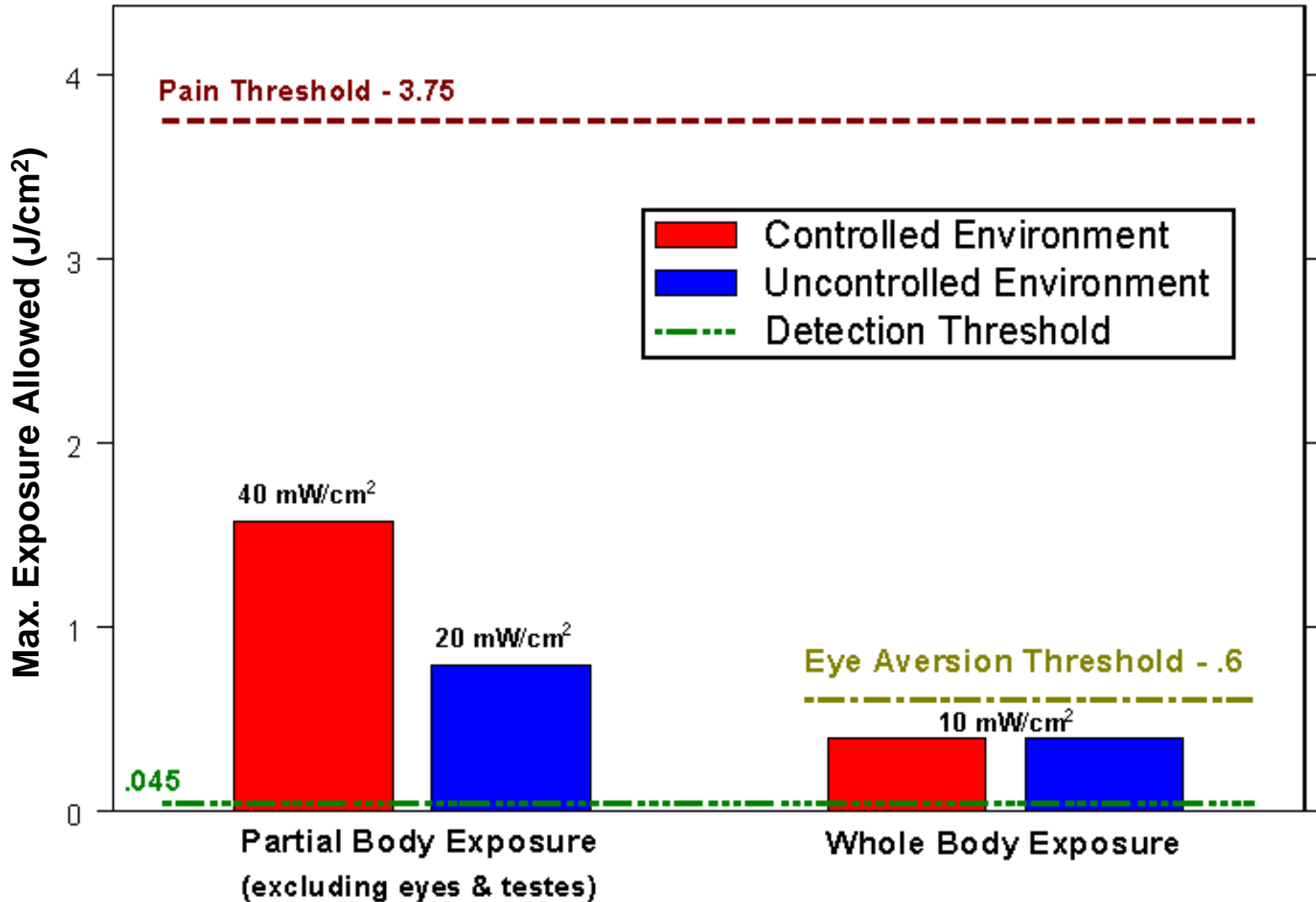
Averaging Time for mmWaves





IEEE Limits for 95 GHz EMF

(averaging time = 39.3 sec)





ICNIRP Limits for mmWaves



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Health Physics

Table 5. Basic restrictions for power density for frequencies between 10 and 300 GHz.^a

| Exposure characteristics | Power density (W m^{-2}) |
|--------------------------|-------------------------------------|
| Occupational exposure | 50 |
| General public | 10 |

^a Note:

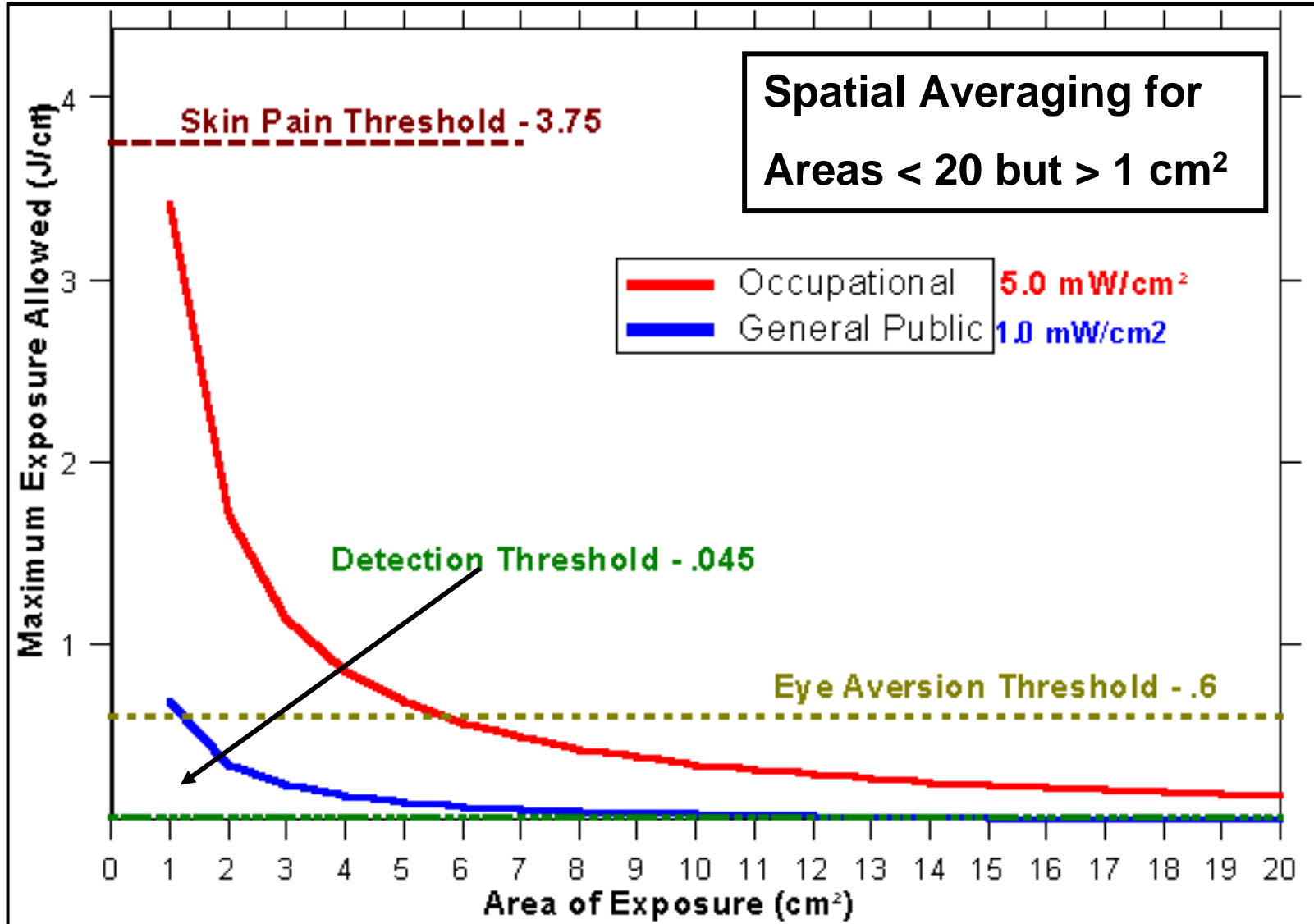
1. Power densities are to be averaged over any 20 cm^2 of exposed area and any $68/f^{1.05}$ -min period (where f is in GHz) to compensate for progressively shorter penetration depth as the frequency increases.
2. Spatial maximum power densities, averaged over 1 cm^2 , should not exceed 20 times the values above.



ICNIRP Limits for 94 GHz EMF



(averaging time = 34.6 sec.)





ICNIRP Limits for mmWaves



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Health Physics

Table 5. Basic restrictions for power density for frequencies between 10 and 300 GHz.^a

| Exposure characteristics | Power density (W m^{-2}) |
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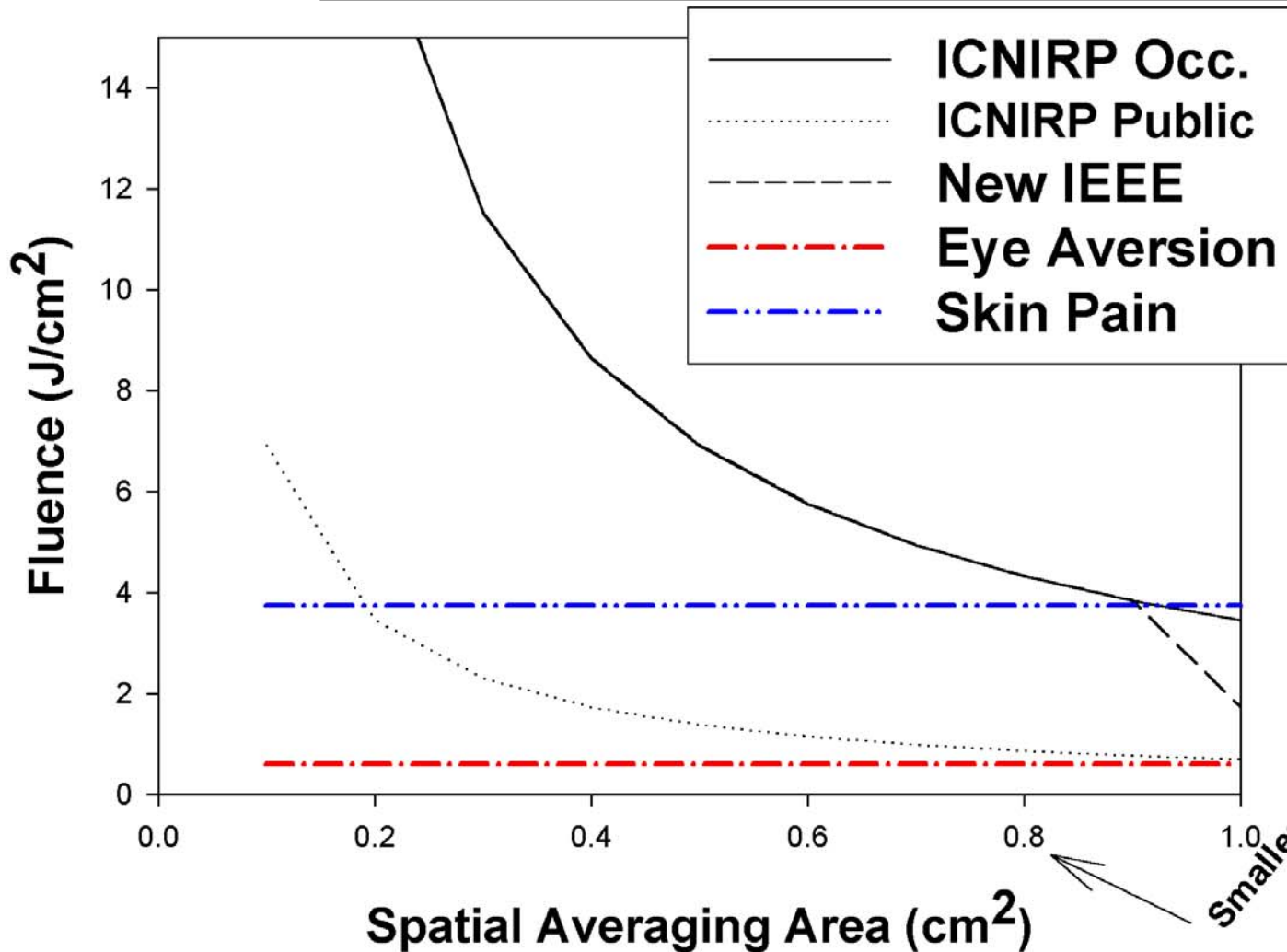
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Limits for mmWaves ICNIRP & "New IEEE"



Spatial Averaging for exposure areas $< 1 \text{ cm}^2$



Smallest spot size for 94GHz ?



Limits for mmWaves

Is there really a problem?



- **Can mmWave exposure spots get that small?**
 - Radiated field?
 - Open ended wave guide?
- **As spots get smaller, heat loss to surrounding area becomes greater**
 - Does mean there is no problem?
 - Or will it still exist as exposure time decreases
- **If a problem exists, how can it be eliminated?**
 - Peak power density that overrides spatial averaging
 - Peak energy density (fluence) for exposure times less than a certain duration (e.g., based on pain threshold)
 - ???

ICES International Liaison Report

Luxemburg, 2 December 2001



Michael R. Murphy, PhD
Chief, RFR Branch
Human Effectiveness Directorate
Air Force Research Laboratory



TOPICS



- **Recent International Standards Meetings**
- **Future Meetings**
- **New Standards Projects**
- **NATO Activities**
- **Additional Contributions**



Recent Meetings



- **2001 Asia-Pacific Radio Science Conference**
 - Tokyo, Japan 1- 4 Aug, 2001
 - No talks on standards
- **European Bioelectromagnetics (EBEA) Meeting**
 - Helsinki, Finland, 6-8 September 2001
 - Nice talk emphasizing ICES standards by David Black
- **WHO EMF Biological Effects and Standards Harmonization**
Seoul, South Korea 22-24 October 2001
 - ICES represented by Dr. Patrick Mason (30 min talk)
- **WHO EMF Standards and RFR Bioeffects Update**
 - South Africa, 5-7 December 2001
 - ICES invited to speak (45 min) – Vitas Anderson?



Future Meetings



- **Bioelectromagnetics Society (ICES meets just before)**
 - June 23-27
- **URSI 27th General Assembly – Maastricht 17-24 Aug, 2002**
 - Not much expected on standards
- **WHO EMF & Human Health. Researches & Standards**
 - 3rd Int. Conference. Moscow & St. Petersburg, 23-27 Sept 2002
- **Biological Effects of Electromagnetic Fields: 2nd Int Congress**
 - Rhodes, Greece, 7-11 October 2002
 - Not much expected on standards?
- **Asia Pacific EMF Research & Standards Harmonization Conference**
 - Organized by WHO, USAF, Thailand
 - Phuket, Thailand 23-25 October 2002
- **WHO Regional Meeting on EMF Health and Standards Harmonization**
 - Southern China, 28-31 October 2002



New International Standard's Projects



**Basic Materials for EMF Standards. (funded by USAF)
Yuri Grigoriev, Russia**

**Criteria for Standards in the Field of Radio Frequency
Radiation in Some East European Countries. (funded by USAF)
Michel Israel, Bulgaria**

**Database of World EMF Standards. (funded by WHO)
Dina Simunic, Croatia**



NATO Standards Agency (NSA)



General Medical Working Group (MED)

50th meeting: Brussels, BE 10-16 Jun 2001

- Standardization Agreement (STANAG) 2345 *Evaluation And Control Of Personnel Exposure To Radio Frequency Fields - 3 KHz To 300 GHz (EDITION 3, Ratification Draft)*: Submitted for ratification
 - **New** medical reporting proforma
 - **New** “*Actions to be taken in case of a suspected or actual overexposure above PEL*”
 - **New** “*The Role of the Physician*”
- STANAG 2345 included in list of essential NATO STANAGs at 49th MED
- Briefing on Standardization of NLW Casualty Care
 - Invited to present full brief to 51st MED Jun 2002

Radio and Radar Radiation Hazards Working Group (RADHAZ)

24th meeting Brussels BE 18-21 Sep 2001

- Liaison report and status report sent in-lieu of travel following 11 Sep



NATO RTO TG-002: *Health Effects of Non-Ionizing Radiation in the Military Setting*



- Chairman: Chris Clemens, NL, TNO Physics and Electronic Lab
Vice-Chair: B Jon Klauenberg, US, USAF/HEDR
- 22-24 May 2001 meeting London, UK (Mr. Bob Gardner: Host)
 - Nations attending included GR, GE, NL, NO, UK, US BE:
 - Reviewed comments from FR on STANAG 2345 *Evaluation And Control Of Personnel Exposure To Radio Frequency Fi-eld-s - 3 Khz To 300 Ghz (Edition 3 Draft 3)*.
 - Site visit MOD Radiation Hazards teams of the Directorate of Engineering and Interoperability (DEI). Blandford, UK (Mr. Andy Hunt: Hazards to Personnel from Land Systems).
- Fall 2001 meeting in San Antonio canceled due to 11 Sep security
- Lecture Series (Fall 2002 proposed): *How New Civilian Radio Frequency Exposure Guidelines Will Impact NATO Operations*

- Public perceptions/misperceptions
- Poor quality of the scientific literature
- Media issues: Effects of recent terrorist events
- Precautionary principle

Public Perceptions/Misperceptions

- All radiation is hazardous and should be avoided (no level of exposure is safe)
- Artificial sources of anything are more dangerous than natural sources
- All radiation causes cancer or at least increases the risk beyond an acceptable level
- Exposure to children is the worst

Public Perceptions/Misperceptions

- There is no difference between risks associated with 60 Hz magnetic fields and with RF energy (assumes a risk from the former)
- The environment is fragile and all “new technologies” threaten the existence of life (Precautionary Principle)
- You can't trust the government or industry (remember when they told us smoking and exposure to asbestos was safe?)

Why these Perceptions?

- Lack of proof of safety (a hazard can be proven, the absence of a hazard cannot)
- Lack of scientific studies of long-term low-level exposures, e.g., from cell-site antennas
- Media “debate” over “thermal” *versus* “non-thermal” effects
- Jargon, e.g., “radiation,” “microwave”
- Uncertainty is intolerable



Why these Perceptions?

- Reports of “Expert Panels” that neither confirm or refute the existence of a potential hazard, e.g., the Royal Society of Canada (1999), the Stewart Committee in the UK (2000)
 - conflicting conclusions, e.g., “no evidence of harm but restrict the use of cell-phones by children and do not place antennas near schools, hospitals, homes, etc.”

Why these Perceptions?

- Media reporting of “new research findings” linking cell-phones with brain tumors, EMF with cancer, etc.
 - willingness of some researchers to announce preliminary research results to the media before peer-review
- Recent media coverage of RF standards committee activities

Why these Perceptions?

“Relaxed RF guidelines drafted”

Washington - Government scientists say they are alarmed by relaxed mobile-phone radiation guidelines being drafted by an *industry standards* group...

RCR Wireless News, November 26, 2001

“IEEE Drafts Major Relaxation of RF/MW Human Exposure Limits”

“Cell Phone SARs Could Be 12 Times Higher”

Microwave News, September/October, 2001





Champs électromagnétiques et Santé

Le cadre juridique européen : réalités et perspectives

LUXEMBOURG, BATIMENT JEAN MONNET, PLATEAU DE KIRCHBERG, M6

30 NOVEMBRE 2001

AGENDA PROVISOIRE

Introduction : M. Fernand Sauer Directeur Direction Générale Santé et Protection des Consommateurs

Quelles connaissances à ce jour ?

1. Le Comité Scientifique Directeur de la Commission européenne : travaux 2001 et nouvelles recommandations

Rapporteur + M. Costa-David (SANCO C)

1. Le projet international EMF de l'O.M.S : présentation et résultats

Dr Michael Repacholi (OMS) (20 mn)

2. Nouvelles technologies - nouveaux risques ? Etat des lieux et perspectives pour la recherche scientifique de demain.

Prof. Ulf Bergqvist (Université de Linköping, Suède, responsable du projet COST 281) (20 mn)

3. Science et Développement de Standards d'exposition : l'approche de l'ICNIRP,

Prof. Bernard Veyret (Laboratoire PIOM, membre de l'ICNIRP, Université de Bordeaux) (20 mn)

Débat (30 mn) + Pause café (30 mn)

Quelles réglementations ?

4. Aperçu sur les aspects juridiques nationaux et communautaires relatifs aux risques liés aux champs électromagnétiques

Norbert Reich, professeur aux Universités de Brème et de Riga (20 mn)

5. Suivi et Développement du cadre réglementaire en Europe : les activités de la Commission européenne. (*Représentant de SANCO*) (20mn)

Discussion (20 mn) +Déjeuner

6. Analyse comparative du droit des Etats membres en matière de normalisation et de responsabilité concernant les champs électromagnétiques

Geraint Howells, professeur à l'Université de Sheffield (20 mn)

7. Précaution, responsabilité et normalisation en matière de champs électromagnétiques

Hans Micklitz, professeur aux Universités de Berlin et de Bamberg (20 mn)

8. Libertés de circulation, sécurité des produits et protection de la santé en matière de champs électromagnétiques

Nial Fennelly, Juge à la Cour suprême d'Irlande, ancien avocat général à la Cour de justice des Communautés européennes (20 mn)

Pause café

9. Débat :

Entre réalités scientifiques et juridiques, développement technologique, et protection de la santé ; comment concilier des attentes et des besoins parfois contradictoires ?

Président (à préciser)

Fin des travaux

