20-1025 (Lead); 20-1138 (Consolidated)

UNITED STATES COURT OF APPEALS
FOR THE DISTRICT OF COLUMBIA CIRCUIT

ENVIRONMENTAL HEALTH TRUST; CONSUMERS FOR SAFE CELL PHONES; ELIZABETH BARRIS; THEODORA SCARATO

CHILDREN'S HEALTH DEFENSE; MICHELE HERTZ; PETRA BROKKEN; DR. DAVID O. CARPENTER; DR. PAUL DART; DR. TORIL H. JELTER; DR. ANN LEE; VIRGINIA FARVER, JENNIFER BARAN; PAUL STANLEY, M.Ed.
Petitioners

v.

FEDERAL COMMUNICATIONS COMMISSION;
UNITED STATES OF AMERICA
Respondents

Petition for Review of Order Issued by the
Federal Communications Commission

DEFERRED JOINT APPENDIX

VOLUME 21

Edward B. Myers
Law Office of Edward B. Myers
14613 Dehaven Court
North Potomac, MD 20878
Phone: 717-752-2032
edwardbmyers@yahoo.com

Counsel for Petitioners 20-1025

Robert F. Kennedy, Jr.
Children's Health Defense
1227 North Peachtree Pkwy #202
Peachtree City, GA 30269
Phone: 845-377-0211
rfk.fcc@childrenshealthdefense.org

W. Scott McCollough
McCollough Law Firm, P.C.
2290 Gatlin Creek Rd.
Dripping Springs, TX 78620
Phone: 512-888-1112
wsmc@dotlaw.biz

Counsel for Petitioners 20-1138

INDEX TO DEFERRED APPENDIX

INDEX TO DEFERRED APPENDIX

INDEX TO DEFERRED APPENDIX

INDEX TO DEFERRED APPENDIX

INDEX TO DEFERRED APPENDIX

INDEX TO DEFERRED APPENDIX

INDEX TO DEFERRED APPENDIX

INDEX TO DEFERRED APPENDIX

INDEX TO DEFERRED APPENDIX

INDEX TO DEFERRED APPENDIX

INDEX TO DEFERRED APPENDIX

INDEX TO DEFERRED APPENDIX

INDEX TO DEFERRED APPENDIX

INDEX TO DEFERRED APPENDIX

INDEX TO DEFERRED APPENDIX

INDEX TO DEFERRED APPENDIX

INDEX TO DEFERRED APPENDIX

INDEX TO DEFERRED APPENDIX

INDEX TO DEFERRED APPENDIX

INDEX TO DEFERRED APPENDIX

INDEX TO DEFERRED APPENDIX

INDEX TO DEFERRED APPENDIX

133	6588-6603	Jul. 13, 2016	Parents For Safe Technology	Wi-Fi; 2.45-GHz Microwave Irradiation Adversely Affects Reproductive Function in Male Mouse, Mus Musculus by Inducing Oxidative and Nitrosative Stress. Free Radical Research (Shahin et al); 2014
134	6604-6611	Jul. 7, 2016	Environmental Health Trust	Wi-Fi - Fertility; Immunohistopathologic demonstration of deleterious effects on growing rat testes of radiofrequency waves emitted from conventional Wi-Fi devices. Journal of Pediatric Neurology. (Atasoy et al); 2013
135	6612-6620	Apr. 8, 2014	MK Hickox	Smart Meters: Correcting the Gross Misinformation, Letter by 54 Scientists and MDs; 2012
136	6621-6622	Nov. 18, 2013	Catherine Kleiber	Smart Meters - Radiation Sickness; American Academy of Environmental Medicine, Smart Meter Case Series; 2013
137	6623-6692	Sep. 3, 2013	Rachel Cooper	Smart Meters; Assessment of Radiofrequency Microwave Radiation Emissions from Smart Meters; Sage Associates, Environmental Consultants; 2011
138	6693-6699	Jul. 7, 2016	Environmental Health Trust	Smart Meters; FCC Maximum Permissible Exposure Limits for Electromagnetic Radiation, as Applicable to Smart Meters. Dr. Ron Powell PhD.; 2013

INDEX TO DEFERRED APPENDIX

INDEX TO DEFERRED APPENDIX

144	7100-7121	Nov. 18, 2013	Kevin Mottus	Cancer-Brain Tumors; Mobile phone use and brain tumour risk: early warnings, early actions? (Gee, Hardell Carlsberg) (Chapter 21 of Report: "Late lessons from early warnings: science, precaution"); 2013
145	7122-7134	Sep. 12, 2019	Environmental Health Trust	Cell Phones; Real-world cell phone radiofrequency electromagnetic field exposures. Environmental Research. (Wall et al); 2019
146	7135-7142	Nov. 18, 2013	Kevin Mottus	Cancer -Brain Tumors; Meta-analysis of long-term mobile phone use and the association with brain tumours, Prof. Lennart Hardell MD. PhD. 2008
147	7143-7156	Jul. 11, 2016	Environmental Health Trust	Cancer - Brain Tumors; Case-control study of the association between malignant brain tumours diagnosed between 2007 and 2009 and mobile and cordless phone use. International Journal of Oncology.(Hardell et al); 2013
148	7157-7183	Nov. 18, 2013	Kevin Mottus	Cancer - Brain Tumors; Use of mobile phones and cordless phones is associated with increased risk for glioma and acoustic neuroma. Pathophysiology. (Hardell et al); 2012

INDEX TO DEFERRED APPENDIX

INDEX TO DEFERRED APPENDIX

INDEX TO DEFERRED APPENDIX

161	7442-7445	Apr. 29, 2019	Environmental Health Trust	Testing – Children; Exposure Limits: The underestimation of absorbed cell phone radiation, especially in children. Electromagnetic Biology and Medicine (Gandhi et al); 2011
162	7446-7504	Nov. 17, 2013	Pong Research Corporation	Testing; Pong Research Corporation Reply Comments
163	7505-7514	Aug. 19, 2012	Pong Research Corporation	Testing; Pong Research Corporation, Letter to the FCC
164	7515-7602	Nov. 17, 2013	L. Lloyd Morgan	Environmental Health Trust, Reply Comments (Erroneous Comments Submitted to the FCC on Proposed Cellphone Radiation Standards and Testing by CTIA – September 3, 2013)
165	7603-7614	Sep. 3, 2013	Dr. Joel M. Moskowitz PhD	"Comments on Notice of Inquiry, ET Docked No. 13-84" GAO Report | "Exposure and Testing Requirements for Mobile Phones Should Be Reassessed." Dr. Joel Moskowitz PhD.; 2012
166	7615-7628	Sep. 2, 2013	Consumers for Safe Cell Phones	Organizations; Consumers for Safe Cell Phones Comments (Petitioner)
167	7629-7640	Nov. 17, 2013	Consumers for Safe Cell Phones	Consumers for Safe Cell Phone Comments (Reply to CTIA Comments from Sep. 13, 2013)
168	7641-7672	Nov. 17, 2013	Environmental Working Group	Organizations; Environmental Working Group, Reply Comments

INDEX TO DEFERRED APPENDIX

INDEX TO DEFERRED APPENDIX

INDEX TO DEFERRED APPENDIX

INDEX TO DEFERRED APPENDIX

INDEX TO DEFERRED APPENDIX

INDEX TO DEFERRED APPENDIX

INDEX TO DEFERRED APPENDIX

INDEX TO DEFERRED APPENDIX

INDEX TO DEFERRED APPENDIX

INDEX TO DEFERRED APPENDIX

INDEX TO DEFERRED APPENDIX

INDEX TO DEFERRED APPENDIX

INDEX TO DEFERRED APPENDIX

296	9181-9182	Sep. 3, 2013	Victoria Jewett	Radiation Sickness; Victoria Jewett Comments
297	9183-9185	Sep. 3, 2013	Michael J. Hazard	Radiation Sickness; Michael J. Hazard Comments
298	9186-9187	Aug. 30, 2013	Melinda Wilson	Radiation Sickness; Melinda Wilson Comments
299	9188-9191	Aug. 30, 2013	Maggi Garloff	Radiation Sickness; Maggi Garloff Comments
300	9192-9199	Sep. 3, 2013	Holly Manion	Radiation Sickness & ADA/FHA; Holly Manion Comments
301	9200-9203	Aug. 22, 2013	James Baker	Radiation Sickness; James Baker Comments
302	9204-9254	Jul. 19, 2013	Deborah Cooney	Radiation Sickness; Deborah Cooney, Verified Complaint, *Cooney v. California Public Utilities Commission et al*, No. 12-cv-06466-CW, U.S.D.C. N.D. Cal. (Dec 17, 2012)
303	9255-9258	Jun. 13, 2013	Mardel DeBuhr	Radiation Sickness; Mardel DeBuhr Comments
304	9259-9260	Jun. 10, 2013	Richard Wolfson	Radiation Sickness; Richard Wolfson Comments
305	9261-9264	Mar. 7, 2013	James E. Peden	Radiation Sickness; James E. Peden Reply Comments
306	9265-9266	Mar. 5, 2013	Carl Hilliard	Radiation Sickness; Carl Hilliard Comments
307	9267-9268	Mar. 4, 2013	Lisa Horn	Radiation Sickness; Lisa Horn Comments

INDEX TO DEFERRED APPENDIX

INDEX TO DEFERRED APPENDIX

INDEX TO DEFERRED APPENDIX

INDEX TO DEFERRED APPENDIX

INDEX TO DEFERRED APPENDIX

INDEX TO DEFERRED APPENDIX

INDEX TO DEFERRED APPENDIX

INDEX TO DEFERRED APPENDIX

391	10078-10086	Mar. 3, 2013	Sandra Schmidt	ADA/FHA; Sandra Schmidt Reply Comments
392	10087-10099	Feb. 11, 2013	Antoinette Stein	ADA/FHA; Antoinette Stein Comments
393	10100-10103	Feb. 5, 2013	David Morrison	ADA/FHA; David Morrison Comments
394	10104-10107	Apr. 16, 2014	MK Hickox	MK Hickox Reply Comments
395	10108-10009	Sep. 3, 2013	Annemarie Weibel	ADA/FHA; Annemarie Weibel Comments
396	10110 - 10117	Sep. 3, 2013	Omer Abid, MD, MPH	Individual Rights; Dr. Omer Abid MD. MPH Comments
397	10118-10120	Sep. 2, 2013	John A. Holeton	Individual Rights; John & Pauline Holeton Comments
398	10121-10129	Sep. 2, 2013	Grassroots Environmental Education, Inc. o/b/o Nancy Naylor	Individual Rights; Nancy Naylor Comments
399	10130-10143	Sep. 2, 2013	Deborah M. Rubin	Individual Rights; Deborah M. Rubin Comments
400	10,144-10149	Sep. 2, 2013	Kevin Mottus	Individual Rights; Kevin Mottus Comments
401	10150 - 10157	Aug. 30, 2013	Alexandra Ansell	Individual Rights; Alexandra Ansell Comments
402	10158-10161	Aug. 25, 2013	Steen Hviid	Individual Rights; Steen Hviid Comments
403	10162-10165	Aug. 21, 2013	Molly Hauck	Individual Rights; Molly Hauck Comments

INDEX TO DEFERRED APPENDIX

INDEX TO DEFERRED APPENDIX

INDEX TO DEFERRED APPENDIX

INDEX TO DEFERRED APPENDIX

427	10432-10440	Sep. 27, 2016	Gary C. Vesperman	Precautionary Principle; Possible Hazards of Cell Phones and Towers, Wi-Fi, Smart Meters, and Wireless Computers, Printers, Laptops, Mice, Keyboards, and Routers Book Three, Gary Vesperman Comments
428	10441-10443	Jul. 11, 2016	Cecelia Doucette	Precautionary Principle; Cecelia Doucette Comments
429	10444-10446	Aug. 31, 2016	Chuck Matzker	Precautionary Principle; Chuck Matzker Comments
430	10447-10460	Sep. 3, 2013	Diane Schou	Precautionary Principle; Dr. Diane Schou PhD, Dr. Bert Schou, PhD., Comments (letter sent to FCC's OET)
431	10461-10465	Sep. 3, 2013	Evelyn Savarin	Precautionary Principle; Evelyn Savarin Comments
432	10466-10468	Jun. 19, 2013	Jamie Lehman	Precautionary Principle; Jamie Lehman, Comments
433	10469-10470	Mar. 7, 2013	Marlene Brenhouse	Precautionary Principle; Marlene Brenhouse, Comments
434	10471-10474	Jul. 11, 2016	Lynn Beiber	Precautionary Principle; Lynn Beiber Comments
435	10475-10489	Sep. 2, 2013	Kevin Mottus	Precautionary Principle; Kevin Mottus Comments
436	10490-10491	Jul.13, 2016	Mary Paul	Precautionary Principle; Mary Paul, Comments
437	10492-10493	Jul. 11, 2016	Stephanie McCarter	Precautionary Principle; Stephanie McCarter Comments

INDEX TO DEFERRED APPENDIX

Industry Influence; The Procrustean Approach: Setting Exposure Standards for Telecommunications Frequency Electromagnetic Radiation, Dr. Donald Maisch PhD.; 2009
(Tab 172 Part 2)

ARPANSA then gave the job to its Radiation Health Committee which then commissioned a working group committee to prepare a draft Standard. The working group had no voting rights but could only refer its recommendations on to the Radiation Health Committee and its chair, Colin Roy, would make the final determination.[107] When ARPANSA's Radiation Health Committee convened the new working group to carry on with the work of the now defunct TE/7 Committee, the CSIRO was asked to nominate an expert member. CSIRO management then selected Dr. Stan Barnett, from the Telecommunications and Industrial Physics (TIP) division, to attend the first two-day meeting. After discussion with CSIRO TIP management, Barnett tendered his resignation from the new committee. His reason was that:

> [The] purpose of the new committee (although it had the same faces[108] as TE/7 but with a new chair) seemed to be way to push through a Standard that had failed to reach consensus under Standards Australia processes. I did not see how this could be achieved by the same group of people without a considerable amount of energy being spent on non-scientific issues. My concern was that there was no benefit to CSIRO in continuing its involvement. . . There was a very high risk that the exercise would be more of a public relations activity than a genuine attempt to pay attention and properly deal with the issues of "non-thermal bioeffects" and the "Precautionary Principle". I held some concerns about the process that was proposed. There was a clear reluctance to answer questions about the definition of "consensus". This was to be an agreed standard and the CEO of ARPANSA seemed to hold sway over whatever was accepted or rejected. Furthermore, this committee was to report to another committee which reported to the CEO. The Chair of this higher committee objected strenuously when questioned about the process. The CEO retained the authority to decide if any dissent by committee members need be considered." [109]

[107] Correspondence with ARPANSA working group member John Lincoln, Oct. 20, 2004.
[108] Virtually all of the faces that had voted in favour of the ICNIRP limits in TE/7 but with only a few members that had voted no. Thus ensuring the final vote would be overwhelmingly in favour of ICNIRP.
[109] Correspondence with Stan Barnett, Snr. Principal Research Scientist, CSIRO, 10 Oct., 2003.

Shortly after Stan Barnett resigned from the working group he was followed by David McKenna, representing the Community and Public Sector Union (CPSU), for reasons not stated.[110]

Out of the 8 members making up the working group, only two were against incorporating the ICNIRP Guidelines in the Australian RF standard. These were John Lincoln, representing the Electro Magnetic Radiation Alliance of Australia, and Dan Dwyer, representing the Telecommunications Officers Association. In addition to the 8 on the working group, there were 2 consultants, 2 on the Secretariat and 7 Observers, who sat in at the meetings; all of these people were firmly in favour of an ICNIRP based standard.[111] The final recommendation of the working group to the Radiation Health Committee was in favour of the proposed ICNIRP based RF Standard. Having no input from the public, other than the token representation of only one community representative on its non-voting working group, ARPANSA's RHC was able to simply ignore the many scientific and public submissions to the previous TE/7 Committee. Using virtually dictatorial powers the CEO of the Health Research Council (HRC) and ARPANSA was able to push through a Standard in a manner that Hollway warned about 19 years earlier. ARPANSA's Radiation Health Committee published its ICNIRP based RF Standard on 7 May 2002, titled: "Radiation Protection Standard – Maximum Exposure Levels to Radiofrequency Fields – 3 kHz to300 GHz".[112]

Democracy excluded from the RHC decision making process

As mentioned previously, Dr. David Black stated to the Senate Inquiry in May 2001 that he saw that democracy does not work in scientific consensus building. Black said, to quote:

[110] Parliament of Australia, 'Inquiry into…', 2001, op. cit., Sect. 4.106, Table 4.4.
[111] Correspondence with working group member John Lincoln, representing the Electro Magnetic Radiation Alliance of Australia (EMRAA), Oct. 24, 2004.
[112] ARPANSA, Fact Sheet, EME Series no.4, 'The ARPANSA radiofrequency radiation exposure Standard', http://www.arpansa.gov.au/pubs/eme/fact4.pdf, Accessed Sept 24, 2007.

> The limiting factor was the fundamentally flawed idea that a scientifically based document could be produced by a democratic process of requiring virtual consensus from a group which deliberately included people with inevitably dissenting views.[113]

From Black's comments, it would be fair to assume that those on TE/7 who had pushed for many years for ICNIRP standards, considered that the only way to get a satisfactory outcome was to exclude from future committees those who had a dissenting view - or only allow a small minority, with no power to influence the desired outcome. This would be not far from the viewpoint of the original 1978 SAA committee that the best people to set standards were those with the relevant technical expertise and managerial experience in handling the technology. This was essentially reinstated within ARPANSA after TE/7 concluded. Even though the ARPANSA working group would have contained four out of the ten members who were against an ICNIRP based standard (if Barnett and McKenna had not resigned), the working group had no voting rights, only an advisory role, to another higher committee. So any dissent within the advisory group would have had no impact on the final outcome as the CEO and head of the RHC had the absolute final say in the process. ICNIRP standards were a foregone conclusion. It would appear that the lesson learned by ARPANSA as a result of the failure of TE/7 to approve the Interim standard was that public participation was detrimental to their desire to reach a particular decision: ICNIRP standards. This clashes with the view that public participation in agency decision making processes is more likely to improve than undermine the quality of agency decisions and that avoiding public participation to avoid conflicts is counterproductive in the long run.[114]

Political considerations end CSIRO's involvement with telecommunications

In September 2003 Barnett, from CSIRO's Telecommunications and Industrial Physics Department (TIP), circulated a letter to announce that he had been forced

[113] Parliament of Australia, 'Inquiry into…', 2001, op. cit., Sect. 4.103, p. 147.
[114] Dietz, Stern, (eds.), 2008.

to accept "involuntary redundancy" from CSIRO and that his division had been told by senior management to cease all further research into the bioeffects and safety of ultrasound and non-ionizing radiation (RF). Barnett stated in his 2003 letter that:

> CSIRO has chosen to stop all research into bioeffects and safety of diagnostic ultrasound and cease any involvement in safety of non-ionizing radiation in general. It seems that research for the good of the community is not considered a priority area unless it is politically attractive or able to attract funding from industry. Clearly, that is not the case for safety related research in a taxpayer-funded research organisation. [115]

This move ended CSIRO's long involvement in telecommunications research and standard setting which began in 1979 with Hollway's work establishing the original SAA RF committee. Henceforth, any research into possible health impacts of mobile phones or other health issues related to telecommunications would go through the National Health & Medical Research Council's (NH&MRC) EME committee that had been established in 1996 by the government for this purpose. Concerned about the potential involvement of the telecommunications industry in this committee, a researcher for the Australian Democrats Senator Lyn Allison, wrote to the NH&MRC in early December 1996 asking about industry representation. On December 30 Richard Morris, Assistant Secretary of the Health Research Branch, replied in writing, stating that members of the telecommunications industry would not be involved. Morris stated that:

> In regard to your concern about the involvement of industry in the NH&MRC process, let me assure you that members of the NH&MRC Expert Committee will be active researchers without links to the telecommunications industry. This independence from industry is seen as being of great importance to NH&MRC.[116]

[115] Correspondence with Dr. Stan Barnett, Sept 22, 2003.
[116] R. Morris, Letter from Richard Morris, Assistant Secretary, Health Research Branch, NH&MRC, to Sarah Benson, researcher for Senator Lyn Allison, 30 Dec. 1996.

Despite this assurance from the NH&MRC, when it came to appointing a key expert radiation adviser to its EME Expert committee, Dr. Ken Joyner, Motorola's Director of "Global EME Strategy and Regulatory Affairs", was given the position [117]. Dr. Joyner has also represented an industry group, the Australian Mobile Telecommunications Association (AMTA), on the standards committee [118] and has represented the Mobile Manufacturers Forum.[119] Such a complete reversal of their former stance that "independence from industry is seen as being of great importance" would likely have come about after pressure from within the government. Joyner had been closely associated with the formulation of government policy on RF exposure. This is seen in the *Bioelectromagnetics Newsletter* of July/August 1998. In his article titled "Australian Government Action on Electromagnetic Energy Public Health Issues" Joyner's affiliation was given as representing the Australian Federal Department of Communications and the Arts[120].

A direct comparison can be made here between the dismissal of Barnett and the removal of the CSIRO/TIP from the debate with similar contemporary events in the Czech Republic. In the case of the Czech Republic Dr. Jan Musil, chair of the National Reference Laboratory and the National Institute of Public Health's Advisory Board on Non-Ionizing Radiation, was removed and replaced by a person who was in favour of accepting ICNIRP Guidelines.[121] As with Barnett, Musil had opposed the acceptance of ICNIRP Guidelines on similar grounds to that of the CSIRO and had called for the application of precautionary principles.[122] (See Chapter 4, pages 160-162). In both cases, government advisory agencies were

[117] National Committees for Science (Australia), ANNUAL REPORT TO COUNCIL on 2004 Activities, http://www.ncrs.org.au/annual/2005.pdf, Accessed Mar. 6, 2007.
[118] Standards Australia, Committee TE/7: Human Exposure to Electromagnetic Fields, meeting No. 1/98, Minutes, 12 Aug. 1998.
[119] Parliament of Australia, 'Inquiry into…', 2001, op. cit., Sect. 4.68.
[120] K. Joyner, 'Australian Government Action on Electromagnetic Energy Public Health Issues'. *Bioelectromagnetics Society Newsletter*, no. 143, July/Aug. 1998.
[121] L. Slesin, 'Czech Government Now Follows ICNIRP', *Microwave News,* vol. 21, no.1, Jan./Feb. 2001, p. 7.
[122] L. Slesin,'Czech Panel on the Precautionary Principle and Numerical Limits', *Microwave News*, vol. 20, no. 3, May/June 2000, p. 14.

giving advice inimical to political and economic interests and in both cases the agencies were silenced for reasons unrelated to science.

Conclusions

Ostensibly the task given to the original SAA committee and later the Standards Australia TE/7 Committee was to conduct a risk assessment on the available peer reviewed scientific literature for RF exposures and then draft a standard specifically for Australia (and New Zealand). However, two distinct and different risk assessments took place and by the time TE/7 was wound up, these proved to be irreconcilable.

On one hand the CSIRO played a central role in critically examining all the available information, including the Russian literature and the more restrictive RF in-house standard set by the Applied Physics Laboratory at Johns Hopkins University. As a result David Hollway from the CSIRO took a more conservative risk assessment approach taking into consideration the possibility of hazards from low-level RF exposures not related to heating. This assessment was scientifically supported by a number of publications by CSIRO and former CSIRO scientists.
Following CSIRO's lead, in the later TE/7 committee, a number of other standard committee members took a similar stance in their various written submissions to the committee. Their shared stand can loosely be termed as calling for a precautionary approach due to the many uncertainties and gaps in the literature. Some opposed the proposal to increase the limits to that of ICNIRP outright, while others indicated that they might support the increase, provided a strong precautionary statement was incorporated into the standard that acknowledged the level of uncertainty that existed in relation to low-level non-thermal exposures.

On the other hand, the opposing assessment supported by the majority of committee members (the telecommunications industry, broadcasters, the military, allied professional bodies, including government representatives from the Australian Radiation Laboratory) was that the assessment promoted by ICNIRP (originally proposed by Repacholi in 1984, see Chapter 4, page 1) was sufficient.

This was that the only health issue to address in standard setting was short-term effects due to the absorption of RF energy of sufficient power to heat up biological tissue. Their shared viewpoint was that the ICNIRP risk assessment was beyond question. This is seen in the TE/7 committee requirement that the only information they would consider in submissions was new scientific information not previously seen by the committee. Re-analyses of pre-existing data, such as referenced by ICNIRP was not to be considered. An example of the unwillingness to re-examine data was seen in a statement by David Black at a 2004 EMF Health Forum held in Hamilton, New Zealand on November 15, 2004. Black, a former TE/7 member and current consulting expert for ICNIRP, was replying to a criticism of another speaker who had incorrectly stated that the 1997 National Cancer Institute Linet study of 638 children with leukaemia was a negative study with no association with the disease and power-frequency EMF exposures. This writer pointed out that the higher exposed children in the Linet study did in fact have a positive association between leukaemia and EMF exposure but that these children had been removed from the analysis and so it was deceptive to claim, without this qualification, that no association was found. Black agreed that there was a positive association at a 3 milliGauss (mG) exposure level but then dismissed it by claiming that one must go with the published statements by the authors / journals for the purposes of standard setting. In this context this would suggest that one must take uncritically published statements used in standard setting regardless of their validity. This was apparently the case in TE/7 with those members wanting to approve ICNIRP Guidelines without qualification.

At the conclusion of TE/7 in 1999 the two opposing risk assessments could not be reconciled and the committee was concluded without approving the proposed ICNIRP based standard. This placed the Australian government in an unviable situation just when it was planning to sell off further parts of the electromagnetic spectrum in the microwave range to accommodate new technology as well as planning on selling more of its shareholdings in Telstra. With the failure of TE/7 to approve the draft ICNIRP based standard there was now no RF standard in force. In addition, the longer the stalemate continued the greater risk that the public would become increasingly concerned about possible health hazards from the

technology. The task of drafting and approving an ICNIRP based standard was then given to a newly created agency, ARPANSA, which convened a Radiation Health Committee (RHC) to finish the task of drafting an ICNIRP based standard for Australia and therefore end the uncertainty.

Thus it is concluded that the long push to increase Australia's former RF exposure standard's limits had little to do with better science but all to do with the 'realpolitik' of pushing through ICNIRP's thermal–effects-only paradigm in order to advance economic interests. This situation belies the claim by ICNIRP chairman Paolo Vecchia that ICNIRP's advice was solely based on established health effects, with no consideration given for economic or social issues.[123] The Australian experience was that the push to accept ICNIRP standards was, above all else, an economic imperative. This was borne out by essentially the same debate in the Czech Republic, examined in Chapter 4.

The whole history of SAA, TE/7 and finally ARPANSA's RHC committee is one where CSIRO scientific advice to government was largely ignored in favour of economic considerations in government policymaking. This is compatible with Collingridge and Reeve's observations in their analysis of technical policy in which they concluded that the impact of science advice on rational government policy was negligible. They saw science advice as always being placed in either an "under-critical" or "over-critical" environment and in each situation science loses out. [124] In the case of RF standard setting and ICNIRP's attempted hegemony over science this is especially the case because both environments apply.

In an "under-critical" environment a policy paradigm (such as ICNIRP Guidelines) already exists and any scientific claims or research findings that appears to support the paradigm are easily accepted, such as by pro-ICNIRP-standards TE/7 members. In the "over-critical" environment adversaries are sharply divided over science claims and research findings (such as the existence of low level non-

[123] P. Vecchia, P, 'Electromagnetic Fields and Health: Effects, Perception, Protection', ICNIRP, Montevideo, Uruguay, Mar. 5, 2009, http://www.msp.gub.uy/andocasociado.aspx?2819,16619, accessed April 3, 2009.

[124] D. Collingridge, C. Reeve, *Science Speaks To Power*, New York, St Martins Press, 1986.

thermal bioeffects from RF exposures) are subjected to intense analysis and differing conclusions by opposing factions. This was very much the case with TE/7 where all research that was presented to the committee to support a precautionary approach to RF standard setting was summarily dismissed as it conflicted with ICNIRP.

Collingridge and Reeve's observations about the fate of scientific advice in supposedly rational government policy making is reflected by the actions of the Australian government in ignoring CSIRO's advice, and later silencing CSIRO altogether. The government's actions can be attributed to the fact that CSIRO advice ran counter to its economic policy to facilitate the roll out of telecommunications technology. This was the underlying theme that was played out in the final round of TE/7 meetings.

Overall Conclusions:
RF standard setting: a weighted assessment of science

"In the councils of government, we must guard against the acquisition of unwarranted influence, whether sought or unsought, by the military-industrial complex. The potential for the disastrous rise of misplaced power exists and will persist."

Public Papers of the Presidents, Dwight D. Eisenhower, 1960, p. 1035- 1040

This thesis has shown that the creation and maintenance of the thermal paradigm in RF standard setting for the past half century has not been one of a straight forward case of advancing scientific knowledge, but one of convenience in order to facilitate the unfettered development of technology free of regulatory restraints. During the opening years of the Cold War, RF standard setting decisions, made in an era of scientific ignorance and fear of Soviet malevolence, led directly to a pragmatic solution to meet the nation's urgent security needs of the day. Consideration of possible health hazards from chronic low-level RF exposures was seen as not only a potential barrier to technological development but also as a threat to national security. In addition, the existence of strict Soviet RF standards that claimed to take into consideration the possibility of low-level non-thermal hazards was a challenge to the scientific hegemony of the U.S. standard. In this situation, scientists involved in the U.S. standard development research found that focussing their research on gaining better understanding over thermal biological effects was what was wanted, not research that questioned that line of inquiry.

The marginalisation of criticisms of the validity of the thermal approach to RF standard setting has been an important issue raised in this thesis and is what I call the Procrustean Approach, where all scientific evidence not in conformity with the thermal bed of knowledge is simply cut off from consideration. Such a state of affairs has been maintained by the creation of restricted risk assessment methodologies, conflicted peer review and expert committees constituted primarily by individuals who have a vested interest in maintaining the status quo. This has been illustrated in this thesis by the analysis of the IEEE's peer review

processes for accepting research papers for consideration in RF standard setting, the IEGMP / ICNIRP's risk assessment committees and the case study of the Australian RF standard setting process. In all three cases the problem of conflict of interest can be more accurately described as a majority shared interest in maintaining the status quo in standard setting for vested interest considerations.

The extent of the problem for public health

A critical examination of the current RF standard setting approach is also important for public health considerations. When the need for an RF exposure standard first arose over half a century ago it was not considered a public health matter as the concern was restricted to military personnel and civilian contractors developing high power military radar systems. The restricted focus of exposure limits from that time, however, has been steadfastly maintained to become a foundation for the global telecommunications revolution. Besides the ubiquitous mobile phone, a large number of communication devices are continually being developed and marketed globally as telecommunications companies struggle to keep up their profit margins under market-place competition. As the electromagnetic spectrum frequencies inevitably become congested as a result, newer wireless devices are then introduced that operate at ever-higher frequencies. The predictable result of this on-going development is increasing RF exposures for society in general, in both the so-called developed and developing nations. If there are deficiencies in the telecommunications risk assessments conducted by RF standard setting organizations, both on a national and international level, the sheer number of people exposed to even a slightly increased risk that is ignored by the standards can equate to a significant risk for society. This was pointed out by the U.S. National Toxicology Program on the inadequacies in the existing thermally based RF standard. To quote:

> Over 100 million Americans currently use wireless communication devices with over 50 thousand new users daily. This translates into a potentially significant public health problem should the use of these devices even slightly increase the risk of adverse health effects. … The existing exposure guidelines

> are based on protection from acute injury from thermal effects of RFR exposure. Current data are insufficient to draw definitive conclusions concerning the adequacy of these guidelines to be protective against any non-thermal effects of chronic exposures.[125]

This thesis argues that the current data is insufficient because for too long the investigation has been hampered by a Procrustean Approach that has cut off avenues of research that were considered inimical to the maintenance of the existing thermal paradigm.

This should no longer be acceptable given the implications for global society if the standard setters have it wrong.

Future directions

There is obviously an immense problem in recommending how to reform an existing RF standard setting process that has been controlled from the start by individuals who have staked their scientific credibility, and careers, on defending the existing thermal paradigm for standard setting. There is also the problem of whether or not biologically relevant standards that address chronic low-level non-thermal exposures are even compatible with the continuing wireless revolution. These are problems, however, that urgently need addressing due to the possibility of a significant adverse global public health impact of the technology. This calls for an international re-assessment of the biological relevance of the existing RF standards: IEEE's C95.1 and ICNIRP's guidelines. This is already happening to an extent in the European Parliament, as examined in Appendix 3. A standard setting process is needed that can open up the assessment process to cover all possible health hazards that might be a consequence of RF technology, regardless of the economic consequences of that assessment.

[125] National Toxicology Program, Fact Sheet, Studies on Radiofrequency Radiation Emitted by Cellular Phones, 2005.
http://ntp.niehs.nih.gov/files/Cellphone05.pdf , accessed Feb. 12, 2009.

It is important to note that the concerns raised in this thesis also apply to other broader environmental debates where industry and other vested interests, following revisionist principles, have been able to influence the parameters for regulation of their activities. In this context, this thesis contributes to the debate over the role played by peer review and expert advisory committees by illustrating that these processes, far from being a source of unproblematic and objective expert advice, can be prone to conflict of interest and a biased interpretation of scientific information, as exampled herein by the RF controversy.

Appendix 1

John D. Graham on risk assessment.

From Graham's Keynote Speech: 'Making Sense or Risk: An agenda for Congress', EMF Risk Perception and Communication, the International Seminar on EMF Risk Perception and Communication, Ottawa, Ontario, Canada, 31 Aug. – 1 Sept. 1998.

Unlike several other presenters at the Ottawa EMF risk seminar who argued that the public's perceptions need to be considered and addressed in the risk assessment/management and communication process, Graham instead, argued that they should be simply ignored. This attitude was expressed earlier in 1996 when Graham stated at a conference that "government agencies should be required to depend on expert analyses, rather than public views, in deciding which threats to regulate."[1]

In contrast to Beck's "reflexive modernization", an inevitable and desirable consequence of the many hazardous risks from modern technology, Graham saw public concerns over all technology as a "syndrome of paranoia and neglect", a term repeatedly used throughout his presentation. Graham defines it as the lay public's 'over attention' to an expenditure of resources for alleged dangers that are speculative and possibly non-existent (overblown/paranoid concerns), while at the same time far more substantial dangers to public health and environmental quality are being neglected and tolerated (neglected hazards). Some of what Graham considers to be "paranoid concerns", which he defines as "alleged, speculative, small or non-existent", include: soil and ground-water contamination from abandoned hazardous waste sites; pesticide residues on fruits and vegetables; the 1990 Congressional amendments to the Clean Air Act[2]; and the EPA's proposed

[1] L. MacCleery, *et al*, 'Safeguards At Risk: John Graham and Corporate America's Back Door to the Bush White House', *Public Citizen*, March 2001, http://baywood.metapress.com/index/6NVWM0K53VNU92WP.pdf, Accessed March 3, 2007

[2] While the amendments address outdoor air pollution (from industrial sources) the considerable problem of indoor air pollution (largely a personal lifestyle issue) remains largely ignored. While this is correct, this example (in this context) tends to deflect attention away from controlling outdoor industrial sources.

regulations to reduce benzine industrial emissions in ambient air of urban & rural communities.[3] It is worth noting that Graham's listing of "paranoid/alleged/speculative/small or non-existent" concerns all have to do with industrial sources of pollution created by industries that provide funding to Graham's HCRA. As for Graham's "neglected hazards", they are defined as well-documented and substantial dangers to public health and environmental quality, including: violence in families and communities; deteriorating lead paint in older homes; inadequate use of basic preventative health services such as immunisations, vaccinations and breast cancer screening; and hazardous lifestyles, such as smoking, abuse of alcohol, high fat diets, lack of physical exercise and failure to use basic safety devices such as smoke detectors and auto seat belts. Note that all these dangers originate from the public's "personal habits". Graham sees one example of the public's "misperception of risk" in surveys that found "A majority of Americans perceive that 'things in the environment' are at least as important as 'personal habits' in causing sickness and poor health. He goes on to say that the "best available scientific data indicate that personal habits are much more a cause of poor health than environmental". In Graham's view the best way to address the public's concerns over various risks is for the Congress to embrace risk analysis in public decision making and require by legislation all federal agencies to: strictly follow quantitative risk assessment before making protective decisions; use risk rankings in setting priorities; report to the public estimated risks/costs and benefits of new legislation; use external peer reviews; require that costs are reasonably related to benefits; and require affected citizens[4] to seek judicial review in the event that agencies do not use an accepted risk-analysis framework.[5]

[3] The EPA's proposal was estimated to cost in the range of $200,000 to $50,000,000 per year life saved (largely a cost on industry), compared to a cancer program of early detection and treatment of cancers estimated to cost in the order of $1000 to $10,000 per year of life saved (a cost borne by the public).
[4] As corporations have the legal status of citizens in the USA this opens all agency regulatory decisions open to litigation by corporations that may be adversely affected by said regulations.
[5] J. Graham, 'Making Sense or Risk: An agenda for Congress', EMF Risk Perception and Communication, the International Seminar on EMF Risk Perception and Communication, Ottawa, Ontario, Canada, 31 Aug. – 1 Sept. 1998. M. Repacholi , A. Muc (eds), WHO, pp. 1-31.

Graham's wish list of 11 points to Congress in order to have "responsible risk assessments" are outlined below and include my comments.

1) *Congress should compel agencies to make use of the "best available scientific information"*[6]

An example mentioned by Graham was "innovative biological studies that suggest that low doses of unleaded gasoline vapours, chloroform and formaldehyde pose less risk to people than previously thought". These "innovative" studies may not be the best available scientific information as they are still restricted to testing individual chemicals at low levels of exposure. According to Dr. Philip Landrigan, Director of the Centre for Children's Health and the Environment at Mount Sinai School of Medicine in New York City, much of the current risk assessment being done on chemical exposures is based on faulty premises. It reflects the single exposure of an individual at one particular age, and to one chemical. According to Landrigan, this does not reflect the realities of multiple exposures over a lifetime that recent research indicates are often synergistic and cumulatively damaging.[7] [8] [9] [10] Graham also claims that where new scientific studies suggest that a hazard is more dangerous than previously thought (examples given: dioxin and fine particles), agencies tend to be slow to respond to the new information.

2) *When scientific knowledge about a risk is imperfect or deficient, Congress should require agencies to employ "probabilistic methods of uncertainty analysis".*[11]

Taking a precautionary approach in areas of scientific uncertainty over risks has no place in Graham's ideology. Instead there is a very complex system of risks

[6] Graham, 1998, op.cit., p. 8.
[7] P. J. Landrigan, B. Sonawane, R.N. Butler, 'Early environmental origins of neurodegenerative disease in later life', *Environmental Health Perspectives*, Sept. 1, 2005, vol.113, issue: 9, pp: 1230-1234.
[8] T. Colburn, D. Dumanski, J. Peterson-Myers, *Our Stolen Future*, Dutton, Penguin Books (NY), excerpt from Chapter 3, Chemical Messengers.
[9] Pesticides and Aggression, *Rachel's Environment & Health Weekly*, No. 648, Apr. 29, 1999.
[10] W.P. Porter, J.W. Jaeger, I.H. Carlson, 'Endocrine, immune and behavioral effects of aldicarb (carbamate), atrazine (triazine) and nitrate (fertilizer) mixtures at ground water concentrations', *Toxicology and Industrial Health*, vol. 15, no. 1 / 2, 1999, pp. 133-150.
[11] Graham, 1998, op.cit., p. 9.

requiring a range of estimates as well as estimates of each estimate's likelihood of being correct![12] Worst case scenarios need to be balanced by optimistic and "realistic" estimates of risk. Graham points out that since this task is quite complex "qualified experts" should be used. This provision, in effect, transfers a great deal of regulatory power to the hands of a "non-elected technical / political elite bureaucracy".

Speaking at an earlier International EMF risk perception & communication seminar in 1997, Ortwin Renn referred to the call for the return to technical handling of risk by the technical/political elite, an elite that questions the wisdom of the lay public in judging the seriousness of risks. Renn noted that many writers have warned that ignoring public concerns violates democratic principles, alienates those who feel they should be part of the decision-making process, and may also underestimate the level of input the public may be able to provide to the risk manager. Renn also raises the philosophical question of whether the technical handling of risk really represents an objective assessment of harm or if it is only the conventions of an elite group that may have no more validity or applicability than competing estimates of stakeholder groups or the lay public.[13]

3) *When a hazard poses more danger to some citizens than others, Congress should insist that agencies report that information through distributional methods of variability analysis.*[14]

This method of analysis takes into account the fact that the public's exposure to an environmental risk can vary considerably. Some citizens may be more sensitive to exposures due to genetic or lifestyle reasons. Some may have a higher level of exposure, and low-income and minorities often incur a disproportionate share of

[12] About as scientifically valid as trying to estimate the winning percentages for next year of all Sydney sports teams – basketball, football, hockey, rugby, etc. – and then come up with an estimate of the likely success for a particular athlete playing in that city.
[13] O. Renn, 'Risk Management: A need to integrate risk assessment and perception', International Seminar on Risk Perception, Risk Communication and Its Application to EMF Exposure, Vienna, Austria, Oct. 22-23, 1997, pp. 23-50.
[14] Graham, 1998, op.cit., p. 9.

risks[15]. This needs to be taken into account by agencies by making available to decision makers and the public, a report on the number of citizens exposed to various levels of risk and differences in susceptibility to hazards. Although the need to address the disproportionate sharing of risks is an laudable point, the requirement for an agency to determine the number of citizens exposed to various levels of risk and individual differences in susceptibility would be an arduous and complex task, making, for example, straightforward regulations on controlling chemical emissions from a chemical plant in a mixed residential neighbourhood into a exceedingly complex task, fraught with uncertainty for the a risk assessor. As Landon Winner (1986) said, when the risk assessor is faced with uncertainty, the task tends to switch from one of taking protective action to one of waiting for more research to be done before action is taken.[16] So, in effect, rather than providing extra protection to those disproportionably exposed, it makes the likelihood of effective pollution controls in their area less likely.

4) *To nurture the public's sense of perspective about risk, Congress should require agencies to make thoughtful use of risk comparisons.*[17]

Graham calls these a "powerful communications and learning tool" provided that they are "crafted with foresight". Graham considers that such a comparison can help citizens and journalists develop an intuition about relative magnitudes. He also mentions that since the purpose of these risk comparisons is "educational", it is neither necessary nor appropriate for an agency to restrict the comparisons to hazards that happen to fall within its jurisdiction, or to ensure that the risks are comparable in terms of other dimensions, such as controllability or preventability. If value judgments are made as to acceptability, then dimensions of risk need to be considered, not just numerical magnitude. An example given is that when agencies report that the extra cancer risk from eating pesticide residues in food is one in a million lifetimes they should also compare this to other risks incurred in daily life, such as the increased risk of four in a million being killed on the ground by a

[15] M. Weintraub, Disparities in Disease, Environmental Justice & Health Union, Aug. 2003, http://www.ejhu.org/disparities.html, Accessed Jan 15, 2006.
[16] Winner, 1986, op.cit., p. 143-144.
[17] Graham, 1998, op.cit., p. 10.

crashing airplane. The obvious inference here is, why worry about pesticides in your food when there's a 4 times greater risk of dying from a plane crashing on your head! Besides the farcical nature of such a comparison, Graham's mentioning of a risk of one in a million for cancer resulting from pesticides is in error because it ignores three things: 1) When assessing the risk from exposure to a particular pesticide, say DDT, the risk is calculated in isolation from other chemicals. 2) Other sources of pesticide exposure, such as widespread areas of America where tap water is contaminated with low levels of a mix of insecticides, weed killers and artificial fertiliser. The most common contaminants are carbamate insecticides, the triazine herbicides and nitrate nitrogen.[18] 3) Research indicating that mixtures of these chemicals in concentrations similar to groundwater levels in agricultural areas have measurable detrimental effects on the nervous, immune and endocrine systems, with far more direct implications for humans than just cancer risk.[19] So, coming up with risk estimations from eating particular pesticide residues in food does not take into account the total 'load' of exposure to other chemicals and other sources of exposure.

The danger of risk comparisons is that they can too easily be used to underplay the seriousness of risks. This was examined by the Washington-based public interest organization *Public Citizen* in their report on John Graham. In June 2000 when Graham was a member of the EPA Science Advisory Board that reviewed the agency's risk assessment on dioxin, he used this tactic to mislead the media about the seriousness of dioxin. To quote:

"The EPA announced a draft of its study, which showed that exposure to the level of dioxin currently in our environment causes an increase in the average American's lifetime cancer risk to as high as 1 in 100. The EPA's reassessment also found that dioxin, even at low levels of exposure, is linked to infertility, immune system damage and learning disabilities, with more than 90% of dioxin exposure

[18] J.E. Barbash, E.A. Resek, *Pesticides in ground water--Distribution trends, and governing factors*: Ann Arbor Press, Chelsea, Michigan, 1996, p. 3. ; R. Wiles, B. Cohen, Tap Water Blues, Environmental Working Group, 1994. ; P. Montague, Pesticides and Aggression # 648, Environmental Research Foundation, April 29, 1999.
[19] Porter, Jaeger, Carlson, 1999.

coming from food, especially fish, meat, and dairy products. But rather than acknowledging that dioxin poses an additional threat to human health, in his comments to the media Grahan misleadingly downplayed the risk by comparing the EPA's finding to other types of risks, such as the risk of dying in a car crash. When compared with these risks, Graham suggested the risk posed by dioxin appears "normal".[20]

5) *Congress should require agencies to access a broad range of potential human health and environmental effects.*[21]

Graham makes the valid point that historically agencies have tended to focus solely on mortality effects (such as cancer), which ignores citizens' concerns about other health effects that may effect health and wellbeing. An example mentioned is the EPA's then proposed reassessment of cancer risks from dioxin where the levels of exposure associated with negligible cancer risk are not necessarily low enough to eliminate concern about possible immune and reproductive effects. Due to the complexities of the risk-analysis approach, Graham considers that it may make more sense for federal agencies to move their assessment function to an outside organization to "achieve a greater degree of objectivity and credibility". This suggestion is to transfer important decisions on public health from government agencies, theoretically answerable to the public via the elected government, to private bodies. If Graham's HCRA is considered, it is answerable to the many private corporations that fund its activities. And who makes the decisions about which private bodies receive this power?

6) *Risk-Based Priority Setting*[22]

Graham mentions that while the Federal government conducts numerous risk analysis surveys each year little attention is being paid to the "big picture" questions on how resources are best allocated among various dangers. Giving one

[20] MacCleery *et al*, 2001.
[21] Graham, 1998, op.cit., p. 10.
[22] Graham, 1998, op.cit., p. 12.

of his risk comparisons, Graham compares the billions of dollars being spent to clean up soil at industrial sites where the probability of childhood exposures is low, versus the fact that little is spent on the problem of deteriorating lead-based paint in older homes, which does expose large numbers of children to lead. Again there is a shift in responsibility away from large industrial sources of pollution to a public "lifestyle" problem by comparing two completely unrelated health issues. In relation to his industrial site example, an important consideration he misses is that in some cases, previously industrial land may be re-developed in the future into residential allotments or adjacent to new residential areas. In this case, both adults and children could be later exposed if there was an inadequate clean-up in the first place. The classic example is the Love Canal toxic waste dump controversy in Niagra Falls, New York. During its use as a waste dump, there were no nearby residential areas, but years after its closure, lands on and adjacent to the site were re-developed as residential neighbourhoods and a school. After a record amount of rainfall, chemicals began leaching out of the ground and even waste disposal drums began breaking up through the ground in backyards. Plants and trees started dying and a faint choking smell was noted in the area. There were reports of abnormally high white blood cell counts, a possible precursor of leukaemia, increased rates of miscarrages and birth-defects in the Love Canal population.[23] A much-disputed study done for the EPA reported increased chromosomal abnormalities among 36 Love Canal residents.[24] The Love Canal development was later abandoned because it was found the concentration of toxic chemicals from the former dump had leached into the surrounding areas.[25]

Graham considered that risk rankings were necessary to give Congress, regulatory agencies and the public what he called a "proper perspective" about the relative importance of each new danger reported in the mass media, which he terms the "risk of the month syndrome". He recommended that Congress "require the executive branch to periodically rank hazards according to the seriousness and the available opportunities for cost-effective reduction". Further tying the ranking of

[23] E.C. Beck, The Love Canal Tragedy, *EPA Journal*, Jan. 1979, http://www.epa.gov/history/topics/lovecanal/01.htm, Accessed Mar. 30, 2007.
[24] Jasanoff , 1990, op.cit., p. 26-29.
[25] Beck, 1979.

hazards to a cost structure, Graham saw that the most serious dangers should not always be ranked the highest since the available risk-reduction strategies may be fairly ineffective or costly. Risks of only a moderate degree of seriousness may be ranked high if it is feasible to eliminate them at a low cost to society. (Low cost to society should be read as low cost to industry as Graham tends to intermix society's needs with industry needs). As ranking of risks would be a complex process, requiring what Graham called "delicate value judgments", agencies would need expert guidelines on risk-ranking drawn up by the Office of Science & Technology Policy and the Office of Management & Budget. According to Graham, Congress should require the development of guidelines and the application of risk-ranking by federal agencies. He mentions one example in relation to the inevitable degree of scientific uncertainty about the seriousness of every hazard. Graham was concerned that if "worst case" [EPA's conservative risk assessments] estimates of risk are used to characterise a hazard, this would bias that hazard toward a higher ranking, something Graham felt was unjustified. Graham's solution here is to incorporate further complexity by including "ranges or probability distributions that reflect uncertainty or simply refusing to rank poorly understood hazards". In addition, Graham felt that all stakeholders, including "laypersons" involved in the risk assessment process, must acknowledge and consider the use of risk ranking value judgements. Along the lines of his technocratic approach to risk, Graham felt that public participation by interest groups was not always the best approach since there may be a clear incentive to "game" the value judgment process in a way that favours industry, environmentalists or consumers. Comparisons could be made here with Graham's organization the HSRA and how HCRA value judgements clearly favour the industries that provide their funding base. A better solution in Graham's opinion is to elicit information on value judgments from a "representative citizen panel", objectively selected by a panel of social and physical scientists (a 'non-elected technical/political elite bureaucracy').

7) *Report Risks, Benefits and Costs*[26]

Graham mentions that Congress must embrace a principle of considering the competing risks of regulation as well as the target risks in its legislative language. As an example Graham mentions several EPA initiatives under the Clean Air Act, designed to reduce industrial air pollution from the chemical, coke production and aerospace industries. He points out that EPA risk assessment included estimates on the level of reduced pollution emissions as well as the estimated cost to industry but "failed" to include "scientifically supportable" estimates of the pollution risks to health or the number of adverse health effects prevented by the estimated reduction.

The scientific evidence that industrial air pollution is a significant environmental health hazard is well established. Graham's suggestions to Congress here adds another layer of complexity and difficulty in regulations, increasing uncertainty and requiring the services of the expert risk assessor. Graham mentioned that "The decision not to invest in benefits analysis will ultimately make it difficult for the EPA to present a persuasive case to congress and the public that their rule makings on hazardous air pollutants have been worthwhile." He urged Congress to pass an across-the-board statutory requirement that all risk-protection rules be accompanied by risk estimates and estimates of benefits and costs.

8) *Reasonable Relationship between Cost and Risk Reduction*[27]

Graham promotes the idea that "Congress should require agencies to make a plausible case that the benefits of legislation bear a reasonable relationship to costs. Graham asserts that his organization (HCRA) has "found that federal regulators frequently make investments in toxin control that would not be considered reasonable by the norms of preventative medicine". Congress can correct this discrepancy by requiring agencies to achieve a reasonable and consistent balance

[26] Graham, 1998, op.cit., p. 15.
[27] Graham, 1998, op.cit., p. 19.

between benefits and costs. He gives the example of the EPA's rule requiring the formulation of gasoline to reduce human exposures to carcinogens, such as benzene and volatile organic compounds. Estimated annual costs to the industry in Phase I were $700 million, and an additional $250 million in Phase II. Estimated benefits of Phase I were 20 fewer cases of cancer and 115,000 fewer tons of VOCs. Phase II benefits were estimated to be 4 fewer cases of cancer and 42,000 fewer tons of VOCs.

9) *External Mechanisms of Scientific Peer Review*[28]

Graham points out that as risk analysts wield a subtle but important power when conducting various types of risk analysis, Congress should insist that their reports be scrutinised and improved through the external mechanism of peer review. This could consist of a public advisory committee of non-governmental scientists from academia and non-profit research organizations. Members would be selected on the basis of their technical expertise rather than of the basis of their affiliation with particular stakeholder groups.[29] He claims that studies have shown that a public process of external peer review improves both the quality of the technical analysis[30] [31] and the degree of public confidence in decisions that are ultimately based on the analysis.[32] In addition, he said, Congress should insist that agencies consider recommendations from international bodies but in conjunction with

[28] Graham, 1998, op.cit., p. 21.
[29] Selecting advisory committee members on a technical basis and ignoring their affiliation with stakeholder groups will insure that industry scientists, who do have the relevant technical expertise, but focused for the benefit of their industry, will have increased representation on committees. This requirement would alienate the participation of environmental or public interest/consumer groups.
[30] According to the International Committee of Medical Journal Editors (ICMJE) all too often the peer review can be undermined by corporate influences. Because of this, the ICMJE have revised their publication guidelines to require disclosures of corporate influence on submitted research papers. See ICMJE uniform requirements, http://www.icmje.org/index.html#peer, Accessed June 23, 2007.
[31] P. Alderson *et al* performed a "meta-analysis" of editorial peer review using published studies as their data, applying statistical methods to the findings of the studies. They looked at the effects of peer review on various criteria, including methodological soundness, completeness and accuracy. When they surveyed the sum of research on peer review, they found only scattered empirical evidence supporting the use of editorial peer review as a mechanism to ensure quality of biomedical research. From: 'Truth or Consequences: Publication ethics', *The Economist*, vol. 360, Sept 13, 2001, pp. 62-63.
[32] Excluding public representation from the public advisory committee is more likely to lose public confidence its in decisions.

independent review by a public advisory committee of scientists in the United States.

10) *Judicial Review under the Principle of Deference*[33]

In order to make optional use of risk analysis and to insure that all agencies enact analytic practices in their decision making process, legislation is required which encourages agencies to take up risk analysis and which gives 'outside parties'[34]the opportunity to bring the agency to court for failure to do so. Graham also considers that risk analysis is unlikely to influence administrative decision makers unless they are compelled by legislation to seriously consider the findings of analysis when making decisions.[35] In Graham's opinion, legislative "reform" can be influential in addressing the mis-allocation of resources resulting from the public's current syndrome of paranoia and neglect about risk.

11) *Analytical Resources*[36]

Graham's wish list for a congressional commitment to risk analysis also includes further budgetary and technical resources as well as more analytical requirements. He sees the need to "cultivate and support a cadre of career public servants who have broad multi-disciplinary experience in risk analysis". Graham sees the need for analytical resources pressing in all fields, but especially in the sub-field of ecological risk assessment, the most immature aspect of this growing discipline. He thought the ultimate solution to the syndrome of paranoia and neglect was in the education of scientists and professionals, and especially in the education curricula used to educate young people in math, science and economics.

[33] Graham, 1998, op.cit., p. 22.
[34] Essentially this refers to industries which felt that they were being adversely affected by agency decisions.
[35] This provision virtually would make all risk-assessment decisions by the non-elected technical/political elite de facto legal requirements that if not followed to the letter of the law by federal agencies could result in legal action of behalf of the affected industry. For agencies involved they would therefore have no recourse except to rubber stamp non-elected technical/political elite dictates.
[36] Graham, 1998, op.cit., p. 23.

Appendix 2

Other relevant presentations at the 1998 International Seminar on 'EMF Risk Perception and Communication', Ottawa, Ontario, Canada

Immediately following Graham's presentation Michael Repacholi, head of the WHO's International EMF Project (IEMFP) gave a presentation on the extent of the possible EMF problem for society and how IEMFP was addressing this issue. He pointed out that "[e]veryone in the world is now exposed to a complex mix of EMF frequencies. EMF has become one of the most pervasive environmental influences and exposure levels at many frequencies are increasing significantly as the technological revolution continues unabated and new applications using different parts of the spectrum are found". In order to address this problem IEMFP was set up to establish better health risk assessments to identify any environmental impacts of EMF exposure and these would then be used to develop an international consensus for exposure guidelines. No details on IEMFP's risk assessment methodology were given. Repacholi then went through the current (as of 1998) state of the scientific literature for both powerfrequency EMF fields and RF fields. His report was a fairly in-depth description of what was known, for both thermal and non-thermal biological effects and identified a number of areas where research was needed to clarify uncertainties.[1]

Dr Philip Gray from the Programme Group MUI, Germany, cited the risk approach taken by the National Research Council (1996)[2] and the Presidential/Congressional on Risk Assessment and Risk Management (1997)[3] as to why dialogue with all stakeholders should be an important part of the overall risk analysis process. Gray suggested that, without this communication, technical

[1] M. Repacholi, 'EMF concerns and WHO's International EMF Project', EMF Risk Perception and Communication, Proceedings of the International Seminar on EMF Risk Perception and Communication, Ottawa, Ontario, Canada, Aug. 3–Sep. 1, 1998, pp. 33-55.
[2] National Research Council (NRC) Committee on Risk Characterisation, "Understanding risk. Informing decisions in a democratic society", Washington D.C., National Academy Press, 1996.
[3] Presidential/Congressional on Risk Assessment and Risk Management, "Framework for Environmental Health Risk Management. Final Report 1, Washington D.C., 1997.

risk assessment by itself was insufficient to be a useful process for risk characterization. Stakeholders would include independent consultants, citizen groups, industry representatives and other affected parties. This was meant to take into consideration the concerned public's risk perceptions but it would not necessarily affect the final risk assessment. Gray pointed out that, in practice, risk assessments may be framed by many implicit and explicit assumptions, subject to controversy both within and without the scientific community, subject to further consultation by decision makers with further review and decisions needing to be made in future years. As for the EMF controversy Gray considered that this dialogue was already happening to an extent with international organizations, such as IEMFP and at many national agency levels.[4] Chapter 5 of this thesis examines the above points relevant to the Australia RF standards controversy.

Peter Wiedemann from Programme Group Humans, Environment & Technology Research Centre, Julich, Germany saw the EMF issue as primarily a communications problem. He presented a detailed public relations guideline, from primarily an industry viewpoint, on how to handle public anxieties and fears in EMF communications with the public. According to Wiedemann lay people show considerable gaps in their understanding and generally are unfamiliar with any scientific data/studies. Some of the strategies mentioned, when dealing with the public, are to explain the limit values (i.e. the exposure standard human exposure limits), information about the state of the art and the quality of the studies and reference to the experts, such as WHO (i.e. IEMFP) which "relies on the best scientists". A risk comparison was given that claimed that the basic exposure from natural EMF fields averages 0.003 W/m2 and after the final extension of mobile phone networks the load of these fields would be 0.0002 W/cm2. Therefore, according to Wiedemann's logic, "[e]xposure due to mobile radio technology is thus clearly lower than the already existing average background exposure of 0.003 W/cm2." This comparison is disingenuous on at least three points. Firstly, it ignores the increasing complexity of ever-higher frequencies in

[4] P. Gray, 'Improving EMF Risk communication and management: the need for analysis and deliberation', EMF Risk Perception and Communication, Proceedings of the International Seminar on EMF Risk Perception and Communication, WHO, Ottawa, Ontario, Canada, Aug. 3–Sep. 1, 1998, pp. 57-76.

telecommunications that never before existed in the natural environment. Secondly, it is impossible to predict what the "final extension of the mobile phone network" will be and thirdly, it is at odds with what Repacholi said earlier at the same WHO seminar that "EMF has become one of the most pervasive environmental influences and exposure levels at many frequencies are increasing significantly."[5] Much of Wiedemann PR guideline consisted of explaining on how to defend the official RF standard limit values, which he termed "protective values."[6] In some respects Wiedmann's PR guidelines were similar to what transpired with industry risk-communication with the concerned public in the Australian TE/7 RF standard setting process. Regardless of community and scientific concerns the industry and its factional supporters on the committee would not budge from the official limit "protective" values during the discussions (Chapter 5).

Gerry Kruk from Gerry Kruk & Associates Communications Ltd., Canada, argued at the Seminar that controversies over EMF risks from both powerline and telecommunications facilities can be effectively managed and resolved using the techniques developed for effective risk communication. After giving a run-down on the important features of risk communication, Kruk concluded that it is an effective strategy for avoiding and defusing EMF and other controversies. As with most of the other speakers at the seminar, the problem was not that there may be a real risk to be dealt with but how to reduce the public's concern that there may be a risk to health.[7]

Of particular interest was the presentation by Judy Larkin, a principal from *Regester Larkin*, a UK-based crisis and issues management consultant firm. Larkin saw the problem as one where modern society now had "more time to spend contemplating over all sorts of long-term theoretical hazards". Nowhere in her

[5] Repacholi, 1998.
[6] P.M. Wiedemann, 'EMF risk communication: Themes, challenges and potential remedies', EMF Risk Perception and Communication, Proceedings of the International Seminar on EMF Risk Perception and Communication, WHO, Ottawa, Ontario, Canada, Aug. 3–Sep. 1, 1998, pp. 77-107.
[7] G. Kruk, 'Risk Communication and the Management of EMF Risks', EMF Risk Perception and Communication, Proceedings of the International Seminar on EMF Risk Perception and Communication, WHO, Ottawa, Ontario, Canada, Aug. 3–Sep. 1, 1998, pp. 109-135.

presentation is there any acknowledgement that the public's concerns may, in some instances, be justified. In addition, according to Larkin, due to past health controversies, such as asbestos, tobacco, genetically modified foods, mad cow disease, etc, the public had become "predisposed to expecting adverse outcomes, no matter whether the risk is real or perceived", and this included distrusting organizations that promote a particular technology. In relation to EMF, Larkin saw the problem internationally as one where the public perception over risks was being shaped by the media and anti-EMF activists, thereby causing high levels of anxiety and controversy. Larkin placed much of the blame for this situation on the media's marked increase in negative articles where "alarmist messages make better stories than reassuring messages". The problem, according to Larkin, was that both "scientists and activists were receiving considerably more airtime than industry". The challenge according to Larkin was to "minimise public anxiety and maximise the effectiveness of communication initiatives". A brief run-down was given on factors influencing the public's perception of risk with the central aim of achieving risk acceptance by the public.[8] She said that as the public was easily influenced by the media, it is the responsibility of the scientists involved to "ensure the right information is available and inaccuracies are corrected when they appear in the media". Revealingly, Larkin saw as possibly the biggest risk issue in the UK as one that threatened the way industry operated, if "communication continues to be led by the media and activists, with inaccurate reporting of scientific research going on unrebutted". She concluded that the way ahead was to support "the WHO and other independent research frameworks providing clear, accurate and consistent information to consumers in order that they can be reassured by responsible action and make informed decisions".[9] The overall message in her presentation was that the primary risk to be assessed and managed was the risk to industry of having to make changes to their operations as a result of public concerns. Assessing whether or not public concerns are justified was apparently not part of the task.

[8] Amount of awareness of possible risk, level of scientific consensus over extent of risk, equity of risk, detectability, dread disease vs. not dreaded, nature of risk (man made or natural), and individual choice/control over risk.

[9] J. Larkin, 'Evaluating Response Options', EMF Risk Perception and Communication, Proceedings of the International Seminar on EMF Risk Perception and Communication, WHO, Ottawa, Ontario, Canada, Aug. 3–Sep. 1, 1998, pp. 137-150.

William Leiss from the School of Policy Studies, Queen's University, Kingston, Ontario, Canada, and Greg Paoli from Decisionalysis Risk Consultants, also from Ontario, made the point in their presentation at the Seminar that concerned members of the public were effectively using the Internet to educate themselves on the science to become effective advocates. This is also briefly examined in Chapter 4 of this thesis where the Australian public was able to effectively tap into Internet resources to gain a credible knowledge of the various RF/MW (and ELF) risk assessments, start up newsletters, and in several cases write books on the topic. According to Leiss and Paoli, "individual members of the public who do not necessarily have scientific expertise, but who have concerns about risk issues, have begun using Internet resources to gather information, establish contact with like-minded people everywhere on the globe, obtain guidance on how to ask questions of experts, and prepare themselves to become skilled intervenors in risk controversies". They were of the opinion that Internet based resources, in spite of weaknesses in the medium, were vital new aids for the empowerment of the public and were part of the proper functioning of legitimate democratic decision-making processes. They laid out basic principles to facilitate dialogue between expert risk assessors and the informed public on risk issues, principles that he felt were not being properly applied to reduce conflicts. They argued that three points must be clearly communicated to the public by both industry and government, whom he referred to as risk promoters:[10]

- The excess (increased) risk in every involuntary exposure
- The level of uncertainty in expert risk assessments
- The rationale for inequitably distributed exposure.

In a democratic society Leiss and Paoli argued the risk promoters have the duty to do so.[11]

[10] Risk Promoters refer to both industry and governments which jointly introduce new technologies.
[11] W. Leiss, G. Paoli,' The Internet as a Public Information resource with a case study on a Canadian controversy about radio-frequency fields', EMF Risk Perception and Communication, Proceedings of the International Seminar on EMF Risk Perception and Communication, WHO, Ottawa, Ontario, Canada, Aug. 3–Sep. 1, 1998, pp. 151-192.

In relation to the communication of uncertainties, in his presentation at the EMF Seminar, William Bailey from Bailey Research Associates stated that acknowledgement of uncertainties to the public was necessary and that risk communication should be at the start of the risk assessment process. He saw an inevitable conflict between the scientists who were aware of the uncertainty in the scientific data, and the public and regulators who typically wanted risk assessments and guidance to reflect a total lack of uncertainty over risk. The problem was that scientists (including industry technical experts) were concerned that any acknowledgement of uncertainty would increase public concerns and result in criticism over their assessments. Bailey argued that such beliefs should not allow scientists to mislead other stakeholders, including the public. Thorough documentation and a transparent evaluation of the scientific data were essential to having risk assessment support an effective risk communication. As for the safety factors in the ICNIRP powerfrequency standards (10 for occupational and 50 for public exposure) Bailey questioned the justification of ICNIRP for the stricter public safety factor if exposures below the occupational limits were without effect. He mentioned that ICNIRP needed to explain its rationale for the extra public exposure safety factor.[12]

Daniel Wartenberg, from the Environmental and Occupational Health Sciences Institute, Piscataway, New Jersey gave a review of the scientific approach to inferring risk, based on weight of evidence, meta-analysis and quantitative risk assessment. He explained that weight of evidence is a careful and systematic review of the scientific literature, including *in-vitro*, *in-vivo* and epidemiological evidence. However, he pointed out that there is a subjective side to this evaluation based on reviewers' judgements of the quality, relevance and importance of the data. Judgement is guided by various accepted criteria but there is concern that there may be a focus on particular studies or specific issues that do not represent the whole body of evidence. [Relevant here is Chapter 3 of this thesis where the

[12] W.H. Bailey, 'Principles of Risk Assessment with Application to Current EMF Risk Communication Issues', EMF Risk Perception and Communication, Proceedings of the International Seminar on EMF Risk Perception and Communication, WHO, Ottawa, Ontario, Canada, Aug. 3–Sep. 1, 1998, pp. 193-211.

subjective nature of the weight of evidence approach taken by the IEEE RF standard setting committee is examined.] Wartenberg then covered meta-analysis, the systematic review of a body of epidemiological literature with statistical methods applied to summarize the quantitative findings of individual studies or find consistent patterns which also may be areas of disagreement in the results. He then covered the basic outline of qualitative risk assessment, the topic of this chapter, and concluded with a brief outline of how these methods could be applied to the EMF powerfrequency controversy.[13]

Caron Chess, from the Center for Environmental Communication, Rutgers University focused on the need for research on public participation in the risk assessment process. There has been little systematic research in this area (as of 1998) and what little research that was available either used vastly differing criteria or was done before the mid-1980s. Chess' main point was that for public participation to be effective, it must be based on solid research not a collection of assumptions. She examined the pros and cons of a number of different forms of public participation, with an emphasis on public meetings and citizen's advisory councils (CACs).[14]

The final presentation of the seminar was given by Richard Woodley, webmaster for the Internet based *Bridlewood Electromagnetic Fields Information Service*. Woodley's presentation was from the activist's viewpoint. Woodley offered the opinion that the EMF issue was one of politics, where evidence of EMF health hazards was being suppressed by the White House, and agencies downplaying or contradicting findings that are contained in the studies. He concluded with the remark that the public deserved better than this.[15]

---

[13] D. Wartenberg, 'How Dangerous Is It Really? Some Approaches for Inferring Risk', EMF Risk Perception and Communication, Proceedings of the International Seminar on EMF Risk Perception and Communication, WHO, Ottawa, Ontario, Canada, Aug. 3–Sep. 1, 1998, pp. 213-227.
[14] C. Chess, 'Public Participation: Guiding Practice With Research', EMF Risk Perception and Communication, Proceedings of the International Seminar on EMF Risk Perception and Communication, WHO, Ottawa, Ontario, Canada, Aug. 3–Sep. 1, 1998, pp.193-227.
[15] R. Woodley , 'The Politics of EMFs- An Activist's Viewpoint', EMF Risk Perception and Communication, Proceedings of the International Seminar on EMF Risk Perception and Communication, WHO, Ottawa, Ontario, Canada, Aug. 3–Sep. 1, 1998, pp. 309-310.

Appendix 3

Summaries of the negative 'no' votes from the Australian TE/7 committee

1). John Hunter, Commonwealth Science and Industrial Research Organisation (CSIRO)

John Hunter opposed the adoption of the draft standard because it departed from the original 1985 standard, particularly with the increase in exposure levels and averaging times. He stated that there was a high level of controversy and uncertainty, making the level of potential risk to human health unknown. Hunter said that with this level of uncertainty it was advisable to set exposure levels far below levels known to cause adverse effects as is technically, economically, and socially feasible. With this, CSIRO saw no evidence being presented to suggest that the industry would be hindered if the levels in the 1895 standard were re-instated.[1]

2). Roger Matthews, Local Government New Zealand

Roger Matthews considered that both the "basic restrictions" and "Derived Reference Levels" were difficult to determine, leaving local governments and other agencies with a standard what could not be enforced. Of special concern was Clause 10(b), having to do with "the primacy of the industry's business interests over neighbours interests, cost minimisation – to the industry, and appropriateness". This was defined by the industry itself – meaning that the industry could disregard the clause if it chose to. There was also no requirement for industry to show that best practice was followed to minimise exposure levels to the public and this should be addressed in the standard. Matthews also pointed out that the most of the submissions to TE/7 requested a precautionary approach and in response the committee had weakened it, therefore there was not a

[1] J. Hunter, CSIRO, CSIRO Ballet Draft (TE/7) WP ID Number 17067. cdr. doc, Mar. 02, 1999.

reasonable balance between the needs of industry and the interests of the community.[2]

3). Dan Dwyer, Communications, Electrical and Plumbers Union (CEPU)

Dan Dwyer saw the ICNIRP guidelines as providing nothing more that a "cooking standard", as it only regulated the amount of heating that could be applied to the human body. Dwyer disagreed with assertions that ICNIRP's standard was international and unassailable. He saw it as a controversial standard that suited industry. There was an acknowledgment that while industry may need massively increased exposures for its various technologies, giving enormous profits to the industry, this had to be balanced against a risk to public safety. Dwyer saw a number of studies reporting adverse findings being criticised as mere anecdotal evidence in a manner similar to what happened in the tobacco and asbestos scandals. Since the 1985 standard Dwyer saw all the research as being aimed at justifying an exploitation of the basic restriction (a rise in temperature of one degree) to the limit, with little effort at replicating previous studies. He considered such an approach was inconsistent with a precautionary approach. Dwyer mentioned that the draft had contained a statement on a precautionary approach which the public supported, but that the wording was later amended to end up merely as "feel good" statements put into the standard to reassure the public. This Dwyer felt was deceitful and misleading to the public. Some other points that he was concerned about were that Table 2 of the draft standard showed that while the whole body should not be heated above the level of 0.4 W/kg, it allowed the head exposure to be increased 25 times to 10.0 W/kg. This gave very significant temperature rise in parts of the head and brain which was a big bonus for the mobile phone industry. Another concern was that the increase in averaging times from the previous 60 seconds to 6 minutes was not consistent with the precautionary approach.

[2] C. Singley, R. Matthews, LGNZ, Ballot for the TE/7 Committee, DR 98627 – Human Exposure to Electromagnetic Fields, Mar. 1999.

Dwyer considered ICNIRP's stated standard of proof as set so high (dismissive) as to be inconsistent with public safety. He said that when there is any doubt the public should be fully informed and precautionary action taken.

The Vienna Resolution was suggested by Dwyer as a model for defining bioeffects. He recommended that instead of using the terms "athermal", "nonthermal" or "microthermal" effects, the term "low intensity biological effects" was more appropriate.

Dwyer said that the entire RF standard setting process was fundamentally flawed as the wrong people were making the decisions over public health. He felt that a political decision was needed, which he defined as "When it comes to public safety, if there is any risk, then the public should be firstly imformed, then protected!" (by the government).

In conclusion Dwyer stated:

> ICNIRP may take a conservative approach. A conservative decision would be the best approach for a professional research body with a reputation to protect! It is clear that any study that finds a link between RF radiation and a health risk will be severely criticised by the RF manufacturers/telecoms. This does nothing for your reputation, let alone your ability to bet more funds to replicate your findings.[3]

4). Sue Pennicuik, Australian Council of Trade Unions (ACTU)

Sue Pennicuik supported the reasons for its no vote as being the same as those expressed in Dwyer's CEPU submission (above). [4]

5). John Lincoln, The Australian Consumers Federation (ACF-1)

[3] D. Dwyer, TOA, TE/7 Ballot TE/7–0090, Mar. 3, 1999.
[4] S. Pennicuik, ACTU, Reasons For Negative Vote, D99030, Mar. 1999.

John Lincoln did not agree to the adoption of the ICNIRP guidelines as they were essentially flawed by the omission of some studies and the incorrect interpretation of others. The submissions by Neil Cherry and myself were mentioned as ones that could have formed a sensible debate in the committee but they were ignored. Lincoln felt that an increase in exposure levels without a meaningful precautionary approach would result in the proliferation of RF technology which had not been proven safe.

Lincoln mentioned Dr. John Holt's submission that explained that while the whole body average SAR rate of 4 W/kg was based on healthy bodies, it failed to consider the fact that diseased tissue absorbs more energy than does healthy tissue. He mentioned that this submission was ignored by the committee as well.

Lincoln took special note that, while public submissions were almost totally ignored by the committee, industry submissions received considerable attention. This was inconsistent with Standards Australia's stance of impartiality and was unjustifiable, in Lincoln's opinion.

As for a precautionary approach, Lincoln saw it as being "completely and utterly confounded so that the draft standard ignores all reference to precaution, despite strong community support for the principle" Lincoln added, "To exclude a precautionary approach mocks the notion of public health protection and utterly discounts community concerns."

Lincoln took issue with how the large number of public submissions that indicated an enormous public concerns about the effects of low level (non-thermal) radiation were in no way addressed in the final draft. Lincoln considered that such concerns could have been addressed with a precautionary approach. He considered that the standard dismissed non-thermal effects on the basis that "causation has not been shown". He explained that to wait for causation to be established was inappropriate in the case of RF as the latency period can be 20 + years. He stated that "when it comes to protecting the community public health, a responsible public health standard would not take such a risk". Furthermore, Lincoln noted

that the wording in the Foreword put public health subservient to the needs of industry. He also wondered why increasing the averaging time to 6 minutes from 60 seconds was so important to industry. Lincoln concluded:

> I cannot in all conscience endorse a document that reflects so little regard for community opinion and community health. The Document must admit to being what it is: a performance standard based on thermal levels of RF only and must not pretend to be a Standard that protects public health at all levels of exposure.[5]

6). Don Maisch, The Australian Consumers Federation (ACF-2)

In justifying my no-vote to the proposed standard, I mentioned my previous submissions on the importance of a precautionary approach to be incorporated into the standard before voting in the affirmative. I pointed out that the draft that was agreed upon at the earlier Wellington NZ meeting, and which was circulated for public comment, did have elements of a precautionary approach. However the final wording in the Foreword and particularly Section 10(d) of the final draft was a significant departure from the concept of a precautionary approach as formulated at the Wellington meeting. In fact any reference to "Precautionary Approach" had been deleted in the final version.

I mentioned the New Zealand Shirley school decision (Chapter 5) and how the judge had erred in his ruling that "A precautionary approach is already implicit in the Act " (ICNIRP). This was because even though the guidelines could be said to have a precautionary approach for thermal effects, it did not address a precautionary approach for possible low-level adverse biological effects. This is what the public submissions to TE/7 were overwhelmingly concerned about.

I saw an apparent bias on behalf of the judge in the Shirley decision where he accused the expert testimony of some of the witnesses as being biased but

[5] J. Lincoln, ACF, Reasons For Negative Vote, Mar. 1999.

uncritically accepted the industry's evidence as correct in its interpretation of the science. For instance Judge Jackson stated that ICNIRP accurately portrays the general scientific view of the research and he referred to the discredited Robinette et al 1980 study. I pointed out that if the judge displayed the same level of critical examination with the ICNIRP Guidelines he would have found that ICNIRP made many significant errors in its evaluation of the epidemiological evidence. As my previous submissions to TE/7 asserted, the ICNIRP Guidelines apparently were incapable of dealing objectively with data on population exposures to RF/MW especially in light of the three epidemiological studies that were referred to on page 11 of the guidelines. This apparent bias in the ICNIRP guidelines was the main reason that I considered that a strong precautionary approach was necessary in relation to possible adverse effects from prolonged RF exposure at intensities insufficient to cause heating. In addition I called for a thorough and independent analysis of the ICNIRP document before it was accepted by the committee.

I considered the final draft as a big step backwards when compared to the original 1985 Standard, where it stated in the Foreword:

> It has been demonstrated that low-level, long-term exposure can induce a variety of effects in the nervous, haematopoietic and immune systems of small animals. Such exposure may influence the susceptibility of such animals to other influencing factors. Thermal influences seem inadequate to account for these and other effects.

I concluded that the final result was a "homoeopathic dose of Precautionary Approach", which had been diluted to the extent that virtually nothing was left of the original intent. Therefore as a public /consumer representative I could not justify any vote except the no option.[6]

[6] D. Maisch, ACF, Final Vote, Mar. 3, 1999, http://www.emfacts.com/papers/submissions.html

7). Jim Leigh, The National Occupational Health and Safety Commission (NOHSC),

Jim Leigh saw the reliance on 1998 ICNIRP guidelines as unsatisfactory when compared to the 1998 U.S. National Institute of Environmental Health Sciences (NIEHS) evaluation that followed the International Agency for Research on Cancer (IARC) cancer classification of extremely low frequency (ELF) EMF as an IARC class 2B carcinogen. He thought that TE/7 should wait until the formal IARC evaluation of RF exposures, scheduled for June of 2003. In the meanwhile the Interim standard could apply.

Leigh also thought it inappropriate for TE/7, composed as it was, to be trying to set a health based standard and giving public assurances (of safety) would be wrong. It was also wrong to be so concerned about giving legal protection to the creators of RF when they have such a strong voice in the process. He concluded that he "was concerned with the almost arrogant dismissal of much of the public comment and the failure to consider the Vienna Resolution of October 1998."[7]

8). Ivan Beale, Adopt Radiation Controls (ARC), New Zealand.

Ivan Beale wrote that in its final form, the draft standard followed the philosophy used in both the IEEE and ICNIRP standards in that maximum permissible exposure levels are related to the well-established adverse effects associated with whole-body heating. Even though there is general agreement that the draft standard does provide adequate protection from adverse effects related to whole-body heating, it failed to consider findings from recent research that found adverse effects at levels far below the maximum permissible levels. Beale pointed out that he and other committee members had consistently argued for a standard that took into consideration the evidence of adverse effects at levels below the basic restriction of 4W/Kg. Details of this evidence, as well as references for precautionary principles and the principles of acceptable risk, had been presented

[7] J. Leigh, NOHSC, Reasons For Negative Vote, March 1999.

to the committee. Beale pointed out that both he and Roger Matthews had presented papers to the committee dealing with these issues and why the draft standard did not serve the public health protection needs of the community. As the final draft standard did not reflect these arguments he could not support it.

Beale said that he would support the draft standard if it was clearly stated what the standard provided protection against and not pretend to provide adequate protection from all practically adverse effects. Beale concluded that:

> In my view, the only honest alternative is to produce a standard that specifies maximum permissible exposure levels for effects associated with whole-body heating at exposure levels above 4 W/Kg, and make it clear that this is not intended to provide protection from other effects. These must be handled using some precautionary principle such as Prudent Avoidance.[8]

Beale made the point that the justification for the standard's dismissal of non-thermal effects was encapsulated in a sentence in the Foreword where it stated: "There is no conclusive evidence of any harmful effects to people exposed to the threshold value of 4 W/Kg". However, he considered that the validity of that sentence rested upon a definition of what "conclusive evidence" constituted but nowhere in the standard was that defined. Beale said that public health protection needed to go beyond "conclusive evidence" to "indicative evidence", especially when the scientific data on RF bioeffects is so limited. This is even more so with modulated RF where there has been almost no research on the effects of exposure to these fields. He stated that "[t]o indicate, as the draft standard does, that we have anything more than a very vague idea of the biological role of low-frequency modulations is as dishonest as it is dangerous".[9]

[8] I. Beale, ARCNZ, Comments on revised draft TE/007-0050-520 and additional reasons for my negative vote,Mar. 1999.
[9] ibid.

Beale concluded:

> In my view, the only honest alternative is to produce a standard that specifies maximum permissible exposure levels for effects associated with whole-body heating at exposure levels above 4 W/Kg, and make it clear that this is not intended to provide protection from other effects. These must be handled using some precautionary principle such as Prudent Avoidance.[10]

[10] ibid.

Appendix 4

Australian/New Zealand public resource documents

1) The 1991 book by retired CSIRO scientist, Les Dalton, *"Radiation Exposures: The hidden story of the health hazards behind official 'safety' standards'*, written for the general public, served as a basic primer in both ionizing and non-ionizing radiation health issues.[1]

2) The January 1994 report by CSIRO scientists A. Doull & C. Curtain, titled *" A Case for Reducing Human Exposure Limits Based on Low Level, Non Thermal Biological Effects"* was made widely available to the concerned public by activist groups in Sydney and Adelaide. In addition the offices of the Australian Democrats in Hobart and Melbourne widely distributed copies. For the public this report gave a general overview on the history of RF standard setting internationally and in Australia, examined the thermal vs. non-thermal controversy and called for reducing the exposure limits.[2]

3) A June 1994 CSIRO report prepared by Stan Barnett was titled *"CSIRO Report on the Status of Research on the Biological Effects and Safety of Electromagnetic Radiation: Telecommunications Frequencies"*. Unlike the ICNIRP guidelines which dismissed chronic low level exposures as beyond the scope of the guidelines, and therefore addressed thermal acute effects only, the CSIRO report, which reviewed the important studies on RF exposure, concluded that a high level of uncertainty existed in the RF literature leading to an inability to address the issue of chronic environmental level exposures to RF. The report concluded that there was insufficient reliable scientific evidence on which to base sound conclusions about the safety of RF/MW radiation exposures in telecommunications. The report stated: "…because of its equivocal nature, the database for RF emissions has

[1] L. Dalton, *Radiation Exposures: The hidden story of the health hazards behind official 'safety' standards*, Scribe Publications, 1991.
[2] A. Doull, C. Curtain, A Case For Reducing Human Exposure Limits Based On Low Level, Non Thermal Biological Effects, Unpublished, 1994.

limited value. It may be dangerous to make general statements on safety based on lack of evidence of harmful effects when so little relevant research has been carried out."[3] Though this report was finalised by June 1994 it was only released in the form of six copies deposited in the Parliamentary library and languished there until March of 1995 when Senator Robert Bell and the magazine *Communications Day* received an anonymous letter about the report's existence. Bell's office requested two copies from Spectrum Management Agency (which later arrived marked confidential) and thereafter widely publicised the report's existence.[4] At about the same time investigative journalist Stewart Fist received a digital copy of the report and placed the entire report on his web site.[5]

According to Betty Venables, the convener of Sydney based Electromagnetic Radiation Alliance of Australia (EMRAA), the Report was the public's first concise and comprehensive document on the RFR health issue. On advising the NSW Local Government Association of the availability of the CSIRO Report the President, Peter Woods, issued instructions for every local Council in NSW to receive a copy. According to Venables, the public concern regarding RFR exposure and the potential health threat was therefore based not on fear and ignorance but on reliable information regarding the state of the science, which they were obliged to seek out in the interest of family health.[6]

4) In October 1994, Senator Bell tabled in the Senate a report titled, *(Non-ionizing) Electromagnetic Fields and Human Health: Are current standards safe?*. This report critically examined the basis for the power frequency exposure guidelines and called for exposure standards to reflect the epidemiological evidence for chronic low level health effects at levels far lower that the standard limits.[7]

---

[3] S. Barnett, Report on the Status of Research on the Biological Effects and Safety of Electromagnetic Radiation: Telecommunications Frequencies, CSIRO Division of Radiophysics, June 1994.
[4] As reported in D. Maisch, 'Fields of Conflict: The EMF Health Hazard Controversy'(self published), p. 57-58, Aug., 1995.
[5] Correspondence with Stewart Fist, Aug. 30, 2005.
[6] Correspondence with Betty Venables, convenor of the The Electromagnetic Radiation Alliance of Australia (EMRAA) Sutherland Shire Environment Centre, Sutherland, NSW. July 27, 2003.
[7] D. Maisch, (Non-ionizing) Electromagnetic Fields and Human Health: Are current standards safe?, Senate Hansard, Oct. 1994.

5) In April of 1995, Dr. Neil Cherry, from Lincoln University, New Zealand, widely circulated a report: *"Potential and Actual Adverse Effects of Cell Site Microwave Radiation"* This report consisted of his own review of the RF literature which highlighted shortcomings in the ICNIRP guidelines, as well as detailing possible adverse effects from mobile phone base stations at levels far below those set by ICNIRP.[8] This report was followed by several later versions, all critical of ICNIRP guidelines.

6) In August 1995, I self published *Fields of Conflict: The EMF health hazard controversy.* This update of my October 1994 Senate paper was widely distributed in Australia by the Office of Senator Bell.[9]

7) In April 1996 Senator Bell tabled in the Senate a background report titled, *"Mobile Phones and Their Transmitter Base Stations: The Evidence For Health Hazards - A local Government and Community Resource Document"* This report was the result of an approximately six month search of literature relevant to health effects from telecommunications technology.[10]

[8] N. Cherry, Potential and Actual Adverse Effects of Cell Site Microwave Radiation, (self published), 17 Apr. 1995.
[9] Maisch, 1995.
[10] D. Maisch, 'Mobile Phones and Their Transmitter Base Stations: The Evidence For Health Hazards, Australian Senate Hansard, Apr. 1996.

Glossary

ACA: The Australian Communications Authority. Now the Australian Communications and Media Authority with responsibilities for the regulation of broadcast, internet, radio-communication and telecommunications technology.

ACRS: The Advisory Committee on Reactor Safeguards advises the U.S. Nuclear Regulatory Commission on reactor safety studies, facility license applications, hazards of proposed facilities and the adequacy of proposed reactor safety standards.

ACTU: The Australian Council of Trade Unions is the peak body representing the Australian trade union movement.

AEC: The Atomic Energy Commission was established by the U.S. Congress in 1946-1947 to fulfil the dual roles of promoting the civilian uses of nuclear energy technology and regulation of that technology. As a result of these conflicting roles the regulatory function was transferred to the Nuclear Regulatory Commission in 1974 and the developmental function transferred to another organization which later became the Department of Energy.

AFRL: The Air Force Research Laboratory (U.S.) was created in October 1997 as a consolidation of four Air Force laboratory facilities with a research and development mission to improve the nation's war-fighting technologies.

AGNIR: The Advisory Group on Non-Ionizing Radiation was established by the U.K.'s NRPB in 1990 to review the scientific literature on the human biological effects of non-ionising radiation to advise on research priorities. Reconstituted in 1999 as an independent advisory group it now advises the Health Protection Agency on radiation, chemical and environmental hazards.

AIEE: The American Institute of Electrical Engineers was a U.S. based organization of electrical engineers from 1884 to 1963 when it merged with the Institute of Radio Engineers to form the IEEE.

ALARA: As Low As Reasonably Achievable is a fundamental principle in radiation protection with the aim of reducing radiation exposure (both for ionizing and non-ionizing radiation) but taking economic and social factors into account.

AMTA: The Australian Mobile Telecommunications Association is the peak industry body representing Australia's mobile telecommunications industry.

ANSI: American National Standards Institute is an industry standards body that promotes and facilitates voluntary consensus standards and assessment systems to aid global competitiveness of the American business sector while helping to assure the safety and health of consumers and the protection of the environment.

AOARD: The Asian Office of Aerospace Research and Development. A foreign detachment of the U.S. Air Force Office of Scientific Research.

ARC: Adopt Radiation Controls was a New Zealand based public interest group opposed to the adoption of the ICNIRP RF Guidelines for the nation.

ARPANSA: The Australian Radiation Protection and Nuclear Safety Agency is a federal government organization with the responsibility for protecting the health and safety of people, and the environment, from the harmful effects of ionising and non-ionising radiation.

ARRL: The American Radio Relay League represents the interests of amateur radio enthusiasts before U.S. regulatory bodies and provides technical advice and assistance to amateur ratio operators in the U.S.

ASA: The American Standards Association was reorganized in 1966 to become the United States of America Standards Institute (USASI), renamed in 1969 as ANSI.

CAG: The Carcinogen Assessment Group formed by the U.S. EPA in order to centralize its in-house expertise on cancer.

CDRH: Center for Devices and Radiological Health within the U.S. FDA is responsible for ensuring the safety and effectiveness of medical devices and eliminating unnecessary human exposure to man-made radiation from medical, occupational and consumer products and educating industry on the relevant policies and regulations.

CENELEC: The European Committee for Electrotechnical Standardardisation comprised of the National Electrotechnical Committees of 30 European countries and 8 National Committees from neighbouring countries. The business orientated organization works to further European harmonization of standards, creating standards requested by the market and harmonized standards in support of European legislation. It focuses on increasing market potential and encourages technological development and guarantees the safety and health of consumers and workers.

CEPU: The Communications, Electrical and Plumbing Union (Australia) represents the interests of the workers of three essential industries, the electrical, communications and plumbing sectors.

CFA: The Consumers Federation of Australia is the national peak body for consumer groups in the nation.

COMAR: The IEEE Committee On Man And Radiation a group of experts on health and safety issues related to electromagnetic fields, from powerline through microwave frequency ranges.

COST: The European Cooperation in the Field of Scientific and Technical Research that supports co-operation among scientists and researchers across Europe. The organization now has 35 member countries and enables scientists to collaborate in a wide spectrum of activities in research and technology.

CPSU: The Community and Public Sector Union (Australia) represents workers from the public sector, telecommunications, call centres, employment services, commercial broadcasting, the aviation industry and the science and research sectors.

CSIRO: The Commonwealth Science and Industrial Research Organisation is Australia's national science agency with more than 50 sites throughout Australia and overseas.

CTIA: The Cellular Telecommunications Industry Association (U.S.) represents all sectors of wireless communications – cellular, personal communication services and enhanced specialized mobile radio. They represent service providers, manufacturers, wireless data and internet companies and other sectors of the wireless industry.

CWD: The Compensating Wage Differential: The acceptance of a higher wage in exchange for a higher occupational risk of injury.

DARPA: The Defense Advanced Research Projects Agency is the central research and development office for the U.S. Department of Defense (DoD). DARPA's mission is to maintain the technological superiority of the U.S. military and prevent technological surprise from harming national security.

***Daubert* ruling**: The U.S. Supreme Court issued a directive on June 28, 1993 relating to how federal judges should decide whether to allow expert testimony into the courtroom. It directed judges to act as scientific "gatekeepers" by examining the scientific method underlying expert evidence and to admit, in their opinion, only that evidence that was both "relevant and reliable."

Diathermy: A now disused therapeutic treatment that used radiofrequency radiation to selectively heat tissue, such as muscles as it was thought to induce relaxation and aid healing.

DoD: The U.S. Department of Defense.

EC: The European Commission is the executive branch of the European Union. The body is responsible for proposing legislation, implementing decisions, upholding the Union's treaties and the general day-to-day running of the Union.

EEPA: The Electromagnetic Energy Policy Board (U.S.).

EHC: Environmental Health Criteria are WHO monographs that provide international, critical reviews on the health effects of electromagnetic fields/radiation, chemicals and biological agents on human health and the environment.

Electromagnetic Spectrum: A way of organizing electromagnetic fields on the basis of their frequency of oscillations expressed in cycles per second, or Hertz (Hz). The higher the frequency, the shorter the distance between one wave and the next, and the greater the amount of energy in the field. The non-ionizing range extends from 0 Hertz to visible light at trillions of Hertz. Frequencies above light are considered to be ionizing and include X-rays and cosmic rays. The EM spectrum is divided into regions based on frequency and usage. See also Extremely low frequency, Radio frequency, and Microwave.

ELF: Extremely low frequency electromagnetic fields are in the portion of the electromagnetic spectrum extending from above zero to 3000 Hertz. This includes the 60-cycle power frequency in the United States and the 50-cycle in Europe and Australia.

EME: Electromagnetic Energy in the non-ionizing part of the electromagnetic spectrum, usually referring to radiofrequency radiations.
EMF: Electromagnetic Fields in the non-ionizing part of the electromagnetic spectrum usually referring to power frequency or extremely low frequency emissions.

EMR: Electromagnetic radiation: referring to radio frequency emissions. See EME.

EMRAA: The Electromagnetic Radiation Alliance of Australia. A Sydney based public interest activist group.

EOARD: The European Office of Aerospace Research and Development, a detachment of the U.S. Air Force Office of Scientific Research.

EPA: The Environmental Protection Agency is America's peak government agency for environmental science, research, education and environment pollution risk assessment efforts. Their mission is to protect human health and the environment.

EPRI: The Electric Power Research Institute: the U.S. power industry's research and development organization relating to the generation, delivery and use of electricity for the benefit of the public.

ESAA: The Electrical Supply Association of Australia is the peak industrial organization to promote the interests of the Australian power generating industry.

EU: The European Union is the economic and political union of 27 member states, located primarily in Europe.

FCC: The Federal Communications Commission a U.S. government agency regulates interstate and international communications by radio, television, wire, satellite and cable.

FDA: The Food and Drug Administration (U.S.) is an agency within the Department of Health and Human Services that is responsible for protecting the public health by assuring the safety, efficacy, and security of human and veterinary drugs, biological products, medical devices, the nation's food supply, cosmetics, and products that emit radiation.

FRE: The Federal Rules of Evidence (1975) govern the introduction of evidence in U.S. Federal Court proceedings, both civil and criminal. They do not apply to suits in state courts but are closely modeled in state provisions.

Frequency: The rate at which a periodic electromagnetic waveform repeats itself in time at one position in space. Frequency is measured in cycles-per-second or Hertz (Hz). The electric power frequency, depending on country is either 50 or 60 Hz. The radiofrequency and microwave frequency band ranges from approximately 3 kilohertz (kHz) to 300 gigahertz (GHz).

FOIA: The Freedom of Information Act.

Frye test: A U.S. legal precedent originating from 1923 regarding the admissibility of scientific examinations or experiments in legal proceedings.

GAO: The Government Accountability Office is an investigative arm of the U.S. Congress that audits and evaluates government programs and activities.

GATT: The General Agreement on Tariffs and Trade negotiated new trade agreements that all countries would enter into. It ran from 1947 to 1994, when it was replaced by the World Trade Organization.

GBR: Ground Based Radar is the primary fire control radar system , providing surveillance, acquisition, tracking, discrimination, fire control support and kill assessment for the U.S. National Missile Defense system.

Gigahertz: An electromagnetic frequency of billions of cycles per second.

GM: Genetic modification/manipulation referring to genetic engineering, recombinant DNA technology, and gene splicing.

HPS: The Health Physics Society is the U.S. society of specialists working in radiation safety issues. Founded in 1956 it established IRPA in 1964.

Hz: Hertz – see Frequency.

HCRA: The Harvard Center for Risk Analysis is a predominantly industry funded organization that promotes its version of risk analysis for addressing environmental risks to while addressing industry concerns.

HFT: High frequency transients are very brief high frequency voltage spikes of either positive or negative polarity in mains power electrical power wiring caused by switching (such as electric motors starting) causing interruptions to the current flow. Characterised as packing a lot of power into a very brief time frame, such as in micro-seconds.

IAC: The International Advisory Committee established to provide oversight to IEMFP.

IARC: The International Agency on Research on Cancer , a WHO agency that coordinates and conducts research on the causes of human cancer, the mechanisms of carcinogenesis, and to develop scientific strategies for cancer control, including disseminating information through publications, meetings, courses, and fellowships.

ICES: The International Committee on Electromagnetic Safety, formerly IEEE's SCC-28 standards committee, operates under the IEEE standards board to develop exposure standards for the frequency range 0 – 300GHz and has a membership representing 26 nations.

ICNIRP: The International Commission on Non-Ionizing Radiation Protection is non-government organization authorized by WHO to deal with non-ionizing radiation protection and recommend exposure standards to national governments.

IEC: The International Electrotechnical Commission. Founded in London in 1906 the organization is an international standards and conformity assessment body for all fields of electrotechnology including capacitors and resistors, semiconductor devices, electrical equipment in medical practice and maritime navigation and telecommunications.

IEEE: The Institute of Electrical and Electronics Engineers is a leading industry trade organisation formed in 1963 with the merger of the American Institute of Electrical Engineers and the Institute of Radio Engineers. It aims for the advancement of electrical and electronic technology including aerospace, computers, electrical power, biomedical and telecommunications and also sets standards over that technology.

IEGMP: The Independent Expert Group on Mobile Phones (U.K.) was established in 1999 and issued a report in May 2000 on its assessment of the scientific literature on the risks to health from mobile phone technology.

IEMFP: The International EMF Project. Under the auspices of the WHO its objective is to conduct risk assessments on the health and environmental effects of exposure to static and time-varying electric and magnetic fields in the frequency range 0 - 300 GHz. It recommends to national governments the exposure guidelines promulgated by ICNIRP with which it is closely allied.

ILGRA: The Interdepartmental Liaison Group on Risk Assessment (now defunct) was a committee of senior policy makers established to draft a uniform approach to risk for the U.K. government's policy on risk assessment.

INIRC: The International Non-Ionizing Radiation Committee was formerly a working group within IRPA formed in 1974 to examine the problems of health protection for non-ionizing radiation. It was renamed INIRC at the IRPA Congress in Paris in 1977. It was superseded by ICNIRP in 1992.

Ionizing Radiation: Electromagnetic radiation with sufficient energy to overcome the bonds of electrons in atoms or molecules. The released electrons then become ions. Usually referred to as radioactivity, it has a far shorter wavelength and consequently higher frequency than visible light.This type of radiation includes X rays and gamma rays.

ILO: The International Labour Organization is a United Nations agency to improve opportunities for women and men to obtain decent and productive work in conditions of freedom, equity, security and human dignity. Its main aims are to promote rights at work, encourage decent employment opportunities, enhance social protection and strengthen dialogue in handling work-related issues.

IRCG: The Geneva based International Risk Governance Council made up of a self-proclaimed independent group of government, industry and academic professionals with the aim of promoting their methodology on risk regulation.

IRIS: The Integrated Risk Information System is the risk analysis system used by the EPA for its risk assessment process.

IRPA: The International Radiation Protection Agency was established in 1964 as an international initiative of the Health Physics Society (U.S.). IRPA is the international forum of national radiation protection organizations with the aim of providing and improving protection from the hazards of radiation in order to facilitate the safe use radiological technology, including scientific, medical, engineering, nuclear and radio-communications. IRPA encourages the establishment of universally acceptable radiation protection standards or recommendations through the international bodies concerned (i.e. IEEE C95.1 and the ICNIRP Guidelines).

MW: Microwave frequency fields are in the upper part of the radiofrequency spectrum (see RF). It ranges from approximately 0.3 Ghz to 300 Ghz. As with all of the RF spectrum, in health protection standard setting the main biological effect of exposure to prevent is an increase in tissue temperature at high exposure levels (see SAR).

NAB: The National Association of Broadcasters is a U.S. trade association that advocates on behalf of more than 8,300 free, local radio, broadcast and television stations and represents their interests before Congress, the Federal Communications Commission and the Courts.

NATO: The North Atlantic Treaty Organization is a military alliance of 26 nations from North America and Europe following the goals of the North Atlantic Treaty signed in April 1949.

NAS: The National Academy of Sciences is a U.S. society of scholars engaged in scientific and engineering research to further science and technology for the betterment of society. NAS includes the National Research Council, the National Academy of Engineering, and the Institute of Medicine. Collectively, the four organizations are known as the National Academies.

NCRP: The National Council on Radiation Protection and Measurements is a U.S. congressionally chartered committee with the mission to formulate and widely disseminate information, guidance and recommendations on radiation protection and measurements which represent the consensus of leading scientific thinking. This includes the responsibility to facilitate and stimulate cooperation among organizations concerned with the scientific and related aspects of radiation protection and measurements.

NEPA: The National Environmental Policy Act (1969) established in the U.S. a national environmental policy to provide for the establishment of a Council on Environmental Quality that would work towards a better understanding of ecological systems and natural resources and promote actions to prevent or eliminate damage to the environment for the betterment of humanity. The Act established procedural requirements for all federal government agencies to prepare Environmental Assessments and Environmental Impact Statements.

NIH: The National Institutes of Health is a part of the U.S. Department of Health and Human Services and is the primary Federal agency for conducting and supporting medical research.

NIOSH: The National Institute for Occupational Safety and Health (U.S.) in the Department of Health and Human Services (DHHS) at the Centers for Disease Control and Prevention (CDC) is the federal agency with the mission to prevent work related illnesses and injuries.

NMD: The National Missile Defense program is a U.S. Department of Defense (DoD) program to develop a national missile defence system consisting of a global network of inter-working radar and missile systems to detect and destroy rogue missiles. In 2008 it was DoD's biggest budget program at $8.8 billion for that year alone.

NOHSC: The National Occupational Health and Safety Commission (Australia) is a statutory body, with government, employer and employee representatives to lead and coordinate national efforts to prevent workplace death, injury and disease in the nation.

Non-thermal effects: Effects on biological tissue resulting from low-level and usually prolonged radiofrequency/microwave exposures of insufficient power to increase tissue temperature. As there may be subtle thermal reactions on cells not easily detectable the term "low-intensity" effects has been used as a replacement term.

Non-Ionizing Radiation: Electromagnetic radiation of insufficient energy to knock electrons from their orbit around atoms or molecules (see ionising radiation). This encompasses the entire frequency range from ELF to and including RF and MW frequencies.

NRC: The National Research Council (U.S.) was established in 1916 and functions under the auspices of the National Academy of Sciences, the National Academy of Engineering, and the Institute of Medicine. The NRC provides political leaders, policy makers, and the public with expert advice based on its assessment of the scientific evidence. Projects are funded by federal agencies, foundations, other governmental and private sources, and the institution's endowment. Committees are made up of scientists, engineers, and other professionals who volunteer their time without compensation.

NRC: The Nuclear Regulatory Commission (U.S.) was created by Congress in 1974 to regulate the use radioactive materials for civilian purposes and ensure that people and the environment were protected.

NRPB: The National Radiological Protection Board (U.K.) is an independent body that has responsibility for advising UK government departments and others on standards of protection for exposure to ionising and non-ionising radiation, which includes electric and magnetic fields.

NSB: The National Science Board (U.S.) serves as an independent body of advisors to both the President and Congress on broad national policy issues related to science and engineering research and education.

NSF: The National Science Foundation is an independent US government agency responsible for promoting science and engineering through research programs and education projects. The NSF is the major source of federal backing for research conducted by academic institutions excluding medical research.

NTIA: The National Telecommunications and Information Administration (U.S.) is the President's principal adviser on telecommunications and information policy.

OECD: The Organization for Economic Co-operation and Development, with a membership of 30 countries, aims to promote the global market economy, support member's economic growth, improve living standards and maintain member's financial stability.

OMB: The Office of Management and Budget (U.S.) is the largest office within the Executive Office of the President and oversees the activities of federal agencies for adherence to presidential policy. OMB gives advice to the Federal Administration on a range of topics relating to federal policy, management, legislative, regulatory, and budgetary issues.

OIRA: The Office of Information and Regulatory Affairs (U.S.) is located within OMB and conducts economic analysis and related analyses on issues related to government policy. It reviews draft regulations and collections of information under the Paperwork Reduction Act and develops and oversees the implementation of government-wide policies in the areas of information technology, information policy, privacy, and statistical policy.

OSHA: The Occupational Safety and Health Administration (U.S.) is the main federal agency charged with setting and enforcing occupational safety and health standards.

Paradigm (scientific): A general viewpoint that dictates a specific way of interpretating scientific data and how and which phenomena are to be described and researched.

PCIA: The Personal Communications Industry Association (U.S.) is a trade organization representing and promoting the telecommunications sector by providing the sector with expertise and support to address regulatory, marketplace and technical issues.

PCS: Personal Communications Service is a wireless phone service similar to cellular telephone service but emphasizing personal service and extended mobility.

Power frequency: The frequency of mains electrical power, either 50 or 60 hertz depending on country. Power frequency fields have wavelengths of more than 3,100 miles (5,000 km) and consequently have very low energy levels that do not cause heating or ionization, though they do create weak electric currents in conducting objects, including people and animals.

Precautionary Principle: A widely used moral and political guideline used in environmental decision-making where a high degree of scientific uncertainty exists. The two main formulations of the precautionary principle are as follows:

> **Article 15 of the Rio Declaration of 1992**: "In order to protect the environment, the precautionary approach shall be widely applied by States according to their capabilities. Where there are threats of serious or irreversible damage, lack of full scientific certainty shall not be used as a reason for postponing cost-effective measures to prevent environmental degradation."
>
> **Wingspread Statement of 1998**: "When an activity raises threats of harm to the environment or human health, precautionary measures should be taken even if some cause and effect relationships are not fully established scientifically."

Precautionary Approach: Similar to the precautionary principle but used specific to RF standard setting in the Australian standard setting TE/7 Committee (Chapter 5) this was meant to address in the RF standard the possibility of RF health hazards at exposure levels below the thermal threshold.

Risk assessment (in the regulatory setting): the scientific and technical quantitative evaluation of risks to health and wellbeing consisting of four steps: hazard identification, hazard characterization, exposure assessment and risk characterization.

RF: The Radiofrequency part of the electromagnetic spectrum that ranges from approximately 30 kHz to 300 HGz. In health protection standard setting the main biological effect of RF exposure to prevent is an excessive increase in tissue temperature at high exposure levels (see SAR).

RFIAWG: The Radiofrequency Interagency Work Group (U.S.) is a joint federal government agency group with the responsibility for different aspects of RF safety and work to ensure coordinated efforts at the federal level. The agencies in this group are the FCC, NIOSH, EPA, OSHA and NTIA.

RNCNIRP: The Russian National Commission on Non-Ionizing Radiation Protection is the national agency with the responsibility for protecting the health and safety of Russian citizens, and the environment, from the harmful effects of ionising and non-ionising radiation.

SAA: The Standards Association of Australia, forerunner to Standards Australia.

SAR: The Specific absorption rate is a time derived compliance measurement expressed in watts per kilogram (W/kg) of the rate of energy absorption (or dissipation) in a volume mass of biological tissue (either 1 or 10 grams). This is essentially a calculation of the heat absorbed by tissue based on mathematical and artificial head models (for mobile phone compliance testing). SAR is the unit used in RF standards/guidelines to designate the threshold limits where adverse biological effects (heating) have been proven to occur when the human body is exposed to an RF field.

Sound Science: See TASSC.

TASSC: The Advancement of Sound Science Coalition was set up in 1993 by APCO (a public relations firm) and funded by the tobacco company Philip Morris in order to attempt to discredit a 1992 EPA study that found second-hand tobacco smoke was a Class-A carcinogen. TASSC also expanded its operation to attract other industries concerned about regulation of their activities. It developed the term "sound science" to demote science that discounted evidence of industrial hazards to health and the term "junk science" to denote research that was inimical to industry interests.

Thermal Effects: Well established adverse biological damage in tissue from short-term acute RF exposures of sufficient intensity to cause internal heating. RF standards are designed to limit such heating.

TIP: The Telecommunications and Industrial Physics division (now defunct) in CSIRO was the Division with the responsibility of researching non-ionizing radiation issues.

TMD: Theater Missile Defense systems (U.S.) are designed to counter battlefield threats from missiles with ranges of hundreds of kilometres.

QRA: Quantitative risk assessment, see risk assessment.

UEWR: Upgraded Early Warning Radar refers to technologically improved phased-array surveillance radars used to detect and track ballistic missiles targeted at the U.S.

UHSG: The Utility Health Sciences Group is an industry group representing the interests of U.S. power industry specific to the EMF health hazards issue.

UMDC: The United Missile Defense Company is a U.S. corporate joint venture established to develop the NMD program.

UNEP: The United Nations Environmental Program coordinates United Nations environmental activities, assisting developing countries in implementing environmentally sound policies and encourages sustainable development through sound environmental practices.

VOCs: Volatile organic chemicals are of predominantly industrial origins with an organic structure containing hydrogen, oxygen, and carbon which readily volatilise, or evaporate into the air. Due to their low water solubility, environmental persistence, and widespread industrial use, they are commonly found in the environment.

WHO: The World Health Organisation is the directing and coordinating authority for global health issues within the United Nations. It makes recommendations to determine the health research agenda as well as recommending health standards (also see IEMFP).

WOE: Weight of Evidence is the term used to refer to a collection of published scientific, legal and policy-making literature. Originally introduced in the 1990s to improve the risk assessment of Superfund toxic disposal sites in the U.S.

WTO: The World Trade Organization was established in 1995 as a replacement for GATT as an international organization designed to supervise and facilitate international trade. The organization deals with the rules of trade between nations and negotiates and implements new trade agreements. It also has the responsibility of enforcing member nation's adherence to all the WTO agreements. WTO membership requires member states to conform to the ICNIRP Guidelines.

XBR: X-Band Radar is an essential part of the U.S. NMD Program that conducts tracking, discrimination, and kill assessments of incoming ballistic missiles at the early phases of a missile's trajectory. It operates at 8 – 12 GHz and uses advanced radar signal processing technology to achieve a high degree of target resolution to discriminate against targets.

Bibliography

AAAS Center for Science, Technology and Congress. 2005, AAAS Policy Brief: Access to Data, Feb. 10, http://www.aaas.org/spp/cstc/briefs/accesstodata/index.shtml, [Accessed Mar. 22, 2008].

ABC News. 1999, 'Worried About Your Wireless?' 20/20 program transcript, Brian Ross (interview reporter), Oct. 20.

ABC TV (Australia) 2006, 'Space Race: Race For Satellites', Chris Spencer (dir.), Deborah Cadbury (prod.).

ACRBR statement on the Bioinitiative report, http://www.acrbr.org.au/FAQ/ACRBR%20Bioinitiative%20Report%2018%20Dec%202008.pdf, [Accessed Apr. 24, 2009].

ACRBR/NH&MRC. 2008, 'Position Statement; Neurosurgeon claims about mobile phones and cancer'. http://www.acrbr.org.au/FAQ/Khurana.pdf , [Accessed Nov. 17, 2008].

Adair, E., Black, D. 2003, 'Thermoregulatory Responses to RF Energy Absorption', *Bioelectromagnetics,* Supplement 6, pp. S17 – S38.

Adey, W. R., Bawin, S., Lawrence, F. 1982, 'Effects of Weak Amplitude-Modulated. Microwave Fields on Calcium Efflux From Awake Cat Cerebral Cortex'. *Bioelectromagnetics.* Vol. 3, no.3, pp. 295-307.

Adey, W. 2003, letter to Dr. Rick Jostes, Senior Program Offices. Board on Radiation Effects Research, NAS, Jul. 31.

Aftergood, S. 1999, 'Ground Based Radar [GBR] X-Band Radar [XBR]', *FAS Special Weapons Monitor*, http://www.fas.org/spp/starwars/program/gbr.htm , [Accessed Dec. 28, 2008].

AFOSR fact sheet. 2005, http://www.tokyo.afosr.af.mil/aboutaoard.html , [Accessed Aug. 26, 2005].

Ahlbon, A., Green, A., Kheifets, L., Savitz, D., Swerdlow, A. 2004, 'Epidemiology of Health Effects of Radiofrequency Exposure', *Environmental Health Perspectives*, vol. 112, no. 17, Dec., pp. 1741–1754.

Albanese, R., Winfree, M. 1982, 'Approaches To Risk Assessment: A Suggested Use For Cost/Benefit Analysis In The Microwave Debate, in *Risk/Benefit Analysis: The Microwave Case,* Steneck (ed.), pp. 117 – 128.

Amateur Radio Relay League (ARRL). 2000, Report of the RF Safety Committee to the ARRL Board of Directors, Jul., http://www.arrl.org/rfsafety/Rpt-7-00.htm, [Accessed May 12, 2005].

American Library Association, 2006, 'EPA Libraries', *Social Responsibilities Round Table*, issue 154-155, June, pp. 12-17.

Anderson, F.R. 2007, 'Science Advocacy and Scientific Due Process' *Issues in Science and Technology Online*, The National Academy of Science, http://www.issues.org/16.4/anderson.htm, [Accessed Mar. 30, 2008].

Anderson, G., Pelkey, M., Smith, G., Shull, R. 2006, 'The Cost Is Too High: How Susan Dudley Threatens Public Protections', A Report by Public Citizen and OMB Watch, Sept. http://www.citizen.org/publications/release.cfm?ID=7448, [Accessed Apr. 12, 2007].

Anderson, V. 1990, Analysis of technical breaches of SA/SNZ Standardization Guidelines in the AS/NZS 2772.1:1990 draft, (TE/7 discussion paper).

Armstrong, B., et al. 1994, 'Association Between Exposure to Pulsed Electromagnetic Fields and Cancer in Electric Utility Workers in Quebec, Canada, and France', *American Journal of Epidemiology*, vol. 140, pp. 805-820.

ARPANSA. 2007, Fact Sheet EME Series no. 1, 'Electromagnetic energy and its effects', Apr., http://www.arpansa.gov.au/pubs/eme/fact1.pdf , [Accessed Sept 10, 2007].

ARPANSA. 2007, Fact Sheet, EME Series no.9, 'What about base stations and telecommunications towers - are there any health effects?', http://www.arpansa.gov.au/pubs/eme/fact9.pdf , accessed Sept. 12, 2007.

ARPANSA/ACA, etc. 2004, Mobile Communications and Health, produced by the Australian government /Aust. Communications Authority, initiated by Telstra, supported by the Mobile Carriers Forum with commentary from the Australian Radiation Protection and Nuclear Safety Agency (ARPANSA), Dec.

AS/NZS 2772.1(Interum). 1998, Radiofrequency fields - Part 1: Maximum exposure levels - 3 kHz to 300 GHz (commenced in March 1998 but was withdrawn by TE/7 vote, effective from 1 May 1999).

Bailey, W.H. 1998, 'Principles of Risk Assessment with Application to Current EMF Risk Communication Issues', EMF Risk Perception and Communication, Proceedings of the International Seminar on EMF Risk Perception and Communication, WHO, Ottawa, Ontario, Canada, Aug. 3–Sep. 1, Repacholi MH, Muc A (eds), p. 193-211.

Bakan, J. 2004, *The Corporation: The Pathological Pursuit of Profit and Power*, Free Press, p. 103.

Balzano, Q., Sheppard, A. 2002, 'The influence of the precautionary principle on science-based decision-making: questionable applications to risks of radiofrequency fields', *Journal of Risk Research*, vol. 5, no. 4, pp. 351 – 369.

Barbash, J.E., Resek ,E.A. 1996, *Pesticides in ground water--Distribution trends, and governing factors*: Ann Arbor Press, Chelsea, Michigan, p. 3.

Barker, L.J. (ed) 1989, *New Perspectives in American Politics*, Transaction Books, p. 116.

Barnes, F.S., Greenbaum, B. (eds.) 2006, *Handbook of Biological Effects of Electromagnetic Fields. Biological and Medical Aspects of Electromagnetic Fields*, CRC Press, p. 151.

Barnett, S. 1994, 'Report on the Status of Research on the Biological Effects and safety of Electromagnetic Radiation: Telecommunications Frequencies'. CSIRO.

Bawin, S., Adey, W., Sabbot, I. 1978, 'Ionic factors in release of $^{45}Ca^{2+}$ from chicken cerebral tissue by electromagnetic fields', *Proc. Natl. Acad. Sci.* vol. 75, no. 12, pp. 6314 – 6318, Dec.

Beale, I. 1999, Adopt Radiation Controls N.Z. (ARCNZ), Comments on revised draft TE/007-0050-520 and additional reasons for my negative vote, Mar.

Beale, I., Maisch, D., Lincoln, J. 1999, 'Joint Submission to TE/7 Committee by the Australian & New Zealand Community / Consumer Committee Representatives', Mar. 3.

Beale, I. 1997, 'The Effects of Electromagnetic Fields on Mental and Physical Health', *Journal of Child and Family Studies*, vol. 6. no. 3, pp. 273-288.

Beale, I. 1997/8, (Statement of Evidence: Dr. Ivan Beale), New Zealand Environment Court, Document RMA NO /97. Decision No: C 136/98. Between Shirley Primary School and Telecom Mobile Communications Ltd., New Zealand Environment Court, May/June 1998, pp. 89, 113.

Beck, U. 1997, *The Reinvention of Politics Rethinking Modernity in the Global Social Order*, Polity Press, Cambridge.

Beck, U. 1994, 'The Reinvention of Politics: Towards a Theory of Reflexive Modernization' in Beck U, Giddens A and Lash S (eds) *Reflexive Modernization: Politics, Tradition and Aesthetics in the Modern Social Order*, Stanford University Press, pp. 1-55.

Beck,U. 1992, 'Infallibility or Ability to Learn' in *Risk Society: Towards a New Modernity*, Sage Publications, pp. 159, 177.

Beck, U, Giddens, A, Lash, S, (eds). 1994, *Reflexive Modernisation: Politics, Tradition and Aesthetics in the Modern Social Order*, Polity Press, Cambridge.

Beck, E.C. 1979, 'The Love Canal Tragedy', *EPA Journal*, Jan., http://www.epa.gov/history/topics/lovecanal/01.htm. [Accessed Mar. 30, 2007].

Beck, MP. 2006, 'Dualism in the German Labor Market', *American Journal of Economics and Sociology*, vol. 57, issue 3, Jul., pp. 261-283.

Becker, R. 1990, *Cross Currents*, Jeremy P. Tarcher, Inc. Los Angeles, p. 299.

Becker, R. Seldon, G. 1985, *The Body Electric*, Quill publications, p.333.

Belyaev, I. 2005, 'Non-thermal Biological Effects of Microwaves', *Microwave Review*, Nov., p. 13 –29.

Berger, M.A. 2005, 'What Has a Decade of *Daubert* Wrought?', *American Journal of Public Health*, Supplement 1, vol. 95, pp. S59-S65.

Berger, P.L., Luckmann. T. 1966, *The Social Construction of Reality: A Treatise in the Sociology of Knowledge*, Anchor Books.

Bick, D., Adair, E., Hurt, W., Sherry, C., Walters. T., Merrit, J. 1998, 'Thresholds of microwave-evoked warmth sensations in human skin', *Bioelectromagnetics*, vol. 18, no. 6, Dec. 6, pp. 403-409.

Binhi, N.V. 2006, Some notes to the new IEEE electromagnetic safety standards, General Physics Institute of the Russian Academy of Sciences, http://www.safewireless.org/Portals/1/Documents/Binhi.IEEE.notes-2006-electromagnetic%20standards%20to%20IEEE.pdf , [Accessed August 28, 2006].

Blackman, C., Blank, M., Kundi, M., Sage, C., Carpenter, D., Davanipour, Z., Gee, D., Hardell, L., Johansson, O., Lai, H., Hanson Mild, K., Sobel, E. Xu, Z., Chen, G., Sage, A. 2007, 'BioInitiative Report: A Rationale for a Biologically-based Public Exposure Standard for Electromagnetic Fields (ELF and RF)', released Aug. 31, 2007, http://www.bioinitiative.org, [Accessed August 31, 2007].

Bodemann, R. 2005, 'Report on WHO IAC meeting June 13-14, 2005'. IEEE ICES TC-95 Meeting, Approved Minutes, Dublin, Ireland, June 26, 2005.

Bohme, S.R., et al. 2005, 'Maximizing Profit and Endangering Health: Corporate Strategies to Avoid Litigation and Regulation', *Int J Occup Environ Health*, vol. 11, no. 4, Oct./Dec., pp.338-348.

Breast Cancer Fund. 2008, 'Fact Sheet on Bisphenol A' http://www.breastcancerfund.org/site/pp.asp?c=kwKXLdPaE&b=2638145. [Accessed April 6, 2007].

Breyer, S. 1993, *Breaking the Vicious Circle: Toward Effective Risk Regulation,* Harvard College.

Breyer, S. 1982, *Regulation and its Reform*, Harvard College.

Broad, W. 1990, 'In Short: Science Books', *The New York Times*, Apr. 8.

Brodeur P. *1977, The Zapping of America*, *Their Deadly Risk, And The Cover-Up*, W.W. Norton & Co.

Brodeur P ,1989, *CURRENTS OF DEATH, Power Lines, Computer Terminals, and the Attempt to Cover Up Their Threat to Your Health* , Simon and Schuster.

Brodeur P. 1993, *THE GREAT POWER-LINE COVER-UP, How the Utilities and the Government Are Trying to Hide the Cancer Hazards Posed by Electromagnetic Fields,* Little, Brown and Co.

Brown, D., Graham, J.D. 2007, Leading the Executive Branch: Strategies and Options for Achieving Success, http://www.rand.org/pubs/occasional_papers/OP181/. [Accessed Apr. 2, 2007].

Brundtland, G.H. 2000, Response of WHO to the Report of the Committee of Experts on Tobacco Industry Documents, WHO, June 10, http://www.feel-free.info/uploads/media/Document_14.pdf , [Accessed Sept. 14, 2005].

Burgess, A. 2004, *Cellular Phones, Public Fears, And A Culture of Precaution,* Cambridge University Press.

Burton, B. 2009, Junk Science, Sourcewatch, http://www.sourcewatch.org/index.php?title=Junk_science, [Accessed Feb. 5, 2009].

Burton, B., Kenny, C. 2008, John D. Graham, Nov 11, Sourcewatch, http://www.sourcewatch.org/index.php?title=John_D._Graham. [Accessed Dec. 12, 2008].

Burton, B. 2004, Corporate influence on the executive makeup and funding for the HCRA, Sourcewatch, http://www.disinfopedia.org/wiki.phtml?title=Harvard_Center_for_Risk_Analysis#Funding. [Accessed Feb. 28, 2007].

Campbell, P. 2006, 'Peer Review Trial and Debate', *Nature*, Dec. http://www.nature.com/nature/peerreview/, [Accessed Oct. 18, 2007].

CENELIC. 2007, http://www.cenelec.eu/Cenelec/About+CENELEC/Our+organization/CENELEC+Members/Default.htm , [Accessed Aug. 30, 2007].

Cervenka, J. 2008, 'Citizens on U.S. Anti-Missile Base in Czech Republic', *Public Opinion Research Centre*, (Czech Republic) Nov. 7, http://www.cvvm.cas.cz/index.php?disp=zpravy&lang=1&r=1&s=&offset=&shw=100837 , [Accessed Dec. 31, 2008].

Chiang, H., Xu, Z. 2003, 'Discussion on Rationale for China EMF Exposure Standards', Bioelectromagnetics Lab, Zhejiang University School of Medicine, Hangzhou 310031, China, 3rd International EMF Seminar in China, 13-17 Oct. http://www.who.int/peh-emf/meetings/archive/en/china03mtgsummary.pdf , [Accessed Aug. 24, 2005].

Cherry, N. 1997, 'Swiss Shortwave Transmitter Study Sounds warning', *Electromagnetic Forum*, vol 1, no. 2, http://www.emfacts.com/forum/issue2/mag_9.html, [Accessed Aug. 17, 2006].

Cherry, N. 1995, Potential and Actual Adverse Effects of Cell Site Microwave Radiation, self published, 17 Apr.

Chess, C. 1998, 'Public Participation: Guiding Practice With Research', EMF Risk Perception and Communication, Proceedings of the International Seminar on EMF Risk Perception and Communication, WHO, Ottawa, Ontario, Canada, Aug. 3–Sep. 1, Repacholi MH, Muc A (eds), pp. 193-227.

Chou, C-K. 2007, 'From IEEE RF Safety Standard to Address Base Station and Mobile Phone Safety Concerns' (powerpoint presentation, slide 8), IEEE /ICES meeting, Apr. 16. http://www.citel.oas.org/sp/ccp2-radio/Taller-Ionizante/P2!R-1370r1_i.ppt. [Accessed Nov. 17, 2008].

Chou, C-K. 2006, New IEEE RF safety standard C95.1-2005, *info-CITEL electronic Bulletin*, No. 25, Jul., http://www.citel.oas.org/newsletter/2006/julio/rni-ieee_i.asp , [Accessed Sept. 5, 2006].

Chou C-K., D'Andrea, J. 2003, 'Reviews of the Effects of RF Fields on Various Aspects of Human Health: Introduction', *Bioelectromagnetics Supplement 6*, pp. S5-S6.

Chubin, D.E., Hackett, E.J. 1990, *Peerless Science: Peer Review and U.S. Science Policy*, SUNY Press.

Churchill, M. 2008, EPA Blasted for Library Closings, OMB Watch, Mar. 18, http://www.ombwatch.org/node/3640, [Accessed Apr. 29, 2008].

Cienski, J. 2007,'Czech village fears over US missile shield plan', *Financial Times*, Mar. 30, http://www.trokavec.cz/en/about-trokavec/articles-about-trokavec/financial-times-czech-village-fears-over-us-missile-shield-plan, [Accessed Dec 31, 2008].

Cleveland, R. 1982, 'Opinions on Costs, Benefits, and Risks: results of an Inquiry by the Federal Communications Commission on Potential Hazards of Radio-Frequency Radiation', in *Risk/Benefit Analysis: The Microwave Case,* Steneck (ed.), pp. 69 – 96.

Colburn, T, Dumanski, D, Peterson-Myers, J. *Our Stolen Future*, Dutton, Peguin Books (NY), Chapter 3, Chemical Messengers.

Collingridge, D., Reeve, C. 1986, *Science Speaks To Power*, New York, St Martins Press.

Cook, H., Steneck, N., Vander, A., Kane, G. 1980, 'Early Research on the Biological Effects of Microwave Radiation: 1940-1960', *Annals of Science*, Vol. 37, pp. 323-351.

Correspondence with NCRP committee member Ross Adey, 1995 (Aug.). Cited in: Maisch D, Mobile Phones and Their Transmitter Base Stations: The Evidence For Health Hazards, *Australian Senate Hansard*, Apr. 1996.

Correspondence with Cindy Sage, Sage Associates, Feb 6, 2005.

Correspondence with IEEE sc-28 committee member, Aug. 25, 2005.

Correspondence with Louis Slesin, editor of *Microwave News*, Nov. 21, 2005.

Correspondence with Professor Huai Chiang, Sept. 26, 2005.

Correspondence with Anthony Doull, Aug.31, 2005.

Correspondence with Anthony Doull, Apr. 19, 2006.

Correspondence with Thomas B. Knudsen, PhD, Editor, *Reproductive Toxicology*, University of Louisville and the US EPA, Feb. 5, 2008.

Correspondence with Dr. Stan Barnett, Sept 22, 2003.

Correspondence with Stewart Fist, Aug. 30, 2005.

Correspondence with Ivan Beale, Nov 8, 2004.

Correspondence with Louis Slesin, editor Microwave News, Oct. 12, 2006.

Correspondence with Louis Slesin, June 2, 2009.

Correspondence with Betty Venables, convenor of the The Electromagnetic Radiation Alliance of Australia (EMRAA) Sutherland Shire Environment Centre, Sutherland, NSW. July 27, 2003.

Correspondence with former TE/7 member Dr. Ivan Beale who assisted the Waiatarua Action group in the High Court Case, November 23, 24, and 25, 2005

Correspondence with ARPANSA working group member John Lincoln, Oct. 20, 2004.

Correspondence with Stan Barnett, Snr. Principal Research Scientist, CSIRO, 10 Oct. 2003.

Correspondence with John Hunter, CSIRO representative on TE/7, November 1998.

Correspondence with working group member John Lincoln, representing the Electro Magnetic Radiation Alliance of Australia (EMRAA), Oct. 24, 2004.

Correspondence with TE/7 committee representative Dan Dwyer, Nov. 1998.

Correspondence with Yuri Grigoriev, Chairman of RNCNIRP, Sept. 21, 2004.

Correspondence with Vladimer Binhi, Oct. 23, 2004.

Correspondence with Andrew Marino, October 20, 2006.

Correspondence with Lloyd Morgan, a director of the United States Central Brain Tumor Registry, Aug. 28, 2006.

Correspondence with Dr. John Holt, Director of the Microwave Therapy Centre, Perth, West Australia. May 3, 2005.

Correspondence with Ross Adey, Jul. 7, 1997.

COST 281 Document Archive. 2004, 'Abstracts: FGF-Workshop: Influence of RF Fields on the Expression of Stress Proteins', Helsinki, Finland, 28-29 Apr, http://www.cost281.org/documents.php?node=73&dir_session=, [Accessed Sept. 30, 2006].

CSIRO media release, 1998,'Beating The $12 Billion Cost of Polluted Air', Mar. 17.

Dalton, L. 1991, *Radiation Exposures* , Scribe Publications, p. 31-32, 37, 41, 52 – 53.

DARPA website, http://www.darpa.mil/body/overtheyears.html , [Accessed Aug. 26, 2008].

David, L. 1980, A Study of Federal Microwave Standards, U.S. Department of Energy, pp. xii, 16, 17, 21.

D'Andrea, J., Chou, C-K., Johnston, S., Adair, E. 2003, 'Microwave Effects on the nervous System', *Bioelectromagnetics Supplement 6*, pp. S107 – S147.

DaubertExpert.com, 'An Introduction to Daubert v. Merrell Dow', http://www.daubertexpert.com/basics_daubert-v-merrell-dow.html, [Accessed Feb. 18, 2008].

Department of Defense. 2007, Program Acquisition Costs by Weapon System, Dept. of Defense Budget For Fiscal Years 2008, http://www.defenselink.mil/comptroller/defbudget/fy2008/fy2008_weabook.pdf , [Accessed December 28, 2008].

Dietz, T., Stern, P. (eds.) 2008, Panel on Public Participation in Environmental Assessment and Decision Making, National Research Council, *Public Participation in Environmental Assessment and Decision-making*, National Academies Press, Aug. 22, http://www8.nationalacademies.org/onpinews/newsitem.aspx?RecordID=12434 , [Accessed Sept. 15, 2008].

Doull, A. 2001, Inquiry into Electromagnetic Radiation, Standing Committee on the Environment, Communications, Information Technology and the Arts, (Australian Senate) May, Testimony of Anthony Doull, Sect. 4.42, p. 132.

Doull, A., Curtain, C. 1994, A Case For Reducing Human Exposure Limits Based On Low Level, Non Thermal Biological Effects, Unpublished, p. 1, 3,

Dokoupil, M, 2008, 'Czech Upper House Approves Missile Shield', *Reuters*, Nov. 27, http://www.reuters.com/article/topNews/idUSTRE4AQ5H820081127?feedType=RSS&feedName=topNews, [Accessed Dec. 31, 2008].

Dumpe, B. 1989, *X-Rayed Without Consent*, (unpublished), Ergotec Association Inc.

Dwyer, D. 1999, Telecommunications Officers Association (TOA), TE/7 Ballot TE/7–0090, Mar. 3.

Edmond, G., Mercer, D. 2004, 'Daubert and the Exclusionary Ethos: The Convergence of Corporate and Judicial Attitudes towards the Admissibility of Expert Evidence in Tort Litigation', *Law & Policy*, vol. 26, no. 2, Apr., pp. 231-257.

Edmond, G., Mercer, D. 2000, 'Litigation Life: Law Science Knowledge Construction in (Bendectin) Mass Toxic Tort Litigation', *Social Studies of Science*, vol. 30, pp. 265-316.

Ellwood, M. 2003, 'Epidemiological Studies of Radio Frequency Exposures and Human Cancer', *Bioelectromagnetics Supplement 6*, pp. S63 – S73.

El-Munshid, H.A. 2001, 'Evaluation Of Peer Review In Biomedical Publication', *The Annals of Saudi Medicine*, Editorial, vol. 21, issue 5 – 6, pp. 275-282.

EMF Health Report 1996, Information Ventures, Nov./Dec. issue.

EMF Update. 1997, Electrical Supply Association of Australia , Jan. issue.

European Commission. 2005, 'Science for Environment Policy, New Electromagnetic Fields Exposure Guidelines', European Commission DG ENV, News Alert, issue 3, Dec.

European Environment Agency. 2007, EEA press release, Radiation risk from everyday devices assessed, Sept. 17, http://www.eea.europa.eu/highlights/radiation-risk-from-everyday-devices-assessed , [Accessed Sept. 18, 2007].

European Parliament. 2009, Directorate for the Media, Press release, 'Avoiding potential risks of electromagnetic fields', Apr. 2, Full resolution at: http://www.europarl.europa.eu/sides/getDoc.do?pubRef=-//EP//TEXT+TA+P6-TA-2009-0216+0+DOC+XML+V0//EN, [Accessed Apr. 7, 2009].

European Parliament. 2008, Motion For A European Parliament Resolution On Health Concerns Associated with Electromagnetic Fields. http://www.europarl.europa.eu/oeil/file.jsp?id=5680652, [Accessed Mar. 3, 2009].

Fan, A., Howd, R., Davis, B. 1995, 'Risk Assessment of Environmental Chemicals', *Annual Review of Pharmacology and Toxicology*, vol. 35, pp. 341-368.

Federal Register 2003, Office of Management and Budget, vol. 68, no. 178, Sept. 15, http://www.whitehouse.gov/omb/fedreg/030915.pdf, [Accessed Mar. 21, 2008].

Federation of American Scientists. 2000, 'National Missile Defense', *FAS Special Weapons Monitor*, http://www.fas.org/spp/starwars/program/nmd , [Accessed Dec. 28, 2008].

Ferguson, C. 1999, 'Bait and Switch: Is Anti-North Korean Missile Defense Designed for China?', *Journal of the Federation of American Scientists* (FAS) vol. 52, no. 6, Nov./Dec.

Finkel, A. 1996, 'Who's Exaggerating?', *Discovery*, vol. 17, no. 5, May, pp. 48-54.

Finkel, AA. 1995, 'Second Opinion on an Environmental Misdiagnosis: The Risky Prescriptions of Breaking the Vicious Circle', Symposium on Risk Assessment in the Federal Government, *New York University Environmental Law Journal*.

Fischof, B. 2003, 'Acceptable Risk: A Conceptual Proposal', Franklin Pierce Law Center, http://www.piercelaw.edu/risk/vol5/winter/Fischhof.htm , [Accessed Mar. 1, 2007].

Flynn, L., Gillard, M.S. 1999, 'GM food: special report', *The Guardian*, Nov. 1, http://www.guardian.co.uk/print/0,3858,3923559-103528,00.html , [Accessed Oct. 31, 2006].

Fottrell, S. 2007, 'Czech fears over missile defence radar', *BBC News*, Jun. 6, http://news.bbc.co.uk/2/hi/europe/6726619.stm , [Accessed Dec. 31, 2008].

Frey, C.1998, 'Quantitative Analysis of variability and Uncertainty in Energy and Environmental Systems', in *Uncertainty Modeling and Analysis in Civil Engineering*, B.M. Ayyub (ed.), CRC Press.

Frey, A. 1962, 'Human auditory system response to Modulated electromagnetic energy', *J. Applied Physiology*, vol.17, no.4, pp. 689-692.

Freudenburg, W.R. 1996, 'Risky Thinking: Irrational Fears About Risk and Society'. *The Annals of the American Academy of Political and Social Science*, vol. 545 annals 44, May., pp. 44-53.

Funtowicz, S., Ravetz, J. 2003, 'Post–Normal Science', International Society for Ecological Economics, Feb., http://www.ecoeco.org/pdf/pstnormsc.pdf , [Accessed Mar. 18, 2008].

Gadsby, G. 2002, Electroanalgesia: Historical and Contemporary Developments, Section 3.2.11, Electroanalgesia in the 20th Century United States, http://www.paintechnology.com/051.htm , [Accessed Apr. 17, 2006].

Gandhi, O., Lazzi, G. [undated] , 'The ANSI/IEEE RF Safety Standard and its Rationale': invited report for the IEEE Antennas and Propagation, Man and Radiation Committee, http://ee.tamu.edu/~eml/AP-S/comar/ANSIstandar1.pdf , [Accessed Aug. 24, 2006].

Gandhi, O. 1982, 'Present and Future Benefits: Applications of Radiofrequency and Microwave Energy', in *Risk/Benefit Analysis: The Microwave Case,* Steneck (ed.), pp. 39 – 52.

GAO. 2008, Report to the Chairman, Committee on Environment and Public Works, U.S. Senate, 'Chemical Assessments: Low Productivity and New Interagency Review Process Limit the Usefulness of EPA's Integrated Risk Information System', Mar. http://www.gao.gov/cgi-bin/getrpt?GAO-08-440 . [Accessed Jan 22, 2009].

Gera, V. 2008, 'Polish Support for Missile Deal Soars' *ABC News*, Aug. 18, http://abcnews.go.com/International/wireStory?id=5602563 , [Accessed Dec. 31, 2008].

Glaser, Z., Dodge, C. 1982,' Comments on Occupational Safety and Health Practices in the USSR and Some Eastern European Countries: A Possible Dilemma in Risk Assessment of RF and Microwave Radiation Bioeffects', in *Risk/Benefit Analysis: The Microwave Case,* Steneck (ed.) pp. 53 – 67.

Global Development Research Center. 1998, 'The Wingspread Statement on the Precautionary Principle', http://www.gdrc.org/u-gov/precaution-3.html. [Accessed April 4, 2007].

Graham, J.D., Brown, E. 2007, 'Preparing for January 2009: How the Next President Can Lead the Executive Branch', Policy Insight, Pardee Rand Graduate School, vol. 1, issue 1, Feb.

Graham, J.D. 2003, 'Reigning in the Regulatory State: The Smart-Regulation Agenda', CATO Institute, Oct. 3, http://www.whitehouse.gov/omb/inforeg/speeches/031003graham.pdf , [Accessed Mar. 18, 2008].

Graham, J.D. 2002, 'Presidential Management of the Regulatory State', Remarks Prepared for Delivery to the National Economists Club, OMB, March 7, http://www.whitehouse.gov/omb/legislative/testimony/graham030702.html. [Accessed Jan. 8, 2009].

Graham, J. 1998,'Making Sense or Risk: An agenda for Congress', EMF Risk Perception and Communication, Proceedings of the International Seminar on EMF Risk Perception and Communication, WHO, Ottawa, Ontario, Canada, Aug. 3–Sep. 1, Repacholi MH, Muc A (eds), pp. 1 – 31.

Grandolfo, M., Michaelson, S., Rindi, A. (eds.) 1983*, Biological Effects and Dosimetry of Nonionizing Radiation: Radiofrequency and Microwave Energies*, Published in cooperation with NATO Scientific Affairs Division by Plenum Press.

Grant, L. 1997, 'Microwave Sickness', 5 part series, *Electrosensitivity News*, vol. 1, no. 6 and vol. 2, no. 1-4.

Gray, G. 1996, 'Key Issues in Environmental Risk Comparisons', Reason Public Policy Institute, Policy Study no. 205, May. http://reason.org/news/show/127533.html, [Accessed Mar. 3, 2007].

Gray, P. 1998, 'Improving EMF Risk communication and management: the need for analysis and deliberation', EMF Risk Perception and Communication, Proceedings of the International Seminar on EMF Risk Perception and Communication, WHO, Ottawa, Ontario, Canada, Aug. 3–Sep. 1, Repacholi MH, Muc A (eds), pp. 57-76.

Green, C.M., Lomask, M. 1970, 'Vangard – A History', NASA Historical Reference Collection, NASA History Office, NASA Headquarters, Washington, DC., Chap 12: 'Success – and After' http://history.nasa.gov/SP-4202/chap12.html, [Accessed Apr. 28, 2006].

Green, M.D. 1996, *Bendectin and Birth defects: The Challenges of Mass Toxic Substances Litigation*, University of Pennsylvania Press.

Greenebaum, B. 2003, 'Editor's Note: Reviews of the Effects of RF Fields on Various Aspects of Human Health', *Bioelectromagnetics Supplement 6*, pp. S3-S4.

Grigoriev, Y. 2004, 'Letter to the Editor, Mobile phones and children: Is precaution warranted?', *Bioelectromagnetics,* vol. 25, issue 5, 9 June, pp. 322-323.

Groth, E. 1982, 'Defining Costs, Benefits, and Other Variables', in *Risk/Benefit Analysis: The Microwave Case,* Steneck (ed.), pp. 25 – 38.

Goldsmith, J. 1995, 'Where the trail leads', *Eubios Journal of Asian and International Bioethics* vol. 5, Jul., p 93.

Goldsmith J., Epidemiologic Evidence of Radiofrequency Radiation (Microwave) Effects on Health in Military, Broadcasting, and Occupational Studies, *International Journal of Occupational and Environmental Health*, Vol. 1, No. 1, Jan.-Mar. 1995.

Gumm, B. 2007, Bush Recess Appointment Threatens Public Protections, OMB Watch press release, Apr. 4. http://www.ombwatch.org/press_room?page=4 . [Accessed April 4, 2007].

Guston, D.H. 2003, 'The expanding role of peer review processes in the United States', Chapter 6 in *Learning from Science and Technology Policy Evaluation*, P. Shapica and S. Kuhlmann (eds.), Edward Elgar Pub.

Hackett, E.J., Chubin, D.E. 2003, 'Peer Review for the 21th Century: Applications to Education Research', National Research Council Workshop, Washington, D.C., Feb. 25, http://www7.nationalacademies.org/core/HacketChubin_peer_review_paper.pdf . [Accessed Mar. 30, 2008].

Hansson Mild, 1997, letter to Dr. Charles Stevens, chairman of the NAS Committee as reported in *Microwave News*, vol. 17, no. 1, Jan/Feb., p. 2

Harvard Center for Risk Analysis: Academic Study, [undated] http://www.hcra.harvard.edu/academics.html . [Accessed Jan. 8, 2009].

Harvard Center for Risk Analysis: Funding, [undated] http://www.hcra.harvard.edu/funding.html , [Accessed Jan. 8, 2009].

Health Council of the Netherlands, http://www.gr.nl/pdf.php?ID=1743&p=1, [Accessed April 24, 2009].

Hecht, K., Balzer, H.U. 1997, 'Biological Effects of Electromagnetic Fields on Humans in the Frequency Range 0 to 3 GHz: Summary and results of a study of Russian medical literature from 1960-1996'. German Federal Ministy for Postal Services and Telecommunications, Berlin.

Heinzerling, L, 2001, 'Testimony of Professor Lisa Heinzerling Concerning the Nomination of John D. Graham to be Administrator of the Office of Information and Regulatory Affairs, Office of Management and Budget', Public Citizen, http://www.citizen.org/congress/regulations/bush_admin/articles.cfm?ID=5262 . [Accessed Jan. 12, 2006].

Heynick, L.N. 1987, 'A Comprehensive Review Pertinent to Air Force Operations', USAF School of Aerospace Medicine, Brooks Air Force Base, Texas, Final Report USAFSAM-TR-87-3.

Hollway, D. 1985, 'The Australian Safety Standard for RF Radiation – A Curates Egg'. CSIRO Manuscript, 31st Jan.

Hora, S., Jensen, M. 2002, 'Expert Judgement Elicitation', *SSI Rapport* , Swedish Radiation Protection Authority, Sept.

Horton, R. 1999, Commentary, *The Lancet*, vol. 354, Oct. 16, p. 1315.

House Committee on Government Reform, Subcommittee on Government Management, Information, and Technology,1999, Legislative Hearing on H.R. 88, regarding Data Available Under the FOIA, Committee on Government Reform, July 15, http://www.agiweb.org/gap/legis106/foia_hearings.html , [Assessed Mar. 22, 2008].

Hughes, A. 2005, Budget Includes Anti-regulatory Proposals, OMB Watch, Feb. 7, http://www.ombwatch.org/node/2263 , Accessed Mar. 18, 2008.

Hunter J, CSIRO, CSIRO TE/7 Ballet Draft WP ID Number 17067. cdr. doc, Mar. 02, 1999.

Huss, A. et al,. 2007, 'Source of Funding and results of Studies of Health Effects of Mobile Phone Use: Systematic Review of Experimental Studies', *Env. Health Perspectives*, vol. 115, no. 1, Jan., pp. 1 – 4.

ICNIRP. 2009, 'Exposure to high frequency electromagnetic fields, biological effects and health consequences (100 kHz-300GHz)' ICNIRP 16/2009. http://www.icnirp.de/documents/Rfreview.pdf, [Accessed Mar. 25, 2010].

ICNIRP. 2008, Main Commission: Members' Biographical Information, http://www.icnirp.de/cv.htm#Repacholi , [Accessed Sept. 12, 2008].

ICNIRP. 2007, Aim and Roots, http://www.icnirp.de/aim.htm, [Accessed Apr. 2, 2008].

ICNIRP. 2007, An Independent Voice In NIR Protection, http://www.icnirp.de/what.htm , [Accessed Sept. 12, 2008].

ICNIRP Statement. 1999, Use of the ICNIRP EMF Guidelines, Mar. 31, http://www.icnirp.de/documents/Use.htm , [Accessed Sept. 24, 2007].

ICNIRP. 1998. Guidelines For Limiting Exposure To Time-Varying Electric, Magnetic, And Electromagnetic Fields (Up To 300 GHz), *Health Physics*, vol. 74, no. 4, Apr., pp 494-522.

ICNIRP. 1996, 'Health Issues Related to the use of Hand Held Radiotelephones and Base Stations', *Health Physics*, vol. 70, no. 4, Apr., pp. 587-593.

IEEE. 2005, IEEE Standard for Safety Levels with Respect to Human Exposure to Radio Frequency Electromagnetic Fields 3 kHz to 300 GHz, IEEE Std. C95.1 – 2005. Sponsored by the IEEE International Committee on Electromagnetic Safety (previously SCC39), 19 Apr. 2006, 1.3 Introduction, p. 2.

IEEE/ICES TC95 Subcommittee 4. 2005, Approved Minutes, San Antonio, Texas, Dec. 10, pp. 3, 5. http://www.ices-emfsafety.org/documents/Minutes/TC95_december%202005%20minutes.pdf. [Accessed Apr. 28, 2006].

IEEE/ICES TC95. 2005, Approved Minutes, Dublin Castle, Dublin, Ireland, 25 June. http://www.ices-emfsafety.org/documents/Minutes/TC95_june%202005%20minutes.pdf, [Accessed Apr. 28, 2006].

IEEE/ICES. 2003, SCC-28 Subcommittee 4 Revision Working Group Meeting, Unapproved Minutes, National Electrical Manufacturers Association, Rosslyn, VA, Sept. 25, pp. 7, 10, 16 – 17, http://grouper.ieee.org/groups/scc28/sc4/sc-4%208th%20rwg%20minutes-september%202003.pdf, [Accessed Apr. 21, 2006].

IEEE/ICES. 2002, SCC-28 Subcommittee 4 Unapproved Meeting Minutes, Hotel Loews Le Concorde, Quebec, Canada, June 29, pp. 21, 23. http://grouper.ieee.org/groups/scc28/sc4/sc-4%20minutes-june%202002.pdf, [Accessed May 15, 2006].

IEEE/ICES. 2001, SCC-28 Subcommittee 4 Unapproved Meeting Minutes, Radisson Riverview Hotel, St Paul, MN, Jun. 8-9, http://grouper.ieee.org/groups/scc28/sc4/sc-4%20minutes-june%202001.pdf , [Accessed May 15, 2006].

IEEE. 1992, USAB Entity Position Statement Human Exposure to Radio frequency Fields from Portable and Mobile Telephones and other Communication Devices, Dec. 2.

IEGMP. 2000, 'Mobile Phones and Health, report of the Independent Expert Group on Mobile Phones, 2000', p. 110 – 113.

IEMFP (WHO). 2008, 'What is the International EMF Project?', http://www.who.int/peh-emf/project/EMF_Project/en/index.html, [Accessed Feb 2, 2009].

IEMFP (WHO). 2001-2002, 'The International EMF Project Progress Report', http://www.who.int/entity/peh-emf/project/en/PR2001_2002.pdf , [Accessed Sept. 4, 2008].

Indiana University School of Public and Environmental Affairs, Environmental Science and Public Affairs Faculty, John D. Graham, Dean, 2009, http://www.iu.edu/~speaweb/faculty/JGG.php , [Accessed Jan. 8, 2009].

Indiana University press release. 2008, John Graham to lead IU School of Public and Environmental Affairs, April 17, http://newsinfo.iu.edu/news/page/normal/8028.html . [Accessed Jan. 8, 2009].

International Committee of Medical Journal Editors, 2003, 'Uniform Requirements for Manuscripts Submitted to Biomedical Journals: Writing and Editing for Biomedical Publication', Nov.8, http://www.icmje.org/index.html#peer, [Accessed June 23, 2007].

International Risk Governance Council, 2009, 'Risk Governance Deficits: An Analysis and Illustration of the Most Common Deficits in Risk Governance', Nov., http://www.irgc.org/IMG/pdf/IRGC_rgd_web_final.pdf, [Accessed Mar. 11, 2010].

IRPA Foundation. [undated], http://www.irpa.net/index.php?option=com_content&task=blogcategory&id=178&Itemid=113 , [Accessed Sept. 6, 2008].

Ivan, A., Roy, R. 1992, 'PR is a better system than peer review. (publicizing new method of diamond synthesis through lay press)', *Science*, vol. 258, no. 5083, Oct. 30.

Jackson J.R. 1998, Decision No: C 136/98. Between Shirley Primary School and Telecom Mobile Communications Ltd. New Zealand Environment Court, Judge JR Jackson, May/June, pp. 89, 113.

Jacobson, E. 1997, Deputy Director, Center for Devices and Radiological Health, FDA Letter Regarding Cellular Phones, May 5, http://www.osha.gov/SLTC/radiofrequencyradiation/fda.html, [Accessed Oct. 3, 2007].

Jasanoff, S. 2003, Comment on Office of Management and Budget (OMB) Proposed Bulletin on Peer review and Information Quality, Dec.16, http://www.whitehouse.gov/omb/inforeg/2003iq/159.pdf [Accessed Mar. 21, 2008].

Jasanoff, S. 1996, 'Research Subpoenas and the Sociology of Knowledge', *Law & Contemporary Problems*, vol. 59, pp. 95-118.

Jasanoff, S. 1990, *The Fifth Branch, Science Advisers as Policymakers*, Harvard University Press, pp. 9, 12, 26 – 29, 61, 73, 184, . 243 – 245.

Johnston, H. 1982, 'Cost Benefit Analysis: An Idea Whose Time May Not Have Come!, in *Risk/Benefit Analysis: The Microwave Case,* Steneck (ed.), pp. 151 – 158.

Joyner, K. 2001, Inquiry into Electromagnetic Radiation, Standing Committee on the Environment, Communications, Information Technology and the Arts, (Australian Senate), 2001, Section 4.68, page 137.

Joyner, K. 1998, 'Australian Government Action on Electromagnetic Energy Public Health Issues'. *Bioelectromagnetics Society Newsletter*, no. 143, July/Aug.

Justesen, D. 1982, 'DealingWith Terminology And Values: Risk Versus Harm Analysis In The Formation Of Protective Standards, in *Risk/Benefit Analysis: The Microwave Case,* Steneck (ed.), pp. 159 – 165.

Kaiser Family Foundation. 2005, 'Some Medical Journals More Critical of Studies Omitting Findings', The Kaiser Family Foundation Health Policy report, Tuesday, May 10, quoting Wilde Mathews in the *Wall Street Journal,* http://www.kaisernetwork.org/daily_reports/rep_index.cfm?hint=3&DR_ID=29952 , [Accessed Mar. 30, 2008].

Kanavy, C. 1993, 'Biological Effects of Microwave Radiation: A White Paper', Reproduced in *Microwave News*, vol. 13, no. 5, Sept./Oct., p. 12.

Kane, R. 2000, *Cellular Telephone Russian Roulette; A Historical and Scientific Perspective*, pp. 4, 10 - 16, 42 - 55.

Kelly, E. 2008, 'Scientists challenge bioelectromagnetics foundations (editorial), *Eur. Journal of Oncology*, vol. 13, no. 3, pp. 193-195.

Kheifets, L, Feychting, M., Schuz, J. 2005, 'Childhood cancer and power lines' (letters), *British Medical Journal*, vol. 331, Sept.17, p. 634-638.

Kheifets, L., Hester, G., Banerjee, G, 2001, 'The Precautionary Principle and EMF: implementation and evaluation', *The Journal of Risk Research*, vol. 4, no. 2, Apr., pp. 113-125.

Kinzer, S. 2006, *Overthrow: America's Century of regime Change from Hawaii to Iraq*, Times Books.

Kniesner, TJ, Leeth, JD. 1991, 'Compensating wage differentials for fatal injury risk in Australia, Japan, and the United States', *Journal of Risk and Uncertainty*, vol. 4, no. 1, Jan., pp. 75-90.

Kolata, G. 2003, 'A Conversation with Eleanor R. Adair; Tuning In to the Microwave Frequency', *The New York Times*, Jan. 16, 2001.

Konick, D. A.1990, 'Peer Review in 18th Century scientific journalism', *JAMA,* vol. 263, no. 10, Mar. 9, pp.1321-3.

Koslov, S. 1982,'The Logical Consequence O)f Application, Cost, Risk, Benefit And The Military', In *Risk/Benefit Analysis: The Microwave Case,* Steneck (ed.), pp. 129 – 137.

Krimsky, S. 2005, 'The Weight of Scientific Evidence in Policy and Law', *American Journal of Public Health*, Supplement 1, vol. 95, pp. S114-S120.

Kruk, G. 1998, 'Risk Communication and the Management of EMF Risks', EMF Risk Perception and Communication, Proceedings of the International Seminar on EMF Risk Perception and Communication, WHO, Ottawa, Ontario, Canada, Aug. 3–Sep. 1, Repacholi MH, Muc A (eds), pp. 109-135.

Kucinich, D. 2008, Chairman, Domestic Policy Subcommittee, Re: White Spaces Unlicensed Operation in the TV Broadcast Bands (ET Docket No. 04-186). Letter to FCC Chairman Kevin Martin, U.S. Congressional Committee on Oversight and Government reform, Nov. 3.

Kuhn, T. 1962, *The Structure of Scientific Revolutions*, University of Chicago Press.

Kundi, M. 2006 , 'Environmental Health Issues of Radiofrequency and Microwave Exposure', http://www.salzburg.gv.at/Proceedings_(06)_Kundi.pdf#search=%22Environmental%20Health%20issues%20of%20Radiofrequency%20and%20Microwave%20Exposure%22 , [Accessed Oct. 9, 2006].

Landman, A. (ed.). 2008, 'Harvard Center for Risk Analysis and Big Tobacco', Sourcewatch, Sept., http://www.sourcewatch.org/index.php?title=Harvard_Center_for_Risk_Analysis_and_Big_Tobacco . [Accessed Oct. 7, 2008].

Lai, H. 1998, 'Neurological Effects of Radiofrequency Electromagnetic Radiation', Workshop on Possible Biological and Health Effects of RF Electromagnetic Fields, Mobile Phone and Health Symposium, Vienna, Austria, Oct. 25-28.

Lakoff, G.P. 2005, 'A Cognitive Scientist Looks at Daubert', *American Journal of Public Health*, Supplement 1, vol. 95, pp. S114-S120.

Landrigan, P., Sonawane, B, Butler, R. 2005, 'Early environmental origins of neurodegenerative disease in later life', *Environmental Health Perspectives*, Sept. 1, vol.113, issue: 9, pp: 1230-1234.

Lapin, G. 2000, N9GL's RF Safety Column: Understanding SAR, ARRL RF Safety Committee, http://www.arrl.org/rfsafety/lapin/2000/08/29/1/index.html , [Accessed May 4, 2006].

LaPorte, R.E., *et al*. 2002, 'Papyrus to PowerPoint (P2P): metamorphosis of scientific communication', *British Medical Journal*, vol. 325 no. 7378, pp. 1478-1481, Dec. 21.

Larkin, J. 1999, 'Evaluating Response Options', EMF Risk Perception and Communication, Proceedings of the International Seminar on EMF Risk Perception and Communication, WHO, Ottawa, Ontario, Canada, Aug. 3–Sep. 1, Repacholi MH, Muc A (eds), pp. 137-150.

Leigh, J. 1999, National Occupational Health and Safety Commission (NOHSC), Reasons For Negative Vote (TE/7), Mar.

Leiss, W., Paoli, G. 1998,' The Internet as a Public Information resource with a case study on a Canadian controversy about radio-frequency fields', EMF Risk Perception and Communication, Proceedings of the International Seminar on EMF Risk Perception and Communication, WHO, Ottawa, Ontario, Canada, Aug. 3–Sep. 1, Repacholi MH, Muc A (eds), pp. 151-192.

Letavet, A.A., Gordon, Z.V. (eds.) 1960, *The Biological Action of Ultrahigh Frequencies*. USSR: Academy of Medical Sciences, 1960. (English edition by the U.S. Joint Publications Research Service.)

Levitt, B.B. 1995, *Electromagnetic Fields, A Consumer's Guide to the Issues and How to Protect Ourselves*, A Harvest Original, pp. 22, 25.

Lin, J.C. 2006, 'Health Effects: Update of IEEE Radio frequency Exposure guidelines', *IEEE Microwave Magazine*, April, pp. 25-26.

Lincoln, J. 1999, Australian Consumers Association (ACF), Reasons For Negative Vote (TE/7), Mar.

Lindsay-Poland, J. 2004, ' U.S. Military Bases in Latin America and the Caribbean', *Foreign Policy in Focus*, vol. 9, no. 3, Aug., http://www.fpif.org/briefs/vol9/v9n03latammil.html , [Accessed Aug. 26, 2005].

Lipton, B.H. 2001, Bioelectromagnetism and Energy-Medicine, http://www.brucelipton.com/bioelectromagnetism.php , [Accessed Apr. 17, 2006].

Lotz, G. 1999, RFIAWG, RF Guideline Issues: Identified by members of the Federal RF Interagency Work Group, June, letter from Gregory Lotz to Richard Tell, Chair of IEEE SCC28 IV, http://www.emrnetwork.org/position/exhibit_a.pdf , [Accessed June 23, 2006].

MacCleery, L., et al. 2001, 'Safeguards At Risk: John Graham and Corporate America's Back Door to the Bush White House', Public Citizen, Mar., http://www.citizen.org/documents/grahamrpt.pdf. [Accessed March 3, 2007].

Madia, M. 2008, 'White House Gains Influence in Toxic Chemical Assessments', OMB Watch, Apr. 15, http://www.ombwatch.org/node/3642, [Accessed May 18, 2008].

Madia, M. 2008, 'Public Protection Standards Have Dropped under Bush', OMB Watch, Mar. 31, http://www.ombwatch.org/node/8743, [Accessed May 18, 2008].

Madia, M. 2007, The Data Quality Act, OMB Watch, Oct. 5, http://www.ombwatch.org/node/3479, [Accessed Mar. 22, 2008].

Mainville, M. 2004, U.S. Bases Overseas Show New Strategy, July 26, GlobalSecurity.org. http://www.globalsecurity.org/org/news/2004/040726-us-bases.htm , [Accessed Aug. 26, 2005].

Maisch, D, 2005, 'Report on the International Conference: Mobile Communications and Health: Medical, Biological and Social Problems, Sept 20-22, 2004, Moscow, Russia', *European Biology and Bioelectromagnetics,* vol. 1, issue 1, Jan. 2005.

Maisch, D. 2004, 'A Corporate Risk Assessment or RF Bioeffects Studies Relevant to the Use of Mobile Phones by Children: Is it Really Science?', *International Conference: Childhood Leukaemia, Incidence, Causal Mechanisms and Prevention*, London England, Sept. 6-10.

Maisch, D. 1999, 'Final vote submission by Don Maisch', TE/7 Committee, March 3, http://www.emfacts.com/papers/submissions.html .

Maisch, D. 1998, 'Power Frequency Electromagnetic Fields and Human Health – Is it time to end further research? An Overview of Three Recent Studies', *JACNEM*, vol. 17, no. 1, June, pp. 5 -16.

Maisch, D. 1998, 'Discussion Paper: The case for a strong Precautionary Approach, and statement of intent, which takes into account possible non thermal effects, to be included in the Australian Standard', Submission to Standards Australia Committee TE/7: Human Exposure to Electromagnetic Fields. Oct. 20. http://www.emfacts.com/papers/submissions.html, [Accessed Sept. 14, 2007].

Maisch, D. 1996,' Mobile Phones and Their Transmitter Base Stations: The Evidence For Health Hazards', Australian Senate Hansard, Apr.

Maisch, D. 1995, 'Fields of Conflict: The EMF Health Hazard Controversy', self published, p. 57-58, Aug.

Maisch, D. 1994, (Non-ionizing) Electromagnetic Fields and Human Health: Are current standards safe?, Senate Hansard, Oct.

Marino, A., Ray, J. 1986, *The Electric Wilderness*, San Francisco Press, pp. 14-17, 23.

Marchall, E. 1992, 'When Does Intellectual Passion Become Conflict of Interest?', *Science*, vol. 257, July 31, pp. 620-623.

Marha, K., Musil, J., Tuha H. 1971, *Electromagnetic Fields and the Life Environment*, Institute of Industrial and Occupational Diseases, Prague, English publisher San Francisco Press.

Martin, P. 1998*, The Sickening Mind: Brain, Behaviour, Immunity & Disease*, (Mind and Immunity) Flamingo Press (Harper Collins), pp. 81-105.

Mason, P., Murphy, M., Peterson, R. 2001, 'IEEE EMF Health & Safety Standards', WHO Meeting on EMF Biological Effects and Standards Harmonization in Asia and Oceania, Shilla Hotel, Seoul, Korea, 22-24 October, 2001, http://www.who.int/peh-emf/meetings/southkorea/en/IEEE_EMF_HEALTH_-_Mason.pdf , [Accessed Aug. 29, 2006].

Matthews, R. 1995, Consideration of Public Submissions on the Draft Australian/New Zealand Standard DR 95900, Report to the New Zealand Local Government Association and Auckland City Council. TE/& Committee, May.

Matthews, R. 1995, Letter to Walter Secord, Sutherland Shire Council, Sydney, May 8.

Mazur, A. 1983, 'Societal and Scientific Causes of the Historical Development of Risk Assessment', in Conrad, J. 1983, *Society Technology and Risk Assessment*, Academic Press. pp. 151-157.

McGarity, T.O. 2005, 'Daubert and the Proper Role for the Courts in Health, Safety, and Environmental Regulation', *American Journal of Public Health*, Supplement 1, vol. 95, pp. S92—S98.

Medici, R. 1982, 'Considerations For Science: Where Has All The Science Gone?, in *Risk/Benefit Analysis: The Microwave Case,* Steneck (ed.), pp. 177 – 196

Melnick, R.L. 2005, 'A Daubert Motion: A Legal Strategy to Exclude Essential Scientific Evidence in Toxic Tort Litigation', *American Journal of Public Health*, vol. 95, no. 51, July, pp. 530-534.

Mercer, D. 1999, 'From Prudent Avoidance to Bureaucratic Avoidance: lessons from the recent RF standard setting process in Australia', Gothenburg conference on Mobile Telephones and Health, Sweden, 16-17 Sept.

Merton, R.K., Zuckerman, H. 1971, 'Institutionalised Patterns of Evaluation in Science', in *The Sociology of Science*. N.W. Storer (ed.). The University of Chicago Press.

Merton, R.K. 1968,' The Matthew Effect in Science', *Science*, vol. 158, no. 3810, Jan. 5, pp. 56-63.

Michaels, D., Monforton C. 2005, 'Manufacturing Uncertainty: Contested science and the Protection of the Public's Health and Environment', *Amer. Jour. Pub. Health*, vol. 95, no. S1, pp. S39-S47.

Michaels, D. 2008, *Doubt is their Product. How Industry's Assault on Science Threatens Your Health*, Oxford University Press, 2008.

Michaels, D. 2003, Comments on Proposed Peer review Bulletin, Peer Review Standards for Regulatory Science and Technical Information Workshop, Science, Technology and Law Program, The National Academies, Washington DC, Nov. 18. http://www.thecre.com/quality/129.pdf , [Accessed Mar. 30, 2008].

Michaelson, S., Suess, M. 1974, 'An International Program For Microwave Exposure Protection', *ITT Transactions on Microwave Theory and Techniques*, Nov., pp. 1301-1302.

Miller, C. 2005, 'Novelty and Heresy in the Debate on Nonthermal Effects of Electromagnetic Fields', in Harris, Randy Allen (ed.) Rhetoric and Incommensurability, Parlor Press, p. 464 - 505.

Montague, P. 1999, 'The Waning Days of Risk Assessment # 652', Environmental Research Foundation, http://ces.iisc.ernet.in/hpg/envis/doc98html/miscrwwe9966.html . [Accessed Feb. 28, 2007].

Montague, P. 1999, 'Pesticides and Aggression# 648' Environmental Research Foundation, http://www.rachel.org/en/node/4644. [Accessed Apr. 14, 2007].

Montague, P. 1998, 'Environmental Trends # 613', Environmental Research Foundation, http://ces.iisc.ernet.in/hpg/envis/doc98html/miscrw829.html. [Accessed Feb. 27, 2007].

Montgomery Watson Inc. 1999, Standards Australia submission DR 98627 PuCo-057, TE/7 Committee, Feb. 1.

Mooney, C. 2004, 'Paralysis by Analysis-Jim Tozzi's regulation to end all regulation', *Washington Monthly,* May. http://www.washingtonmonthly.com/features/2004/0405.mooney.html, [Accessed Mar 28, 2008].

Moore, P. 1996, 'Not cooking but Warming', *New Scientist*, vol. 152, no. 2061/2, 21-28 Dec., pp. 54-55.

Morris, R. 1996, Letter from Richard Morris, Assistant Secretary, Health Research Branch, NH&MRC, to Sarah Benson, researcher for Senator Lyn Allison, 30 Dec.

Motorola. 2003, 'Motorola fact sheet, China Standard', July, http://www.motorola.com/content/0,,2387-5025,00.html, [Accessed Aug. 18, 2004].

Moyers, B. 2004, 'This is the Fight of Our Lives', Keynote speech, Inequity Matters Forum, New York University, June 3, http://www.commondreams.org/cgi-bin/print.cgi?file=/views04/0616-09.htm. [Accessed Apr. 9, 2007].

Mrak, EM, et al. 1969, Report of the Secretary's Commission on Pesticides and their Relationship to Environmental Health, Parts I and II, Washington, D.C.: U.S. Department of Health, Education, and Welfare.

Murphy, M. 2003, 'Dedication: Eleanor Reed Adair', *Bioelectromagnetics Supplement* 6, pp. S1-S2.

NASA. 2007, Sputnik and The Dawn of the Space Age, http://history.nasa.gov/sputnik/index.html , [Accessed Apr. 28, 2006].

Nair, I., Morgan, M.G., Florig,H.K. 1989, 'Biological Effects of Power Frequency Electric and Magnetic Fields', Office of Technology Assessment,

National Research Council of the National Academies (U.S.). 2008, *Identification of Research Needs Relating to Potential Biological or Adverse Health Effects of Wireless Communication Devices*, The National Academies Press, 2008.

National Committees for Science (Australia). 2004, Annual Report To Council on 2004 activities, http://www.ncrs.org.au/annual/2005.pdf , [Accessed Mar. 6, 2007].

National Research Council. 2007, Scientific review of the proposed risk assessment bulletin from the Office of Management and Budget. http://www8.nationalacademies.org/onpinews/newsitem.aspx?RecordID=11811. [Accessed Apr. 4, 2007].

National Research Council Committee on Risk Characterisation. 1996, *Understanding risk. Informing decisions in a democratic society*, Washington D.C., National Academy Press.

National Toxicology Program 2005, Fact Sheet: Studies on Radiofrequency Radiation Emitted by Cellular Phones, National Institute of Environmental Health Sciences, http://ntp.niehs.nih.gov/files/Cellphone05.pdf, [Accessed Nov. 12, 2008].

NCRP. 1986, NCRP Report No. 86: Biological Effects and Exposure criteria for Radiofrequency Electromagnetic Fields. http://www.ncrponline.org/Publications/86press.html, [Accessed Aug. 12, 2007].

Nelson, G. 1980, 'How the First Earth day Came About', http://earthday.envirolink.org/history.html. [Accessed Feb. 27, 2007].

Nelson, G. 1980, 'Earth Day 70': What it Meant', http://www.epa.gov/history/topics/earthday/02.htm. [Accessed Feb. 27, 2007].

Neoral, J. 2007, The anti-missile shield cannot defend the Czech Republic, Trokavec against the radar, Apr. 6, http://www.trokavec.cz/en/about-the-radar/articles-about-the-radar/the-anti-missile-shield-cannot-defend-the-czech-republic, [Accessed Sept. 28, 2008].

[No author] 2010, Aviation During World War II: The German Side of the Story, http://www.century-of-flight.net/Aviation%20history/WW2/german_radar.htm, [Accessed March 26, 2010].

[No author] 2005,'Russia comes into serious crisis with its WTO membership talks', *Pravda,* Jun. 29, http://www.english.pravda.ru/main/18/89/356/15722_WTO.html , Accessed Aug. 18, 2005.

[No author], 2005, Profiles, Royal Society, GM Watch, http://www.gmwatch.org/profile1.asp?Prid=113, [Accessed Oct. 31, 2006].

[No author] 2003, 'EU Bans Toxic Atrazine Herbicide Still Widely Used in US Corn Belt', Organic Consumers Association, Oct. 24, http://www.organicconsumers.org/foodsafety/atrazine102703.cfm , [Accessed Mar. 18, 2008].

[No author]. 2003, 'China Considers Setting New Cell Phone Radiation Standards', *Interfax News Agency*, China, Oct. 20, http://www.buergewelle.de/body_emf_omega-news_24-10-03.html , [Accessed Aug. 18, 2005].

[No author]. 2002, 'China May Draw a Sharp Lower Line on Mobile Phone Radiation', *IEEE Spectrum*, Aug. 13.

[No author] 2002, 'Background on Data Quality Guidelines', OMB Watch, May 28, http://www.ombwatch.org/node/645, [Accessed Mar. 24, 2008].

[No author]. 2001, 'Truth or consequences: publication ethics', *The Economist*, vol. 360, Sept. 13, pp. 62-63.

[No author] 1999, 'Analysis of the Draft of the Second OMB Proposal', OMB Watch, July 15, http://www.ombwatch.org/files/npadv/1999/a110draft2.html , [Accessed Mar. 22, 2008].

[No author] 1997, 'The Story of Silent Spring', Natural Resources Defense Council, http://www.nrdc.org/health/pesticides/hcarson.asp . [Accessed Feb. 27, 2007].

NRPB. 2004, Statement by the National Radiological Protection Board. Advice on Limiting Exposure to Electromagnetic Fields (0 – 300 GHz). Doc. NRPB 15 (2) 2004. ISBN 0-85951-532-X, http://www.nrpb.org/publications/documents_of_nrpb/abstracts/absd15-2.htm, [Accessed May 23, 2004].

NRPB Press Release Apr 5, 2004, http://www.nrpb.org/press/press_releases/2004/press_release_5_04.htm [Accessed May 25, 2004].

Oder, N. 2008, 'Congress Backs EPA Funding', *Library Journal*, Jan. 2, http://www.libraryjournal.com/article/CA6523463.html, [Accessed Jan. 21, 2009].

Office of Management and Budget, 2004, 'OMB Releases Revised Bulletin on Peer review: Seeks Additional Public Comment', Apr. 15, http://thefdp.org/OMB_2004_08.pdf , [Accessed Mar. 21, 2008].

Office of Management and Budget 2001, Guidelines for Ensuring and Maximizing the Quality, Objectivity, Utility, and Integrity of Information Disseminated by Federal Agencies, Oct. 1, http://www.whitehouse.gov/omb/fedreg/final_information_quality_guidelines.html, [Accessed Mar. 25, 2008].

Osepchuk, J., Petersen, R. 2003, 'Historical Review of RF Exposure Standards and the International Committee on Electromagnetic Safety (ICES)', *Bioelectromagnetics Supplement* 6, pp. S7-S16.

Osepchuk, J. 1982, 'Dealing With Misperception: On The Costs Of Perceived Versus Real Risks Of Microwave Radiation', in *Risk/Benefit Analysis: The Microwave Case,* Steneck (ed.), pp. 97 – 115.

Otway, H. 1980, 'Societal and Scientific causes of the Historical Development of Risk Assessment', in: *Society Technology And Risk Assessment,* Conrad J., Academic Press, pp. 163-164.

Pardee RAND Graduate School website, 2009. http://www.prgs.edu/curriculum/. [Accessed Apr. 2, 2007].

Pardee RAND Graduates School. 2006, 'John D. Graham Appointed Dean of Pardee RAND Graduates School', Rand Corporation media release, Mar. 1. http://www.rand.org/news/press.05/10.17.html. [Accessed Apr. 2, 2007].

Parliament of Australia. 2001, 'Inquiry into Electromagnetic Radiation', Report of the Senate Environment, Communications, Information Technology and the Arts References Committee, May.

Pekarek LK, 'Our experiences with introducing ICNIRP Guidelines', http://www.forum.europa.eu.int/.../jrc/jrc_eis_emf/library?l=/preliminary_country/**czech_republic**doc/_EN_1.0_&a=d , [Accessed Aug. 17, 2005].

Park, 2000, *Voodoo Science, The Road from Foolishness to Fraud*, Oxford Univ. Press, Chapter 7, Currents of Fear pp. 140-161.

Pennicuik, S. 1999, Australian Council of Trade Unions (ACTU), Reasons For Negative Vote (TE/7), D99030, Mar.

Petersen, R. 2005, 'Chairman's Report', Attachment 3. IEEE ICES TC-95 Meeting, Dublin, Ireland, June 26, 2005. (print copy).

Philips, A. 1997, 'The Powerwatch Network Responds - July 2, 1997', Re: RESIDENTIAL EXPOSURE TO MAGNETIC FIELDS AND ACUTE LYMPHOBLASTIC LEUKAEMIA IN CHILDREN, New England Journal of Medicine, July 3, 1997. http://www.feb.se/Bridlewood/NCISTUDY.HTM, [Accessed Apr. 5, 2010].

Phinisee, T. 2006, 'Brooks City-Base diversifying its strategy', *San Antonio Business Journal*, Sept. 1, http://memphis.bizjournals.com/sanantonio/stories/2006/09/04/story7.html, [Accessed Sept 29, 2006].

Pool, R. 1997,'Searching for Safety', exerpt from *Beyond Engineering: How Society Shapes Technology*, Oxford University Press, 1997. http://www.pbs.org/wgbh/pages/frontline/shows/reaction/readings/search.html . [Accessed Feb 28, 2007].

Porter, W.P., Jaeger, J.W., Carlson, I.H. 1999, 'Endocrine, immune and behavioral effects of aldicarb (carbamate), atrazine (triazine) and nitrate (fertilizer) mixtures at ground water concentrations', *Toxicology and Industrial Health*, vol. 15, nos. 1 and 2, pp. 133-150.

Pound, R.V. 1980, 'Radiant Heat for Energy Conservation', *Science*, vol. 208, p. 494, May 2.

Presidential/Congressional Commission on Risk Assessment and Risk Management. 1997, 'Framework for Environmental Health Risk Management'. Final Report 1, Washington D.C. http://www.riskworld.com/riskcommission/default.html . [Accessed Apr. 2, 2007].

Presman, A.S. 1970, *Electromagnetic Fields and Life*, Plenum Press, New York-London, Foreword xi.

Rampton, S, Stauber J. 2002, *Trust Us, We're the Experts: How Industry Manipulates Science and Gambles with your Future,* Jeremy P. Tarcher/Penguin, p. 111.

Reinhart, M. 2006, 'Peer Review', The Institute for Research Information and Quality Assurance (Germany), Oct., http://www.research-information.de/iq/agora/Peer_Review/_peer_review.html, [Accessed Mar. 30, 2008].

Renn, O, 1997, 'Risk Management: A need to integrate risk assessment and perception', International Seminar on Risk Perception, Risk Communication and Its Application to EMF Exposure, WHO, ICNIRP, Vienna, Austria, Oct. 22-23, pp. 23-50.

Repacholi, M, 2004, Welcoming presentation, 9th International Advisory Committee (IAC) meeting, Istanbul Turkey, Jun. 7, http://www.who.int/entity/peh-emf/meetings/archive/en/repacholi_iac_welcome.pdf, [Accessed Sept 14, 2005].

Repacholi, M. 2004, 'WHO Framework for Developing EMF Standards', Asia Pacific EMF Conference, Electromagnetic Fields, Research, Health Effects, and Standards Harmonization, Bangkok, Thailand, p. 46, Jan.

Repacholi, M. 2004, Conference statement by Repacholi as quoted in: Maisch D, *Report on the International Conference: 'Mobile Communications and Health: Medical, Biological and Social Problems', Sept 20-22, 2004, Moscow, Russia,* European Biology and Bioelectromagnetics, vol. 1, issue 1, January 2005.

Repacholi, M., van Deventer, E. 2003, 'WHO Framework for Developing EMF Standards', Proceedings of the International Conference on Non-Ionizing Radiation at UNITEN (ICNIR 2003) Electromagnetic Fields and Our Health, Oct. 20-22.

Repacholi, M. 2001, Inquiry into Electromagnetic Radiation, Standing Committee on the Environment, Communications, Information Technology and the Arts, (Australian Senate) May 2001. Testimony of Michael Repacholi, Sect. 2.233, 4.39, 4.52, 4.115.

Repacholi, M. 1998, 'EMF concerns and WHO's International EMF Project', EMF Risk Perception and Communication, Proceedings of the International Seminar on EMF Risk Perception and Communication, WHO, Ottawa, Ontario, Canada, Aug. 3–Sep. 1, Repacholi MH, Muc A (eds), pp. 33-55.

Repacholi, R. 1984, 'Problems with Regulating Radiofrequency (RF) Radiation Exposure', IRPA 6, May, pp. 1291-1294, http://www.2000.irpa.net/irpa6/cdrom/VOL.3/B3_96.PDF , [Accessed Sept. 4, 2008].

Richards, E.P., Walter, C. 1998, 'Science in the Supreme Court: Round Two', *17 IEEE Engineering in Medicine And Biology*, no. 2 Mar.- Apr., pp. 124-125.

RNCNIRP. 2008, Children and Mobile Phones: The Health of the Following Generations is in Danger, Apr. 14, http://www.emfacts.com/papers/rncnirp_children.pdf, [Accessed Sept. 4, 2008].

Roguska, B. 2008, 'The Poles about the anti-missile shield', *Polish Public Opinion*, Oct., http://www.cbos.pl/PL/publikacje/public_opinion/2008/10_2008.pdf , [Accessed Dec. 31, 2008].

Robbins, A. 2003, 'Science for special interests', *The Boston Globe*, July 12.

Rosqvst, T. 2003, 'On the use of expert judgement in the quantification of risk assessment', *VTT Industrial Systems*, VTT Publications 507. Dec., http://virtual.vtt.fi/inf/pdf/publications/2003/P507.pdf , [Accessed Oct. 18, 2006].

Rothman, K. 1993, 'Conflict of Interest: The New McCarthyism in Science', *JAMA*, vol. 269, issue 21, June 2, pp. 2782-2784.

Roy, R. 1998, 'Science Teachers and Recent Research', *Bulletin of Science Technology Society*, vol. 18, pp. 3-6.

Roy, R. 1997 (ed.), *Materials Research Innovations*, Springer-Verlag, publisher, 1997, http://www.in-cites.com/journals/MaterialsResearchInnovations.html , [Accessed Mar. 21, 2008].

Rushing, R., Brennan, M., Bass, G., Agrast, M., Ferguson, S., Shull, R. 2004, 'Special Interest Takeover: The Bush Administration and the Dismantling of Public Safeguards', The Centre for American Progress & OMB Watch for The Citizens for Sensible Safeguards Coalition, http://www.ombwatch.org/files/regs/2004/sitreport.pdf, [Accessed Mar. 18, 2008].

Sage, C. 2003, 'Comment on Reviews of the effects of RF fields on various aspects of human health', [Bioelectromagnetics Supplement 6 (2003)]', *Bioelectromagnetics*, vol. 26, issue 2, pp.157-158.

Schwan, H.P. 1982, 'Physical properties of biological matter: some history, principles and applications', *Bioelectromagnetics*, vol. 3 no.1, pp. 3 – 8.

Shapiro, S., Steinor R, 2003, Recent Developments that Threaten the Freedom and Integrity of Academic Research, The Centre for Progressive Regulation, http://www.progressiveregulation.org/articles/Sound_Science_Overview.pdf , [Accessed Mar. 18, 2008].

Shrader-Frechette, K. 2002, 'Risky Business Nuclear Workers, Ethics, and the Market-Efficiency Argument', *Ethics & the Environment*, vol. 7, no. 1, http://www.iupjournals.org/ethics/ee7-1.html. [Accessed Mar. 1, 2007].

Shrader-Frechette, K. 1991, *Risk and Rationality*. Berkeley: University of California Press.

Simon, WE. 1978, *A Time For Truth,* Reader's Digest Books, McGraw-Hill Book Company.

Singley. C., Matthews, R. 1999, Local Government N.Z., Ballot for the TE/7 Committee, DR 98627 – Human Exposure to Electromagnetic Fields, Mar.

Slesin, L. 2007, 'Will the FCC Adopt Looser Cell Phone Safety Standards?', *Microwave News,* vol. 27, no. 5, Apr., p. 4.

Slesin, L. 2006, 'ANSI Approves Revised IEEE RF/MW Standard', *Microwave News*, vol. 26, no.6, Nov., p. 1.

Slesin, L. 2006, 'Radiation Research and The Cult of Negative Results', ,*Microwave News*, vol. 26, no. 4, July.

Slesin, L. 2005, 'WHO and Electric Utilities: A Partnership on EMFs', *Microwave News*, Oct. 1, http://www.microwavenews.com/fromthefield.html#partners , [Accessed October 10, 2005].

Slesin, L. 2005, 'WHO Welcomes Electric Utility Industry To Key EMF Meeting, Bars the Press', *Microwave News*, Sept. 22, http://www.microwavenews.com/fromthefield.html#partners , [Accessed Oct. 10, 2005].

Slesin, L. 2005, 'Money Talks and the WHO Follows', *Microwave News*, Aug. 8, http://www.microwavenews.com/nc_aug2005.html , [Accessed Sept. 12, 2005].

Slesin L. 2005,'The 1994 DNA Breaks Study', *Microwave News,* vol. 25, no. 1, Mar.

Slesin, L. 'Why EMF Risks Get No Respect', *Microwave News*, http://www.microwavenews.com/nc_dec2004.html , [Accessed Apr. 3, 2010].

Slesin, L. 2004, 'Industry Rules RF Controlling Research, Setting Standards and Spinning History', *Microwave News*, July, http://www.microwavenews.com/IndustryRulesRF.html, [Accessed Sept. 27, 2005].

Slesin, L. 2004, 'News & Comment: What's New', *Microwave News* , Jul. 22, http://www.microwavenews.com/nc_ja2004.html, [Accessed Sept. 30, 2006].

Slesin, L. 2003, 'IEEE Move To relax Cell Phone SAR Exposure Limit Under Fire', *Microwave News*, vol. 23, no. 3, May/Jun., p. 4.

Slesin, L. 2002, 'EPA: Current RF Limits Are Adequate for Thermal Risks', *Microwave News*, vol. 22, No. 5, Sept./Oct., p. 8.

Slesin, L. 2002, 'Standards', *Microwave News*, vol. 22, no. 4, Jul./Aug., p. 16.

Slesin, L. 2002, 'IEEE RF/MW Exposure Limits: Revise or Stand Pat?', *Microwave News*, vol. 22, no. 4, Jul./Aug., p. 9.

Slesin, L. 2002, 'IEEE Says No to Brillion Precursors', Standards, *Microwave News*, vol. 22, no. 4, Jul./Aug., p. 16.

Slesin, L. 2002, 'Brillouin Precursers: Robert Adair, Albanese and Oughstun' Letters to the Editor, *Microwave News*, vol. 22, no. 3, May/June, pp. 13-14.

Slesin, L. 2002, 'China Weighs 1 W/Kg SAR Limit for Mobile Phones', *Microwave News*, vol. 22 no. 3, May/June, p. 6.

Slesin L. 2002, 'Cell Phone-Brain Tumor Lawsuit Hangs on a Single Swedish Study', *Microwave News,* vol. 22, no. 2, Mar./Apr., pp. 1 -7, 9

Slesin, L. 2002, 'Introducing Brillouin Precursers: Microwave Radiation Runs Deep', *Microwave News*, vol. 22, no. 2, Mar/Apr. pp. 1, 10-12.

Slesin, L. 2002, 'Revision of RF/MW Standard Stalls As IEEE Panel Is Split on Key Issues', *Microwave News*, vol. 22, no. 1, Jan./Feb., pp. 1 & 7.

Slesin L. 2001, 'High-Profile Criminal Lawyer Takes on Wireless Industry', *Microwave News*, vol. 21, no. 6, Nov./Dec.

Slesin, L. 2001, 'IEEE Drafts Major Relaxation of RF/MW Human Exposure Limits', *Microwave News*, vol. 21, no. 5, Sept./Oct., pp. 1 & 10.

Slesin, L. 2001, 'Czech Government Now Follows ICNIRP', *Microwave News*, vol. 21, no.1, Jan./Feb., p. 7.

Slesin L. 2000, 'Baltimore Doctor Files Cell Phone-Brain Cancer Lawsuit; His Lawyer Plane a Dozen More by December', *Microwave News,* vol. 20, no. 5, Sept./Oct.

Slesin, L. 2000, 'SCC-28/SC-4 Okays Ear as "Extremity"', *Microwave News*, vol. 20, no. 5, Sept./Oct., p. 5.

Slesin, L. 2000, Efforts to Harmonize RF/MW Exposure Standards in Disarray, *Microwave News*, vol. 20, no. 4, Jul./Aug., pp. 1, 8-9.

Slesin, L.2000, 'Czech Panel on the Precautionary Principle and Numerical Limits', *Microwave News*, vol. 20, no. 3, May/Jun., p. 14.

Slesin, L. 1999, 'Industry Seeks Higher Exposure Limit for the Ear', *Microwave News*, vol. 19, no. 6, Nov./Dec., pp. 1, 11.

Slesin, L. 1999, 'Motorola Memos: Small Changes in Manufacturing or Test Procedures Can mean Big Changes in SARs', *Microwave News*, vol. 19, no. 5, Sept./Oct., p. 12.

Slesin, L. 1999, 'IEEE Adopts Some Changes in Standards for RF/MW Exposure', *Microwave News*, vol. 19, no. 3, May/Jun., pp. 5-6.

Slesin, L. 1997, 'FCC Reaffirms Health Rules Based on NCRP Limits', *Microwave News*, vol. 17, no. 5, Sept/Oct., pp. 10-11.

Slesin, L. 1997, 'Wireless Notes', *Microwave News*, vol. 17, no. 1, Jan./Feb., p. 8.

Slesin, L. 1996, 'Views on the News: The NAS-NRC Report', *Microwave News*, vol. 16, no. 6, Nov./Dec., p. 8.

Slesin, ' NAS Finds No EMF-Cancer Link: Report Stirs Controversy', *Microwave News*, vol. 16, no. 6, Nov/Dec. 1996, pp.1, 5 - 7.

Slesin, L. 1996 'New Zealand Bans Cellular Antennas at Public Schools', *Microwave News*, vol. 16, no. 5, Sept./Oct., p. 7.

Slesin, L. 1996, 'Industry, Activists Challenge FCC's New RF/MW Rules', *Microwave News,* vol. 16, no. 5, Sep./Oct., pp. 9-10.

Slesin, L. 1996, 'FCC RF/MW Rules Favor NCRP Limits; Cell Phones To Be Tested for Safety', *Microwave News*, vol. 16, no. 4, Jul./Aug., pp. 1, 13.

Slesin, L. 1996, 'Cellular Phone Notes', *Microwave News*, vol. 16, no. 3, May/June, p. 9.

Slesin, L. 1996, 'ANSI/IEEE v. NCRP: Battle for Control of RF/MW Standards', *Microwave News*, vol. 16, no. 2, Mar./Apr., pp. 1,12.

Slesin, L. 1996, 'Millimeter-Wave Eye Research Funded by Hewlett-Packard', *Microwave News*, vol 16, no. 2, Mar./Apr., pp. 9-10.

Slesin, L. 1996,'Industry Pressures FCC To Adopt ANSI RF/MW Exposure Standard', *Microwave News*, vol. 16, no. 2, Mar./Apr., p. 11.

Slesin, L. 1995, 'Opposition to Communication Towers on the Rise in the U.S. and Around the World', *Microwave News,* vol. 15, no. 6, Nov./Dec., p. 12.

Slesin, L. 1994, 'Transients and Lung Cancer: A "Strong" Association and a "Remarkable" Exposure-Response', *Microwave News*, vol. 14, no. 6, Nov/Dec, pp. 4-6.

Slesin, L. 1994, 'ARRL Bioeffects Committee Quits in RF/MW Controversy', *Microwave News*, vol. 14, no. 4 Jul./Aug., p. 9.

Slesin, L. 1994, 'Industry Urges FCC Adoption of ANSI/IEEE C95.1-1992', *Microwave News*, vol. 14, no. 3, May/June, pp. 13-14.

Slesin, L. 1994, 'EPA Assails ANSI RF/MW Standards as Seriously Flawed', *Microwave News*, vol. 14, no. 1, Jan./Feb., p. 10.

Slesin, L.1993, 'ANSI RF/MW Standard Challenged, U.S. Air Force and Hughes Units Adopt Limits up to 100 Times stricter', *Microwave News,* vol. 13, no. 5, Sept./Oct.

Slesin, L. 1993, 'U.S. Air Force v. U.S. Air Force: Labs at Odds over RF/MW Health Risks', *Microwave News*, vol. 13, no. 5, Sept./Oct.

Slesin, L. 1993, 'Standards: FCC Seeks To Adopt 1992 RF/MW Limits', *Microwave News,* Mar./Apr.

Slesin, L.1984, 'Hopkins Lab Sets 100 uW/cm2 RF/MW Safety Standard', *Microwave News*, Nov/Dec.

Smith, C., Best, S. 1989, *Electromagnetic Man: Health & Hazard in the Electrical Environment*, JM Dent & Sons Ltd. London , pp.14-16.

Smolchenko, A. 2008, 'Putin casts doubt on Russia's WTO accession', *The Moscow Times*, Aug. 25, http://www.iht.com/articles/2008/08/25/business/wto.php , [Accessed Sept. 10, 2008].

Standards Australia, Draft Standard 98627. 1999, – Maximum Exposure Levels – 3 KHz to 300 GHz-Foreword.

Standards Australia. 1998, Committee TE/7: Human Exposure to Electromagnetic Fields, meeting No. 1/98, Minutes, 12 Aug.

Standards Association of Australia. 1985, Foreword: Australian Standard 2772, Maximum Exposure Levels – Radiofrequency Radiation – 300kHz to 300 GHz.

Starr, C, Whipple, C. 1980, 'Risks of Risk Decisions', *Science,* vol. 208, no. 4448, pp. 1115-1117.

Starr, C. 1976, 'General Philosophy of Risk-Benefit Analysis' in, *Energy and the Environment,* Ashley, H, Rudman, R, Whipple, C. (eds), New York: Pergamon Books.

Starr C. 1969, 'Social Benefit versus Technological Risk', *Science*, vol. 165, no. 3899, pp. 1232-1237, Sept. 19.

Steinzor, R. (ed) 2006, *Rescuing Science from Politics: Regulation and the Distortion of Scientific Research*, Cambridge University Press, pp. 236-237.

Steneck, N, *The Microwave Debate*, MIT Press, 1984, p. 25-39, 42, 45, 46, 48, 49, 50 - 53, 56 – 57, 59, 60 – 63, 74, 76-79, 150 – 152, 237 – 239.

Steneck, L.(ed.), 1982, *Risk/Benefit Analysis: The Microwave Case*, San Francisco Press.

Steneck, N.H. *et al*. 1980, 'The Origins of US Safety Standards for Microwave Radiation' , *Science,* vol. 208, pp.1230-7.

Stock, M. 2005, Technical Note 124: RF Shock And Burn: Notes From The Research Side, LBA Group, http://www.lbagroup.com/associates/lbatn124.php , [Accessed Feb 4, 2008].

Strong,R, 2005, 'Radar: The Evolution Since World War II', *Aerospace and Electronic Magazine, IEEE*, Vol. 20, Issue 1, Jan.

Sturgis, P., Allum, N. 2004, 'Science in society: re-evaluating the deficit model of public attitudes', *Public Understanding of Science*, vol.13, pp. 55-74.

Subcommittee on Science, Research and Technology of the House Committee on Science and Technology, 94th Congress, 2nd Session. 1976, 'National Science Foundation Peer Review 13' (Committee Print 1976).

Swedish Union of Clerical and Technical Employees in Industry (SIF), *No Risk in the IT environment*, 1999.
Suter, G.W. 2005, *Ecological Risk Assessment*, Lewis Publishing Co., p 86.

Swett, L. 2003, NPRA Comments on OMB's Proposed Bulletin on Peer Review and Information Quality, Dec. 15, http://www.whitehouse.gov/omb/inforeg/2003iq/111.pdf, [Accessed Mar. 24, 2008].

Swicord, M. (ed.). 2006, 'C-K Chou will receive the 2006 D'Arsonval Award' *Bioelectromagnetics Newsletter,* no. 188, Jan./Feb. p. 1.

Swicord, M. (ed.), 2006, 'New Disclosure Policy Begins With This Issue', *Bioelectromagnetics Newsletter,* no. 188, Jan./Feb., p. 4.

Swicord, M. (ed.) 2003, 'Third EMF Seminar in China a Success', *Bioelectromagnetics Newsletter*. no. 174, Sept./Oct., pp. 8-9.

Swicord, M. 1982, 'The Importance Of The Policy-Making Environment: Right, Wrong, And Regulation', in *Risk/Benefit Analysis: The Microwave Case,* Steneck (ed.), pp. 139 – 149.

Swiss Agency for the Environment, Forests and Landscape (SAEFL). 2005, 'Electrosmog in the environment', p.17, http://www.scrutiny.gov.je/documents/docs/34102-13793-1912007.pdf . [Accessed April 12, 2007].

Swiss Federal Office of Energy. 1995, Study on Health Effects of the Shortwave Transmitter Station of Schwarzenburg, Berne, Switzerland (Major Report), BEW Publication Series, Study No. 55, Aug.

The National Academies. 2007,'Report Recommends Withdraw of OMB Risk Assessment Bulletin', *The National Academies NEWS*, Jan. 11, http://www8.nationalacademies.org/onpinews/newsitem.aspx?RecordID=11811, [Accessed Feb 7, 2009].

The National Academies. 1999, Letter to OMB by Academy President Bruce Alberts on OMB Circular A-110 Revision, http://www7.nationalacademies.org/ocga/Other/Bruce_Alberts_Letter.asp, Accessed Mar. 22, 2008.

Theriault, G., et al. 1994, 'Cancer Risks Associated with Occupational Exposure to magnetic Fields Among Electric Utility Workers in Ontario and Quebec, Canada, and France: 1970-1989', *American Journal of Epidemiology*, vol. 139, pp. 550-572.

Tickner, J., Raffensperger, C., Myers, N. 1998, 'The Precautionary Principle in Action', The Science and Environmental Health Network, pp. 14-15, http://www.sehn.org/precaution.html. [Accessed April 4, 2007].

Towne, L., Fletcher, J.M., Wise, L.L. (eds.) 2004, *Strengthening Peer Review in Federal Agencies That Support Education Research*, Committee on Research in Education, Center for Education, Division of Behavioral and Social Sciences and Education, National Research Council of the National Academies, The National Academies Press, Washington, D.C. http://books.nap.edu/openbook.php?record_id=11042 , [Accessed Mar. 30, 2008].

Trachtman, L.E., Perrucci, R. 2000, *Science under Seige?: Interest Groups and the Science Wars*, Rowman & Littlefield, pp. 22-23.

Trueman, C., The Radar and the Battle of Britain, http://www.historylearningsite.co.uk/radar_and_the_battle_of_britain.htm, [Accessed Mar. 26, 2010].

Tukay, JW. et al. 1995, *Restoring the Quality of our Environment; Report of the Environmental Pollution Panel [of the] President's Science Advisory Committee*, Washington, D.C.: U.S. Government Printing Office.

Uegaki, A. 2001,' Russian Federation's Foreign Economic Relations, Mar., Economic and Social Research Institute,(U.S.), Mar., www.esri.go.jp/en/tie/russia/russia5-e.pdf, [Accessed Aug. 17, 2005].

United Kingdom Interdepartmental Liaison Group on Risk Assessment (UK-ILGRA). 2004, 'The Precautionary Principle: Policy and Application, Health and Safety Executive', http://www.hse.gov.uk/aboutus/meetings/ilgra/pppa.htm . [Accessed April 4, 2007].

United Nations Environment Programme. 1992, 'The Rio Declaration on Environment and Development', http://www.unep.org/Documents.Multilingual/Default.asp?DocumentID=78&ArticleID=1163. [Accessed April 4, 2007].

University at Albany, Institute for Health and the Environment, 2008, 'European Parliament Recommends Stricter Safety Limits for Cell Phones', Sept. 8, http://www.emfnews.org/European-Parliament-Recommends-Stricter-Safety-Limits-for-Cell-Phones.html, [Accessed Sept. 19, 2008]

U.S. Court of Appeals for the Fourth Circuit, No. 02-2424, Decided Oct. 22, 2003, http://pacer.ca4.uscourts.gov/opinion.pdf/022424.U.pdf, [Accessed May 18, 2008].

U.S. Dept. of Labor, Occupational Safety and Health Administration. 1997, FDA Letter Regarding Cellular Phones, May 5, http://www.osha.gov/SLTC/radiofrequencyradiation/fda.html, [Accessed Oct. 3, 2007].

U.S. District Court For The District Of Maryland, Memorandum, Newman v Motorola et al, Civil No. CCB-00-2609, p. 4-5. http://news.findlaw.com/hdocs/docs/cellphone/newmanmotorola93002mem.pdf , [Accessed May 18, 2008].

U.S. Food and Drug Administration. 1981, 'The Long Struggle For The 1906 Law', *FDA Consumer Bulletin*, June, http://www.cfsan.fda.gov/~lrd/history2.html , [Accessed April 17, 2006].

U.S. House of Reps., Committee on Government Reform-Minority Staff, Special Investigations Division. 2003, 'Politics and Science in the Bush Administration' (prepared for Rep. Henry A. Waxman), http://oversight.house.gov/features/politics_and_science/pdfs/pdf_politics_and_science_rep.pdf . [Accessed Mar. 10, 2008].

Vecchia, P. 2009, 'Electromagnetic Fields and Health: Effects, Perception, Protection', ICNIRP, Montevideo, Uruguay, Mar. 5, http://www.msp.gub.uy/andocasociado.aspx?2819,16619, [Accessed April 3, 2009].

Vecchia, P. 2008, 'Epidemiological results and Policy Implications' Electromagnetic Fields and Epidemiology, Erice, Italy, Mar. 26-Apr. 2, http://www.ccsem.infn.it/ef/emfcsc2008/bioelectromagnetics/Vecchia_Epidemiology%20and%20Guidelines.ppt.pdf, [Accessed Apr. 2, 2009].

Vecchia, P. 2005, ' The approach of ICNIRP to protection of Children', *Bioelectromagnetics*, vol. 26, issue S7, pp. S157 – S160.

Wakefield, T. 2000, 'The Appliance of Science', *The Ecologist*, vol. 30, no.5, July - August, p. 56.

Wartenberg, D. 1998, 'How Dangerous Is It Really? Some Approaches for Inferring Risk', EMF Risk Perception and Communication, Proceedings of the International Seminar on EMF Risk Perception and Communication, WHO, Ottawa, Ontario, Canada, Aug. 3–Sep. 1, Repacholi MH, Muc A (eds), pp. 213-227.

Weed, D. 2005, 'Weight of Evidence: A Review of Concept and Methods', *Risk Analysis*, vol. 25, no. 6, Dec., pp. 1545-1557.

Weintraub, M. 2003, 'Disparities in Disease', Environmental Justice & Health Union, Aug., http://www.ejhu.org/disparities.html . [Accessed Jan. 15, 2006].

Weiss, R. 2004, 'Data Quality' Law Is Nemesis Of Regulation', *The Washington Post,* Aug. 15, http://www.washingtonpost.com/ac2/wp-dyn/A3733-2004Aug15, [Accessed Mar. 18, 2008].

Westall, D. 2001, 'Will Radiation Regulation Matter in the 21th Century?', Australian Radiation Protection Society (ARPS 26 conference), Surfers Paradise, Qld.,17-21 Sept.

White, T. 2003, United States Early Radio History, http://www.earlyradiohistory.us/index.html, [Accessed April 7, 2006].

WHO. 2007, WHO summary of Health Effects, http://www.who.int/peh-emf/about/WhatisEMF/en/index1.html , [Accessed Sept. 12, 2007].

WHO. 2006, Standards and Guidelines, http://www.who.int/peh-emf/standards/EMF_standards_framework%5b1%5d.pdf , [Accessed Aug. 24, 2006].

WHO. 2004, Electromagnetic Fields, Research, Health Effects, and Standards Harmonization, Asia-Pacific EMF Conference, Jan. 26-30, Bankok, Thailand, http://www.bankokemf.com , [Accessed Aug. 25, 2005].

WHO. 2003, 3rd International EMF Seminar in China, Meeting Summary, http://www.who.int/peh-emf/meetings/archive/en/china03mtgsummary.pdf , [Accessed Aug. 24, 2005].

WHO, 2000, Tobacco Company Strategies to Undermine Tobacco Control Activities at the World Health Organization, Report of the Committee of Experts on Tobacco Industry Documents, July. http://www.who.int/tobacco/policy/who_inquiry/en/print.html , [Accessed Sept. 18, 2005].

WHO. 2000,Electromagnetic Fields and Public Health Cautionary Policies, WHO Backgrounder Fact Sheet, Mar., http://www.elettra2000.it/pdf/report/oms-eng.pdf, [Accessed Jul. 4, 2008].

WHO. 1999, EMF Risk Perception and Communication, Proceedings of the International Seminar on EMF Risk Perception and Communication, Repacholi MH, Muc A (eds), Ottawa, Ontario, Canada, Aug. 3–Sep. 1, 1998.

WHO, ICNIRP. 1998, Risk Perception, Risk Communication and its Application to EMF Exposure, Proceedings of the International Seminar on Risk Perception, Risk Communication and its Application to EMF Exposure, Vienna, Austria, Oct. 22, 23, 1997.

WHO. 1982, 'Environmental Health Criteria 16: Radiofrequency and Microwaves'.WHO, Geneva, *International Journal of Radiation Biology*, vol. 42, issue 3, Sept., p. 354.

WHO, USAF, Min. Pub. Health, Thailand. 2004, 'Electromagnetic Fields, Research, Health Effects, and Standards Harmonization', Asia-Pacific EMF Conference, Bankok, Thailand, Jan. 26-30, p. 44, http://www.who.int/peh-emf/meetings/archive/en/bangkok04_proceedings.pdf, [Accessed Aug. 27, 2005].

Wiedemann, P.M. 1998, 'EMF risk communication: Themes, challenges and potential remedies', EMF Risk Perception and Communication, Proceedings of the International Seminar on EMF Risk Perception and Communication, WHO, Ottawa, Ontario, Canada, Aug. 3–Sep. 1, Repacholi MH, Muc A (eds), pp. 77-107.

Wiles, R., Cohen, B. 1994, 'Tap Water Blues: Herbicides In Drinking Water' , Environmental Working Group, Washington D.C.

Winner, L. 1986, *The Whale and the Reactor: A Search for Limits in an Age of High Technology*, University of Chicago Press.

Wireless LAN Association. 2006, Do Wireless LANs Pose a health Risk to the Consumer?, Quoting from the IEEE USAB Entity Position Statement Human Exposure to Radio frequency Fields from Portable and Mobile Telephones and other Communication Devices, December 2, 1992, http://www.wlana.org/learn/health.htm, [Accessed April 18, 2006]

Woodley, R. 1998, 'The Politics of EMFs- An Activists Viewpoint', EMF Risk Perception and Communication, Proceedings of the International Seminar on EMF Risk Perception and Communication, WHO, Ottawa, Ontario, Canada, Aug. 3–Sep. 1, Repacholi MH, Muc A (eds), pp. 309-310.

Wood, A. 2003, 'Effective Protection against Non-Ionizing Radiation (NIR) or: the Devil's in the Detail', ARPS-28 Conference, Hobart Function and Conference Centre, Oct. 28.

Industry Influence; Illusion and Escape: The Cell Phone Disease Quagmire.
Dr. George L. Carlo PhD. JD.; 2008

October 2008

The World Foundation for Natural Science™
Fact Sheet

Illusion and Escape: The Cell Phone Disease Quagmire

A Summary of American Legal Actions Regarding Mobile Phones and Health Effects

by Dr. George L. Carlo

About the author

Dr. George L. Carlo is the Chairman of the non-profit Science and Public Policy Institute in Washington, D.C. Since 1993, he has overseen the world's largest independent research effort into the dangers of wireless technology, with funding that has included $28.5 million from the mobile phone industry itself, oversight by U.S. Government Interagency Working Groups and peer review coordinated through the Harvard University School of Public Health. He has training in pathology, epidemiology, medical science and law, is a Fellow of the American College of Epidemiology, and has served on the medical faculties of The George Washington University, the University of Arkansas and the State University of New York at Buffalo.

Contact Information:
Science and Public Policy Institute
1101 Pennsylvania Ave., N.W.–7th Floor
Washington, D.C. 20004
866-620-4459
www.sppionline.org
www.safewireless.org

"Anything can be faked… by anyone. In the many years that I have been before the public, my secret methods have been steadily shielded by the strict integrity of my assistants…. But then, so far as I know, I am the only performer who ever pledged his assistants to secrecy, honor and allegiance under a notarial oath."……

Harry Houdini

Cell phones expose you to near field radiation differently with age

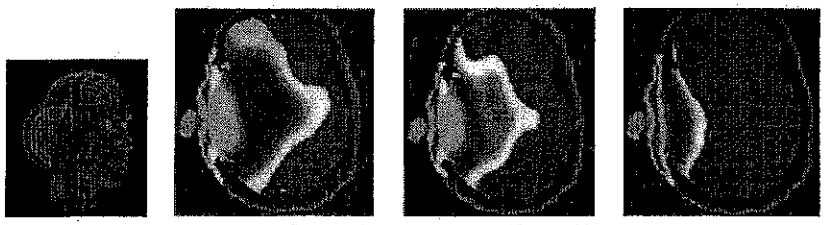


Illustration 1: The degree of penetration of the near-field plume from the cell-phone antenna into the skull varies (as shown in the picture on the left), based on a number of factors including frequency, wave-length, field-intensity and a person's age. The MRI models above show radio frequency field penetrations by varying age while other variables are held constant.

Reference: Cell phones: Invisible Hazards in the Wireless Age, by Dr. George Carlo and Martin Schram (2001, Carell and Graf publishers).

It struck me while watching the film classic, The Great Houdini, the other night. The most skilled magician and escape artist of all time would likely be in awe of the deft illusions that have lured the global public into buying four billion life-threatening devices called cell phones. That slight of hand being accomplished right under the noses of a legal system avowed to protect the rights of victims – while the perpetrators escape all accountability. Just think what Houdini could have done with a trillion dollar industry behind him!

Sadly, the story is not metaphor. It is the reality that threatens the essence of our being, the futures of our children, and the fragile ecological balance of a planet already under siege. It is potentially more serious than global warming – and already claiming lives.

So, you say: "If this technology is so dangerous, why isn't it portrayed that way in the news? Do we not have scientists who study this to make the technology safe? Do we not have regulations and government policing to keep us safe? Do we not have the news media to keep us informed? And do we not have lawyers who will advocate on our behalf to ensure that we are treated fairly?"

Yes, we have all of those protections. But they are not working to protect us. And, there is catastrophic trouble ahead if corrective steps are not taken to stem the tide of danger being precipitated by the unbridled expansion of wireless technology.

FACT
Cell Phones Cause Disease

When cell phones were first proposed for consumer use in 1983, the fledging wireless communications industry succeeded in convincing the Food and Drug Administration (FDA) that pre-market safety testing was not necessary.

The rationale: cell phones were like little microwave ovens that operated at power levels too low to cause heating. Thus, because cell phones could not be used to cook food, they were deemed safe by the FDA. That mistake in 1983 was the foundation for a long-term detrimental public health threat that is increasing daily.[1]

By 1993, there were 15 million Americans using cell phones – 25 million people worldwide. When a Florida lawsuit raised public questions about cell phones causing brain cancer, the industry, the FDA and the media were caught by surprise. The confusion prompted Congressional hearings and a subsequent deal between the cell phone industry and the FDA to do research as a means of filling in the data gaps that were present because of their 1983 decision to forego pre-market safety testing.[2] By the end of 2008, there will be more than 280 million American users and more than four billion users worldwide.[3] The cell phone has become ubiquitous among all demographic groups – including young children.

While a cell phone is held close to the head, electro-magnetic radiation penetrates deep into brain tissue, and that is where the problem begins. *(See Illustration 1)* Indeed, a decade ago the primary concern was the penetrating near-field plume – or the area within six inches of the antenna. However, that concern is now one of many, as ambient radiation has become a very serious problem for those who are electro-sensitive or otherwise symptomatic with conditions involving cell membrane sympathetic stress.[4]

Every cell phone must be connected to a base-station antenna to be functional. Each connection results in a biologically active electromagnetic directional wave, which combines with the waves from other cell phones and wireless devices to form a mesh of information carrying radio waves (ICRW) from which there is little escape for most people. The mechanism of harm perpetrated by ICRWs is biological and therefore carries no threshold for effects – in other words, there is no absolutely safe level of exposure. All cells, tissues and organs in the range of exposure are therefore triggered, and the difference between people who develop symptoms and those who do not is related to factors such as age, state of wellness, gender and genetics.[5]

Peer-reviewed studies from around the world show cell phones and other wireless technologies ranging from WiFi in schools to transmission towers in neighborhoods, cause adverse biological effects and disease. *(See bibliography: Key Cell Phone Disease Causation References)*. Epidemiological studies indicate the risk of benign and malignant brain tumors, acoustic neuroma, melanoma of the eye and salivary gland tumors increases significantly after ten years

[1] To be sure: had scientific studies, which are now completed, been done appropriately as pre-market testing, cell phones as we know them today would not have made it to the marketplace.

[2] The history of those occurrences is detailed in the book, Cell Phones: Invisible Hazards in the Wireless Age, 2001, co-written by Dr. George Carlo and Washington syndicated columnist, Martin Schram.

[3] This magnitude of growth is astonishing – especially when considering that the item is a radiation emitting device that has never been tested for safety and that consumer surveys indicate more than half of all users believe there is an associated health risk.

[4] Reports from clinicians who treat electro-magnetic radiation-related membrane sensitivity conditions suggest that between five and ten percent of the general population could now be affected.

[5] Indeed, clinicians familiar with cell phone pathology suggest that the proper distinctions for most of the population are 'those symptomatic' and 'those not yet symptomatic'.

Side Bar 1:

Cell Phone-Related Diseases and Early Warning Symptoms

More than 1,000 peer-reviewed, published studies form the basis for establishing the link between mobile phone use and a variety of health problems.

Cell Phone-Related Diseases:

- brain, eye and salivary gland tumors;
- neurological diseases including Autism and Alzheimer's;
- debilitating illnesses including electro-hypersensitivity, anxiety syndromes, sleep disorders, and depression;
- exacerbation of immune, endocrine, gastrointestinal and reproductive system symptoms; and
- compromising efficacy of necessary medical and therapeutic interventions

Early Warning Symptoms:

- fatigue, shortness of breath and lethargy
- difficulty sleeping including restless leg and other nuisance syndromes
- difficulty keeping focus and attention deficits
- short term memory lapses
- daydreaming and staring off into space
- dizziness and tingling in extremities
- loss of appetite or persistent diarrhea
- unusually severe allergic reactions
- intolerance to alcohol
- extreme sensitivity to sunlight and noise
- impotence and sexual dysfunction
- ineffectiveness of prescription remedies

Side Bar 2:

The Causal Mechanism

Laboratory experiments, epidemiological studies and clinical observations form a convergent database that has fostered a clear elucidation of the mechanism through which Information Carrying Radio Waves (ICRW) from cell phones and other wireless devices cause disease.

Key parts of the mechanism:

- Spatially and temporally coherent ICRW, necessary for wireless communication, do not occur in nature. When these waves resonate with cell membrane vibration receptors, they trigger a protective, sympathetic response.
- Because the ICRW are standing waves, the sympathetic response is chronic and causes a biological cascade of effects at the cellular level that includes a decrease in cell membrane permeability. This leads to cellular energy depletion, intra-cellular build-up of free radicals, and metabolic inefficiency.
- Intercellular communication is disrupted, leading to acute symptoms that are the result of cells not being able to work together as tissues, organs and organ systems. This fundamental disruption of normal physiology can lead to myriad diseases.
- As waste product becomes trapped inside cells, free-radical damage increases, including interference with DNA repair and genetic transcription.
- Disruption of DNA repair leads to the formation of micronuclei and other aberrant genetic constructs. When the burden becomes intolerable to the cell, the process of apoptosis facilitates cloning of the aberrant constructs, cell proliferation and consequent tumor development.
- Interference with genetic transcription alters the genomic fingerprint carried to daughter cells following normal mitosis, causing somatic alterations and chronic disease manifestations.

Of critical note: this causal mechanism is consistent with the unusual notion that varied diseases can follow from a single type of exposure. Thus, mobile phone exposure can plausibly lead to one type of disease in one person and another disease in another person. The differences in susceptibility are based on genetics, environment, lifestyle, occupation and other health status parameters.

Side Bar 3:

Governments Recommending Precautions for Mobile Phone Use Among Young People

Country	Warning
India	No use in children under 16 years of age
Japan	General limitation under 8 years of age
Russia	General limitation; no use under 12 years
France	No long calls; no use under 16 years of age
Israel	No use under 12 years of age
United Kingdom	General limitation under 2 years of age

Note: The United States does not officially recognize mobile phone health risk problems. However, the National Research Council has now recommended more research on the risks of cell phone use in children and pregnant women. This is the first such action by any U.S. government agency.

of cell phone use – some studies suggest that even short-term use statistically increases cancer risk.[6]

Cancer is not the only concern, as studies confirm myriad conditions associated with wireless radiation exposure, including neurological disease and Autism.[7] *(See Side-Bar 1: Cell Phone-Related Diseases and Early Warning Symptoms)* As more precise scientific information is gathered, it is clear that ICRW and other types of electromagnetic radiation can act both as direct causes of disease and as indirect antagonists or synergens.[8]

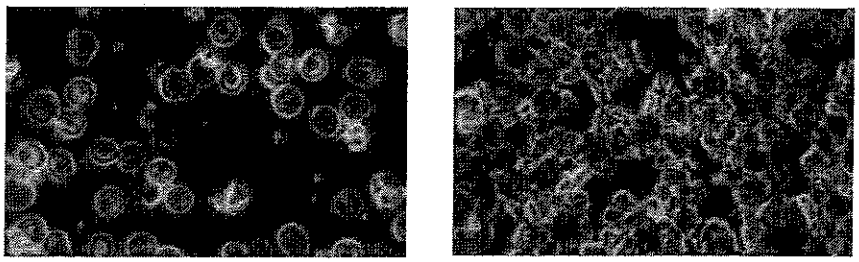


Illustration 2: Distrupted red blood cell intercellular communication occurs within minutes of exposure to Information Carrying Radio Waves. Red blood cells must be able to sense the location of other blood cells to avoid clumping. Left picture: prior to cellphone exposure - red cells are functional. Right picture: after five minutes on a cell phone - red cells are clumped and non-fuctional.

With respect to cause and effect proof, the key is that in the past two years, clear elucidation of the pathological mechanism of harm has been discerned. *(See Side-Bar 2: The Causal Mechanism; See Illustrations 2 and 3).* The cumulative science thus lays the groundwork for establishing medical causation under the stringent Daubert standard. Indeed, among scientists and clinicians whose work is focused on wireless technology induced health effects, the debate has shifted from the presence or absence of cause and effect to the urgent need for remedies to control an emerging medical problem impacting millions of people every day.

[6] In the peer-reviewed published epidemiological literature addressing the link between cell phones and tumors, there are more than 300 statistically significant findings of excess risk.

[7] Autism is believed to be associated with heavy metal toxicity, including exposures sustained through mercury containing vaccinations. Data now suggest that electromagnetic radiation exposure could be exacerbating the effects of heavy metals by closing down cell membranes and trapping metals within cells. Mariea and Carlo, Australasian Journal of Clinical Environmental Medicine, November 2007.

[8] Clinical data suggest that therapeutic medications necessary for controlling symptoms from heart disease, cancer, diabetes and other conditions do not work efficiently in the presence of electromagnetic radiation.

Side Bar 4:

The Story of J.G. Brady

(Personal Account of G. L. Carlo)

In October of 1999, following the airing of an ABC News 20/20 special on the health effects of mobile phones which featured our work, my assistant received a phone call from a fellow who identified himself as J.G. Brady. During the call, Mr. Brady indicated that he was retired military, and that he had served as secretary for the U.S. Joint Chiefs of Staff. He indicated that he had information that I needed to see. I was not able to take the call, but suggested that he send the information to us in a letter.

We received his 17-page letter two days later, but regretfully I did not read it until the first of December. After reading the first page, I attempted to call Mr. Brady on the phone. The phone number he gave in the letter was disconnected. As I continued to read the letter, I was stunned by its contents, page after page. We tried to reach Mr. Brady in all ways at our disposal: the letter had a P.O. Box return address that had been closed a week earlier; his number was unlisted in Seattle, Washington, where the letter originated; he appeared to have no other family in Seattle, as we attempted to call all of the 'Brady's' listed in the telephone book. I later gave the letter to the CBS 60 Minutes news magazine, but they were also unable to find Mr. Brady. I later passed the letter to Washington ABC News reporter Del Walters, who was not able to find Mr. Brady, but indeed was able to confirm the viability of the contents of the letter through interviews with a number of retired military personnel.

What did the J.G. Brady letter say?

- The military establishment had been studying radio frequency health effects since the late 1940s because of radiation poisoning occuring among radio communications personnel in the services.
- The top-secret health effects research involved commercial co-sponsors including many of the main players in the mobile phone industry of today.
- The work was completed in the late 1980s, with solutions to the health risk problems identified and readied for implementation within the armed services.
- Prior to public release of the de-classified data reports in 1992, the commercial co-sponsors were granted by the White House their request that the research findings be re-stated so as not to alarm the public with respect to dangers of wireless communication devices such as cell phones. An Executive Order was signed by President George H. W. Bush that facilitated the re-writes.
- The original research clearly identified specific health risks and remedies. In the re-stated reports, the health risk findings were absent.
- In 1996, President Bill Clinton signed an Executive Order that allowed for the original research data to be destroyed.

J.G. Brady has never been found. But, the implications of the content of his letter, much of it independently verified, are far-reaching and suggest that many of the health problems associated with wireless technology were likely avoidable.

The urgency is profound because the most vulnerable are the young, the sick, the elderly and the poor – population groups who, for survival, routinely rely on assistance from public and private caretakers. Effected patients from around the world report personal devastation and economic ruin coinciding with electromagnetic radiation related disease. Patients with electro-hypersensitivity, for example, are not able to work in environments where there is any type of electromagnetic radiation exposure – areas absent the exposure are near impossible to find. These people become permanently unemployable.[9] Thus, the effects of cell phone radiation have drifted into areas of fundamental public policy, lifestyle choices, politics, health care, national security and personal economic viability. Indeed, some governments around the world have begun to take steps to protect vulnerable populations. *(See Side-Bar 3: Governments Recommending Precautions for Mobile Phone Use Among Young People)*

The tragedy is that most of the suffering is probably avoidable. The problems associated with electromagnetic radiation health effects have been known for at least three decades, and technological solutions have been available, but not implemented, for at least two.[10] *(See Side Bar 4: The Story of J.G. Brady)*

FACT

Orchestrated Illusions Have Shaped Public Opinion

Were these devastating and far-reaching effects accidents of nature, finding solutions could be collective collaborations of citizens, government and industry. However, the unfortunate reality is that a dangerous fraud is being perpetrated upon the public that has kept knowledge regarding mobile-phone related health and ecological dangers suppressed and technologies capable of saving lives from reaching the consumer market place. The perpetrators are the ever expanding brethren of the telecommunications and internet industries. Armed with the experiences of public relations, marketing and defense law personnel who learned their skills in the tobacco and asbestos wars, the orchestrated ruse around the safety of telecommunications technology is the most sophisticated in history.[11] *(See Side-Bar 5: The Cell Phone Industry Playbook: Controlling Illusion)*

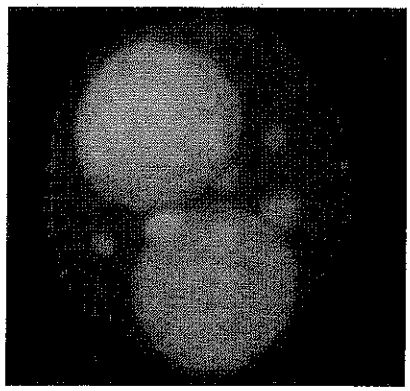


Illustration 3: Intracellular build-up of free radicals, including heavy metals, are a result of cell membrane sympathetic response to Information Carrying Radio Waves. The smaller spots in this photo are micronuclei which are indicative of disrupted DNA repair, a form of genetic damage consistent with the development of brain tumors.

The cornerstone of the industry approach: Keeping the cell phone health effects issue out of the scientific and medical playing fields and in the public relations and political arena. According to the rules

Side Bar 5:

The Cell Phone Industry Playbook: Controlling Illusion

The mobile telephone industry has been successful in manipulating scientific data, public opinion and public information to protect their interests, promote the unbridled sale of their technologies and create the illusion of safety – all to the detriment of public health.

Here is how they do it.

- Public relations "hit squads" are permanently in place in trade associations and corporate offices to monitor scientific, medical and consumer information for consistency with industry interests.
- When "problems" are identified, the public impact of detrimental information is altered first through public statements and written press releases.
- The media are 'managed' by leveraging advertising dollars
- Second level 'management' is achieved through control of scientific research and scientific organizational channels.

Key watch words that signal industry manipulation:

- Expert panel reports say.....
- Third party opinions are....
- The 'weight of scientific evidence' indicates.....
- The studies need to be 'replicated' before.....
- The 'safety guidelines' are being met
- More research is needed before.....
- Scientists around the world agree that.....

Industry institutional collaborators:

- The World Health Organization
- The American National Standards Institute
- The IEEE – Institute for Electronics and Electrical Engineers
- The International Commission on Non-Ionizing Radiation Protection
- The American Cancer Society
- The Bioelectromagnetics Society – BEMS
- The Federal Communications Commission
- The Food and Drug Administration

Industry consultants who publicly support industry positions:

- Dr. William Bailey – Exponent Consultants
- Dr. Linda Erdreich – Exponent Consultants
- Dr. John Moulder – University of Wisconsin
- Dr. Michael Repacholi – University of Rome (Italy)
- Dr. Bernard Veyret – University of Bourdeax (France)
- Dr. Michael Thun – American Cancer Society
- Dr. Joseph Roti Roti – Washington University (St. Louis)
- Dr. John Boice – International Epidemiology Institute
- Dr. Paolo Vecchia – International Committee on Non-Ionizing Radiation Protection

in their playbook, the issue is not about public health and safety – it is about public perception. It is not about scientific truth – it is about opinion. And, to achieve that end, sometimes it becomes necessary to change the science to suit the desired outcome. *(See Side-Bar 6: Data Manipulation: Thumbs on the Scales of Science)*

The complexity of the science is used to advantage by the industry in their public positioning. Professional word-smiths within the industry split hairs with complicated scientific concepts such as the differences between thermal and non-thermal mechanisms; biological effects and health effects; replication of studies and corroborative research; and weight of scientific evidence versus proper scientific judgment. Reporters glaze over when confronted with the complicated nuances, and public reports of harm are either not communicated or are so watered down that readers, listeners and viewers are left with the impression that 'the issue is being looked into and so far, there are no problems'. Thus, consumers continue to buy.

The most obvious motivation for the wireless industry's focus on manipulating public opinion is maintaining sales volume. The industry is highly competitive as companies work on narrow profit margins. A shift of one or two percentage points of market share can have devastating effects of the bottom line of even the largest industry players.[12]

However, more insidious and equally motivating has been the decision by insurance carriers to exclude health risk claims from product liability coverage sold to the wireless industry. Beginning in 2002, major insurers walked away from health risk coverage to protect themselves from expenses *(See Side-Bar 7: Chronology of Key Cell Phone Personal Injury Litigation)* and potential losses *(See Side-Bar 8: Workers' Compensation Cases)* associated with ongoing product liability and personal injury litigation against the cell phone industry.

To avoid appearing as a lone target for litigation, the cell phone industry has continued to meld itself into the burgeoning information technology and internet industries. In 1999, the main cell phone industry trade association, the Cellular Telephone Industry Association, changed its name to the Cellular Telephone and Internet Association. That opened the door to recruit the likes of Microsoft and Apple into their midst. In 2005, they moved into the entertainment industry – exemplified by the joint venture between Sprint and the Disney Corporation that brought Disney into the ranks of wireless signal carriers. Café companies such as Starbucks Coffee and Panera Bread have been lured into wireless Internet partnerships. These moves have diluted the potential liability for cell phone companies. These moves have spawned an institutional arrogance within the industry – their new breadth and apparent strength in numbers portraying their apparent belief in their own invincibility. Over time, however, it remains to be seen whether or not Microsoft, Apple, Disney and Starbucks among others are willing to carry the burden of the cell phone industry's self-inflicted liability.[13]

Manipulation of the consumer market is also part of the industry strategy to extend their reach. Campaigns remain in place to convince parents and teachers that WiFi wireless Internet connections in schools improve education – while there is no evidence to support improvement and the pathology associated with ICRW is consistent with learning deficiencies being caused by the WiFi itself.[14] The use of cell phones as personal safety devices for young and old alike remains a selling point – even though there are no data to support the claims that

Side Bar 6:

Data Manipulation: Thumbs on the Scales of Science

Studies funded by the mobile phone industry are more than six times more likely to find "no problem" than studies funded by independent sources. This difference is statistically significant – suggesting the occurrence is not by chance. The following is an example.

- In 1995, a young epidemiology student was working as an assistant to a senior scientist when their organization was contracted by an independent group to conduct a case-control study of brain tumors and cell phone use. When the lead investigator passed away before the study was completed, the work continued with the student and was completed in the fall of 1998. The results were peer-reviewed and the report submitted in compliance with the research contract revealed a statistically significant doubling in risk of rare neuro-epithelial brain tumors among cell phone users.
- Between 1999 and 2000, the student forged a relationship with a cell phone industry epidemiologist who had been hired to assist in 'peer review' of studies prior to publication.
- In late 2000, a paper describing the case-control study was submitted to the prestigious Journal of the American Medical Association (JAMA). In that paper, three cases of cancer that had been part of the previous analyses had been eliminated. That change in the number of cancer cases included in the study – a breach of the protocols that had been in place since the study began in 1995 – eliminated the statistical significance of the link between brain tumors and cell phones.
- In the original peer-reviewed report, he also detailed a statistically significant correlation between the side of the head where tumors were located and the side of the head where people reported using their cell phones. Another study from Sweden that same year showed a similar significant risk increase with ipsilateral phone use. The new finding was very damaging to the mobile phone industry, especially since there was another corroborative study.
- With the three cases of cancer eliminated the statistically significant correlation between the side of the head where the phone was used and the side of the head where the tumor was located also conveniently disappeared. The peer-reviewers at JAMA had no way of knowing about the data manipulation.
- In the end, manipulated data were published in a highly reputable peer-reviewed journal. The industry was able to use the paper as a public relations tool. Today, the paper remains prominent in the data package the industry uses to advance its position that cell phones pose no health risk.

[9] A very high proportion of indoor work environments – offices, schools, universities, banks, service providers – contain wireless Internet, cordless phones, and other sources of electromagnetic radiation.

[10] While corrective technologies exist, few have made it successfully into the consumer marketplace.

[11] Following a 2005 U.S. Supreme Court ruling denying a request for certiorari regarding a 4th Circuit Court of Appeals ruling against the industry – the case argued by Kenneth Starr as counsel to the cell phone industry – written public statements by cell phone industry operatives must be cleared through litigation counsel.

[12] It is noteworthy that Motorola, Inc. is set to leave the wireless device space and become a component manufacturer only. There will be no American companies manufacturing cell phones in the near future.

[13] Thus far, Microsoft, Apple, Disney, Starbucks and other of these new telecommunications industry partners have not been named as co-defendants in personal injury, workers' compensation or consumer fraud lawsuits. Actions naming these co-defendants, however, could change the landscape.

Side Bar 7:

Chronology of Key Cell Phone Personal Injury Litigation

1992

Reynard v. NEC Corp. et al.

1 First Cell phone - brain cancer case
2 Filed in Florida
3 Disposition in favor of industry

1994

Kane v. Motorola, Inc.

1 Motorola cell phone research and development employee
2 Developed brain tumor after testing early cell phone prototypes
3 Case filed in Illinois and settled as a confidential employer-employee resolution

1996

Wright v. Southwestern Bell Mobile Systems

1 Employee of mobile phone carrier who developed brain tumor
2 Unlimited cell phone minutes as perk of her job
3 Case filed in Illinois and settled as a confidential employer-employee resolution

1997

Busse v. Motorola, Inc. et al.

1 Class Action filed in Illinois on theory that industry supported epidemiological studies of phone users based on phone records were meant to withhold health risk data from public
2 Illinois court agreed that the action represented several million mobile phone users across the U.S.
3 Certified as a nation-wide Class Action in 1999, with public notice in the Wall Street Journal and other national newspapers
4 Dismissed upon mutual consent of opposing counsel in 2003

2000

Newman v. Motorola, Inc. et al.

1 Neurologist with brain tumor filed suit in Maryland
2 Removed to Multi-District Litigation in Federal Court in Baltimore under Judge Catherine Blake
3 Daubert evidentiary hearing in 2002 with historical scientific data prior to 1999 presented by witnesses
4 Case dismissed due to lack of scientific evidence to support causation

cell phones accrue safety benefits that would outweigh the associated health risks.

Manipulating science for profit is not one-sided as another opportunistic emergent 'industry' is serving to exacerbate the public health problem. Multi-layer marketing companies and other 'grass roots' participatory businesses sell numerous products such as pendants and stick-on tabs through unsupportable claims of protecting consumers against the dangers of cell phones and other electro-magnetic radiation emitting devices. The science of prevention and therapeutic intervention with respect to cell phone-related diseases is still being formed, but one aspect is abundantly clear: there is no panacea for the problem. Thus, bogus devices are being sold that not only give desperate consumers a false sense of security – luring them into more excessive use of wireless devices – but data now show that improper use of intervention devices can cause an exacerbation of symptoms and serious disease relapses.[15]

Because these businesses are person to person, they fly under the radar of regulatory groups such as the Federal Trade Commission and there are no incentives for these companies to develop proper scientific data on safety and efficacy. These companies prey on patients who are ill or

Side Bar 8:

Workers' Compensation Cases

California 2005

- Female employee of telecommunications company who tested cell phones 8 hours per day in closed environment
- Brain tumor within three years after began work
- Levels of ICRW exposure several times higher than FCC guidelines
- Evidentiary hearing where scientific study findings post-2000 were presented
- Settlement agreement reached for $180,000

California 2006

- Male employee who used cell phones in his job
- Brain tumor within six years after began using phone
- Same science presented as in evidentiary hearing above
- Patient deceased
- Undisclosed amount of settlement with surviving family member

Alaska 2007

- Maintenance worker contracted to do repairs on a tower facility he expected
- was not operating during the work period
- Developed severe cognitive and neurological damage and permanently disabled
- Exposures to RF were far above the FCC guidelines
- AT&T appealed decision and the award was upheld by the Alaska Supreme Court

Reference Assistance: Jeff Silva, Washington Bureau Chief, Radio Communications Reports

[14] Teachers' Unions and university faculty in the United States and Canada have taken public note of the potential hazards.

[15] See Medical Alert: www.safewireless.org.

[16] Earlier this year, a video hoax traveled the Internet world with a scene depicting popcorn being popped by four cell phones surrounding the kernels on a table. The hoax was proudly claimed by a Pittsburgh, Pa. company selling wireless Blue Tooth headsets. The hoax was apparently orchestrated by using internal components of a microwave oven situated out of sight below the table.

[17] It is noteworthy that the verbiage on the FDA website over the years regarding the dangers of cell phones closely follows the public positions taken by the cell phone industry itself.

[18] Jeff Silva, the Washington, D.C. Bureau Chief for Radio Communications Reports, through meticulous inquiry including review of FCC day books, uncovered and reported that the FCC amicus brief was precipitated and written by counsel under retainer to the cell phone industry, and then submitted to the court through the FCC.

Dahlgren v. Audiovox Communications Corp. et al.

1 Consumer fraud Class Action filed in D. C. Superior Court
2 Plaintiffs contend inadequate notice from cell phone manufacturers and carriers regarding possible health risks from mobile phones
3 Current status: ongoing

Schofield v. Matsushita Electronics Corp. of America et al.;
Cochran v. Audiovox Communications Corp. et al.;
Keller v. Nokia, Inc. et al.;
Schwamb v. Qualcomm, Inc. et al.;
Agro v. Motorola, Inc., et al..

1 Brain cancer cases filed in D.C. Superior Court
2 Same movement and status as Murray above

2002

Brower v. Nokia, Inc. et al.

1 Filed in California as a potential Class Action
2 Removed to Multi-District Litigation in Baltimore, Md. in 2003
3 Remanded to California in 2004
4 Dropped by consent of opposing counsel in 2007

Louther v. AT&T

1 Filed in Florida
2 Plaintiff, Mary Louther, represented self in proceeding
3 Removed to Multi-District Litigation in Baltimore, Md. in 2003
4 Dropped by consent of opposing parties in 2007

September 2008: In *Farina v. Nokia*, Senior U.S. District Judge John R. Padova, in dismissing the suit alleging cancer risk from cell phone use, concluded that a consumer suit alleging breach of warranty claims stemming from the alleged dangers of cell phone radio frequency, or RF, emissions is pre-emted by federal law because Federal Communications Commission has the exclusive power to set the standards for radio frequency radiation in cell pones.

The American Trial Lawyer · 81

2008

2001

Murray et al. v. Motorola, Inc. et al.

1 Brain cancer in Motorola employee
2 Filed in Superior Court of the District of Columbia
3 Removed to Multi-District Litigation in 2002
4 Remanded to D.C. Superior Court in 2004
5 Dismissed on Defendant's motion in 2007
6 Currently in appeals process

J. Douglas Pinney, et al. v. Nokia, Incorporated, et al., and consolidated cases, U.S. Court of Appeals for the 4th Circuit, App. Ct. No. 03-1433, an appeal from the U.S. District Court for the District of Maryland, D.C. Nos. CA-01-1421-CCB, CA-01-1456-CCB, CA-01-3259-CCB, CA-01-3260-CCB, CA-01-3261-CCB, and CA-01-3899-CCB), Judge Catherine Blake presiding..

1 Five separate state Class Actions filed in Louisiana, Maryland, Pennsylvania, New York and Georgia
2 Plaintiff's seeking money to purchase headsets for all cell phone users on theory that cell phones without headsets are defective products
3 Removed to Multi-District Litigation in Baltimore, Maryland
4 Dismissed in 2003 on grounds of federal pre-emption due to jurisdictional overlap of the Telecommunications Act of 1996 and the regulatory function of the Federal Communications Commission
5 Overturned on split decision by the United States Court of Appeals for the 4th Circuit in 2005
6 Defendant's petition for certiorari to the United States Supreme Court denied in 2005
7 Cases returned to state courts where all but one have been dropped by consent of opposing counsel.

Reference Assistance: Jeff Silva, Washington Bureau Chief, Radio Communications Reports.

poorly informed consumers who can be swayed by unscientific and unsupportable personal testimonials and other wild claims about miracle cures. The fraud perpetrated by these 'helpful' companies is equally as damaging to public health as the ruse promoted by the wireless industry itself.[16]

FACT

The Industry Has Escaped Accountability

Thus far, the cell phone industry has been freed from any accountability pertaining to the health and environmental damage done by their devices and supportive infrastructure. Those who are being injured are left without recourse. In short, the system is not working.

The industry has the FDA held in abeyance. Because the FDA gave the industry a variance on the requirement for pre-market safety, it is unlikely that any other action will be taken by them. With respect to radiation-emitting devices, the FDA has very narrow regulatory authority: they can require pre-market testing; they can do post-market surveillance; they can ban products if post-market surveillance identifies problems. With upwards of 280 million Americans using cell phones, a cell phone ban is politically infeasible. The FDA has their hands tied and as such is not directly involved in the safety regulation of cell phones at all.[17]

The wireless industry controls the Federal Communications Commission (FCC). The revolving door between the FCC and the wireless industry is well documented. Indeed, the partnership is cited publicly by both industry and the FCC as a major reason for the tremendous growth and 'success' of the wireless industry itself. It is noteworthy that in a recent cell phone-brain cancer proceeding in D.C. Superior Court, the FCC entered an amicus brief in support of the cell phone industry's motion for dismissal. The FCC had never before mingled in state or federal court proceedings regarding cell phone dangers, and the filing signals a new level of bold interference by the industry with the workings of that federal agency.[18] Further, the emission guidelines for wireless radiation promulgated under the Telecommunications Act of 1996 and administered through the FCC, are routinely misrepresented by the cell phone industry as 'safety standards'. The FCC has no safety authority. Thus, currently in the U.S., there are no safety standards to protect consumers from the dangers of cell phones and other wireless devices.

Litigation thus far against the cell phone industry has provided yet another escape route. Federal pre-emption has been the battleground serving to delay existing cell phone litigation and prevent finders of fact from hearing scientific and medical causation testimony based on data generated after 1999.

FACT

Legal and Legislative Actions Are Necessary

In matters of public policy and consumer protection, litigation and legislation should be considered as last resorts to be employed when available remedial options have failed – such is the case with cell phones and other wireless technology.

Health risk questions about wireless have been on the national agenda for a half century. For the past fifteen years, the debate has been public. As time has elapsed, the public health threat has become exacerbated, not ameliorated, as personal and environmental exposures to dangerous electromagnetic fields have dramatically increased without health risk or ecological mitigation. Most importantly, there are large numbers of persons who are now affected with accumulating medical bills, lost wages, pain and suffering.

Litigation is necessary to compensate victims and to provide deterrents to the continued disingenuous and dangerous behavior of the wireless industry.

- Personal injury litigation is supportable by medical science for cell phone-related brain tumors, parotid gland tumors, acoustic neuroma, eye cancer, neurological disorders, electro-hypersensitivity and Autism.
- Product liability actions are needed to compensate injury and to eliminate the detrimental public health impact of company practices that victimize patients and fraudulently promote products under false claims of protection against the effects of various types of electromagnetic radiation.

In addition to compensating victims, there is an urgent need to apply political pressure to effectuate long term solutions and to ensure the health and safety of future generations.

- Legislative actions to place warnings on cell phones and wireless devices, as well as warning signs in public spaces that carry WiFi and other wireless signals are necessary.
- The Telecommunications Act must be amended to include victims' compensation provisions; incentives for the development and commercialization of technologies that are protective against electromagnetic radiation harms; and civil rights provisions for homeowners in communities where cell phone base stations and other wireless infrastructure are constructed without environmental and health risk due process.

Harry Houdini did not tell his secrets for fear that the magical illusion would be gone. Rest assured, Harry…there are no illusions here…..

Bibliography:

Key Cell Phone-Disease Causation References

Carlo GL., Schram MJ. Cell Phones, Invisible Hazards in the Wireless Age. Carroll and Graff Publishers. January 2001; second printing, February 2002; English, French, German, Chinese and Japanese.

Carlo GL, Thibodeau P. Wireless Phones and Health II, State of the Science. Kluwer Academic Press, October 2000.

Carlo GL, Supley M, Hersemann S, Thibodeau P. Wireless Phones and Health, Scientific Progress., Kluwer Academic Press, August, 1998

Carlo GL, Steffens RS. Scientific Progress: Wireless Phones and Brain Cancer: Current State of the Science. Medscape General Medicine. July 31, 2000.

Friedman J, Kraus S, Hauptman Y, Schiff Y, Seger R. "Mechanism of Short-term ERK Activation by Electromagnetic Fields at Mobile Phone Frequencies", Biochem J 2007; 405: 559-568

Gandhi AG., Singh P. 2005. Mobile Phone Users: Another High Health Risk Group. Journal of Human Ecology 12(1):1-11

Gandhi AG. May-August 2005. Genetic Damage in Mobile Phone Users: Some Preliminary Findings. Indian Journal of Human Genetics. 11(2):99-104

Hallberg O., Johansso, O. FM Broadcasting Exposure Time and Malignant Melanoma Incidence. Electromagnetic Biology and Medicine, Volume 24, Issue 1 January 2005 , pages 1 – 8

Hallberg O., Johansson O. Mobile Handset Output Power and Health. Electromagnetic Biology and Medicine, Volume 23, Issue 3 December 2004 , pages 229 - 239

Hardell LH, Mild KH, Sandstrom, M, Carlberg, M, Hallquist A, Pahlson A. 2003. Vestibular Schwannoma, Tinnitus and Cellular Telephones. Neuroepidemiology 22:124-129

Hardell LH, Mild, KH, Carlberg, M, Hallquist A. March. 2004. Cellular and Cordless Telephone Use and the Association with Brain Tumors in Different Age Groups. Archives of Environmental Health 59(3):132.

Hardell L, Carlberg M, Mild KH. 2005. Case-Control Study on Cellular and Cordless Telephones and the Risk for Acoustic Neuroma or Meningioma in Patients Diagnosed 2002-2003. Neuroepidemiology 25:120-128.

Hardell, L, Carlberg M, Mild KH. 2004 Use of Cellular Telephones and Brain Tumor Risk in Urban and Rural Areas. Occup. Environ. Med. 62:390-394.

Hardell L, Carlberg M, Mild KH. 2006: Pooled Analysis of Two Case-Control Studies on Use of Cellular and Cordless Telephones and the Risk for Malignant Brain Tumours Diagnosed in 1997-2003. International Archives of Occupational and Environmental Health.

Hardell L, Carlberg M, Mild, KH. 2006. Case-control Study of the Association Between the Use of Cellular and Cordless Telephones and Malignant Brain Tumors Diagnosed During 2002-2003. Environmental Research. 100:232-241

Hardell L, Mild KH, Carlberg M, and Soderqvist F. 2006 Tumor Risk Associated with Use of Cellular Telephones or Cordless Desktop Telephones. World Journal of Surg. Oncology 4:74, 1477-7819-4-74

Hayes DL, Wang PJ, Reynolds DW, Estes M, Griffith JL, Steffens RS, Carlo GL, Findlay FK, Johnson CM. Interference with Cardiac Pacemakers by Cellular Telephones. New England Journal of Medicine, 1997; 336(21):1473-1479.

Johansson O. Electrohypersensitivity: State-of-the-Art of a Functional Impairment. Electromagnetic Biology and Medicine, Volume 25, Issue 4 December 2006 , pages 245 – 258.

Johnasson O. (2004). Screen Dermatitis and Electrohypersensitivity: Preliminary Observations on Human Skin. In Electromagnetics Environments and Health in Buildings. Eds Derek J. Croome, Derek Clements-Croome. Taylor & Francis.

Kundi M, Mild K, Hardell L, Mattsson M. 2004. Mobile Telephones and Cancer – A Review of Epidemiological Evidence. Journal of Toxicology and Environmental Health, Part B. 7:351-384

Kundi, M. 2004. Mobile Phone Use and Cancer. Occupational and Environmental Medicine. 61:560-570.

Mariea T, Carlo GL. Wireless Radiation in the Etiology and Treatment of Autism: Clinical Observations and Mechanisms. Journal of the Australasian College of Nutritional Environmental Medicine. November 2007

Markova E, Hillert L, Malmgren L, Persson B, Belyaev I. 2005. Microwaves from GSM Mobile Telephones Affect 53BP1 and γ-H2AX Foci in Human Lymphocytes from Hypersensitive and Healthy Persons. Environ Health Perspect 113:1172-1177

Mashevich M, Folleman D, Kesar A, Barbul A, Korenstein R, Jerby E, Avivi L. 2003. Exposure of Human Peripheral Blood Lymphocytes to Electromagnetic Fields Associated with Cellular Phones Leads to Chromosomal Instability. Bioelectromagnetics 24:82-90

Persson B, Salford LG, Brun A: Blood-brain Barrier Permeability in Rats Exposed to Electromagnetic Fields Used in Wireless Communication. Wireless Networks 3: 455-461. 1997.

Salford LG, Brun AE, Eberhardt JL, Malmgren K, Persson B. (2003) Nerve Cell Damage in Mammalian Brain After Exposure to Microwaves from GSM Mobile Phones. Environmental Health Perspectives 111: 881-883.

Imprint

We are especially proud that **Dr. George Carlo** spoke to us at our **14th International "New Scientific Outlook" World Congress** in Ulm, Germany, October 31st to November 2nd, 2008. Dr. Carlo was talking about pathological processes due to mobile phone radiation, electrosensitivity, his research regarding mobile phones and autism and about what he is doing for mobile phone victims... and he showed how each and every one can promote a healthy life without unnatural radiation. We would like to thank Dr. George Carlo for allowing us to publish his scientific essay "Illusion and Escape: The Cell Phone Disease Quagmire".

Publisher
The World Foundation for Natural Science™

Editor-in-chief
The Right Rev. Sr. Kann Fuchs-Hasell, SF

Graphics and Layout
Brigitte Capeau

Order Address
The World Foundation for Natural Science
European Headquarters
Postfach 7995
6000 Luzern 7, Switzerland
Tel. (+41) 41 798 03 98
Fax (+41) 41 798 03 99
www.naturalscience.org
info@naturalscience.org

Industry Influence; Quote of Prof. Henry Lai PhD. from NY Times Article about Percent of Negative Studies Funded By Industry; 2013

On Tue, Feb 12, 2013 at 9:18 AM, Joel Moskowitz <jmm@berkeley.edu> wrote:
I'm not sure what you're referring to.

In my comments on the GAO Report, I quoted the NY Times,

> "Henry Lai, a research professor in the bioengineering department at the University of Washington, began laboratory radiation studies in 1980 and found that rats exposed to radiofrequency radiation had damaged brain DNA. He maintains a database that holds 400 scientific papers on possible biological effects of radiation from wireless communication. He found that 28 percent of studies with cellphone industry funding showed some sort of effect, while 67 percent of studies without such funding did so. "That's not trivial," he said." (Randall Stross. Should you be snuggling with your cellphone? New York Times, Nov 13, 2010. URL: http://www.nytimes.com/2010/11/14/business/14digi.html)

Industry Influence; Warning: Your Cell Phone May Be Hazardous to Your Health. Christopher Ketcham, GQ; 2010

Warning: Your Cell Phone May Be Hazardous to Your Health

Ever worry that that gadget you spend hours holding next to your head might be damaging your brain? Well, the evidence is starting to pour in, and it's not pretty. So why isn't anyone in America doing anything about it?

BY **CHRISTOPHER KETCHAM**
PHOTOGRAPH BY **TOM SCHIERLITZ**

FEBRUARY 2010

EARLIER THIS WINTER, I met an investment banker who was diagnosed with a brain tumor five years ago. He's a managing director at a top Wall Street firm, and I was put in touch with him through a colleague who knew I was writing a story about the potential dangers of cell-phone radiation. He agreed to talk with me only if his name wasn't used, so I'll call him Jim. He explained that the tumor was located just behind his right ear and was not immediately fatal—the five-year survival rate is about 70 percent. He was 35 years old at the time of his diagnosis and immediately suspected it was the result of his intense cell-phone usage. "Not for nothing," he said, "but in investment banking we've been using cell phones since 1992, back when they were the Gordon-Gekko-on-the-beach kind of phone." When Jim asked his neurosurgeon, who was on the staff of a major medical center in Manhattan, about the possibility of a cell-phone-induced tumor, the doctor responded that in fact he was seeing more and more of such cases—young, relatively healthy businessmen who had long used their phones obsessively. He said he believed the industry had discredited studies showing there is a risk from cell phones. "I got a sense that he was pissed off," Jim told me. A handful of Jim's colleagues had already died from brain cancer; the more reports he encountered of young finance guys developing tumors, the more certain he felt that it wasn't a coincidence. "I knew four or five people just at my firm who got tumors," Jim says. "Each time, people ask the question. I hear it in the hallways."

It's hard to talk about the dangers of cell-phone radiation without sounding like a conspiracy theorist. This is especially true in the United States, where non-industry-funded studies are rare, where legislation protecting the wireless industry from legal challenges has long been in place, and where our lives have been so thoroughly integrated with wireless technology that to suggest it might be a problem—maybe, eventually, a very big public-health problem—is like saying our shoes might be killing us.

Except our shoes don't send microwaves directly into our brains. And cell phones do—a fact that has increasingly alarmed the rest of the world. Consider, for instance, the following headlines that have appeared in highly reputable international newspapers and journals over the past few years. From summer 2006, in the *Hamburg Morgenpost*: ARE WE TELEPHONING OURSELVES TO DEATH? That fall, in the Danish journal *Dagens Medicin*: MOBILE PHONES AFFECT THE BRAIN'S METABOLISM. December 2007, from Agence France-Presse: ISRAELI STUDY SAYS REGULAR MOBILE USE INCREASES TUMOUR RISK. January 2008, in London's *Independent*: MOBILE PHONE RADIATION WRECKS YOUR SLEEP. September 2008, in Australia's *The Age*: SCIENTISTS WARN OF MOBILE PHONE CANCER RISK.

Though the scientific debate is heated and far from resolved, there are multiple reports, mostly out of Europe's premier research institutions, of cell-phone and PDA use being linked to "brain aging," brain damage, early-onset Alzheimer's, senility, DNA damage, and even sperm die-offs (many men, after all, keep their cell phones in their pants pockets or

attached at the hip). In September 2007, the European Union's environmental watchdog, the European Environment Agency, warned that cell-phone technology "could lead to a health crisis similar to those caused by asbestos, smoking, and lead in petrol."

Perhaps most worrisome, though, are the preliminary results of the multinational Interphone study sponsored by the International Agency for Research on Cancer, in Lyon, France. (Scientists from thirteen countries took part in the study, the United States conspicuously not among them.) Interphone researchers reported in 2008 that after a decade of cell-phone use, the chance of getting a brain tumor—specifically on the side of the head where you use the phone—goes up as much as 40 percent for adults. Interphone researchers in Israel have found that cell phones can cause tumors of the parotid gland (the salivary gland in the cheek), and an independent study in Sweden last year concluded that people who started using a cell phone before the age of 20 were five times as likely to develop a brain tumor. Another Interphone study reported a nearly 300 percent increased risk of acoustic neuroma, a tumor of the acoustic nerve.

As more results of the Interphone study trickled out, I called Louis Slesin, who has a doctorate in environmental policy from MIT and in 1980 founded an investigative newsletter called *Microwave News*. "No one in this country cared!" Slesin said of the findings. "It wasn't news!" He suggested that much of the comfort of our modern lives depends on not caring, on refusing to recognize the dangers of microwave radiation. "We love our cell phones. The paradigm that there's no danger here is part of a worldview that had to be put into place," he said. "Americans are not asking the questions, maybe because they don't want the answers. So what will it take?"

TO UNDERSTAND HOW radiation from cell phones and wireless transmitters affects the human brain, and to get some sense of why the concerns raised in so many studies outside the U.S. are not being seriously raised here, it's necessary to go back fifty years, long before the advent of the cell phone, to the research of a young neuroscientist named Allan Frey.

In 1960, Frey, then 25, was working at General Electric's Advanced Electronics Center at Cornell University when he was contacted by a technician whose job was to measure the signals emitted by radar stations. At the time, Frey had taken an interest in the electrical nature of the human body, specifically in how electric fields affect neural functioning. The technician claimed something incredible: He said he could "hear" radar at one of the sites where he worked.

Frey traveled to the facility and stood in the radar field. "And sure enough, I could hear it, too," he said, describing the persistent low-level hum. Frey went on to establish that the effect was real—electromagnetic (EM) radiation from radar could somehow be heard by human beings. The "hearing," however, didn't happen via normal sound waves perceived through the ear. It occurred somewhere in the brain itself, as EM waves interacted with the brain's cells, which generate tiny electrical fields. This idea came to be known as the Frey effect, and it caused an uproar in the neuroscience community.

The waves that Frey was concerned with were those emitted from the nonionizing part of the EM spectrum—the part that scientists always assumed could do no outright biological damage. When Frey began his research, it was assumed that the only way microwaves could have a damaging biological effect was if you increased the power of their signals and concentrated them like sword points—to the level where they could cook flesh. In 1967, this resulted in the first popular microwave oven, which employed microwave frequencies at very high power, concentrated and contained in a metal box. Aside from this engineered thermal effect, the signals were assumed to be safe.

Allan Frey would help pioneer the science that suggested otherwise. At the vanguard of a new field of study that came to be known as bioelectromagnetics, he found what appeared to be grave *nonthermal* effects from microwave frequencies—the part of the spectrum that belongs not just to radar signals and microwave ovens but also, in the past fifteen years, to

cell phones. (The only honest way to think of our cell phones is that they are tiny, low-power microwave ovens, without walls, that we hold against the sides of our heads.) Frey tested microwave radiation on frogs and other lab animals, targeting the eyes, the heart, and the brain, and in each case he found troubling results. In one study, he triggered heart arrhythmias. Then, using the right modulations of the frequency, he even stopped frog hearts with microwaves—stopped the hearts dead.

Frey observed two factors in how microwaves at low power could affect living systems. First, there was the carrier wave: a frequency of 1,900 megahertz, for example, the same frequency of many cell phones today. Then there was the data placed on the carrier wave—in the case of cell phones, this would be the sounds, words, and pictures that travel along it. When you add information to a carrier wave, it embeds a second signal—a second frequency—within the carrier wave. This is known as modulation. A carrier wave can support any number of modulations, even those that match the extra-low frequencies at which the brain operates (between eight and twenty hertz). It was modulation, Frey discovered, that induced the widest variety of biological effects. But how this happened, on a neuronal level, he didn't yet understand.

In a study published in 1975 in the *Annals of the New York Academy of Sciences*, Frey reported that microwaves pulsed at certain modulations could induce "leakage" in the barrier between the circulatory system and the brain. Breaching the blood-brain barrier is a serious matter: It means the brain's environment, which needs to be extremely stable for nerve cells to function properly, can be perturbed in all kinds of dangerous ways. Frey's method was rather simple: He injected a fluorescent dye into the circulatory system of white rats, then swept the microwave frequencies across their bodies. In a matter of minutes, the dye had leached into the confines of the rats' brains.

Frey says his work on radar microwaves and the blood-brain barrier soon came under assault from the government. Scientists hired and funded by the Pentagon claimed they'd failed to replicate his findings, yet they also refused to share the data or methodology behind their research ("a most unusual action in science," Frey wrote at the time). For more than fifteen years, Frey had received almost unrestricted funding from the Office of Naval Research. Now he was told to conceal his blood-brain-barrier work or his contract would be canceled.

Since then, no meaningful research into the effect of microwaves on the blood-brain barrier has been pursued in the United States. But a Swedish neurosurgeon, Leif Salford, recently expanded on Frey's work, confirming much of what Frey revealed decades ago. Salford found that microwave exposure killed rodents' brain cells and stimulated neurons associated with Alzheimer's. "A rat's brain is very much the same as a human's," he said in a 2003 interview with the BBC. "They have the same blood-brain barrier and neurons. We have good reason to believe that what happens in rats' brains also happens in humans'. " His research, he said, suggests that "a whole generation of [cell-phone] users may suffer negative effects in middle age."

THE POTENTIAL complications don't end there. In the mid-1990s, a biophysicist at the University of Washington named Henry Lai began to make profound discoveries about the effects of such frequencies not only on the blood-brain barrier but also on the actual *structure* of rat DNA. Lai found that modulated EM radiation could cause breaks in DNA strands—breaks that could then lead to genetic damage and mutations that would be passed on for generations. What surprised Lai was that the damage was accomplished in a single two-hour exposure.

"This was explosive news," Slesin said. "The reason it was so important was at the time you had all these allegations of brain tumors and cell phones being connected"—specifically the 1992 lawsuit brought by a Florida man, David Reynard, against a number of companies that manufactured phones and provided cell service, following the death of his wife from a brain tumor. "If you can break up DNA with cell-phone radiation, suddenly it's not such a stretch to think of brain tumors developing from this radiation."

Galvanized by the Reynard case, Motorola frantically mobilized to reassure its investors. Then, in 1994, the company went on the attack to discredit Lai, issuing a memo, later obtained by Slesin, stating it had "war-gamed" Lai's work. "We do not believe that Motorola should put anyone on-camera," the memo said. "We must limit our corporate visibility." It further stated that the "key question" was whether "this experiment [can] be replicated."

The cell-phone industry funds lots of risk studies, and many of them show no effect from cell-phone-related radiation. The industry pointed to those favorable studies when countering Lai's DNA findings. (In 2004, it should be pointed out, a European Union–funded study carried out by twelve research groups in seven countries found evidence of genotoxic effects resulting from cell-phone radiation—the same kind of DNA damage that Henry Lai uncovered in the 1990s.) But when Jerry Phillips, a scientist with the Veterans Administration whose work was funded by Motorola, replicated Lai's findings, the company put him under so much pressure not to publish that Phillips abruptly quit microwave research altogether.

Industry-funded studies seem to reflect the result of corporate strong-arming. Lai reviewed 350 studies and found that about half showed bioeffects from EM radiation emitted by cell phones. But when he took into consideration the funding sources for those 350 studies, the results changed dramatically. Only 25 percent of the studies paid for by the industry showed effects, compared with 75 percent of those studies that were independently funded.

The cell-phone industry has managed to exert its influence in other ways, too. In the United States, the organization most influential in the government's setting of standards for microwave exposure is the Institute of Electrical and Electronics Engineers (IEEE), which bills itself as "a leading authority on areas ranging from aerospace systems, computers, and telecommunications to biomedical engineering, electric power, and consumer electronics." According to Slesin, "The committees setting the EM safety levels at the IEEE historically have been dominated by representatives from the military, companies like Raytheon and GE, the telecom companies, and now the cell-phone industry. It is basically a Trojan horse for the private sector to dictate public policy." The IEEE's "safe limits" for microwave exposure are considerably higher than what they should be, says Allan Frey, who was a member of the organization in the '70s. "When it comes to this matter, the IEEE is a charade," Frey told me.

There have been attempts over the years to set exposure limits based on something other than industry and military preference. In the '70s and '80s, the Environmental Protection Agency was foremost in this effort. But with Ronald Reagan in office, antiregulatory sentiment crested and the EPA's research and standards programs were gutted.

Among the EPA's most talented bioelectromagnetics experts at the time was Carl Blackman, who has worked at the agency since its inception in 1970. Blackman's research at the EPA would advance much of what Allan Frey and others had discovered: The effects from EM fields were many and troubling, though far from fully understood. In 1986 the EPA killed Blackman's research entirely. Carl Blackman believes "a decision was made to stop the civilian agencies from looking too deeply into the nonthermal health effects from exposure to EM fields. Scientists who have shown such effects over the years have been silenced, had funding taken away, been laughed at, been called charlatans and con men. The goal was to only let in scientists who would say, 'We know that microwave ovens can cook meat, and that's all we need to know.' " One veteran EPA physicist, speaking anonymously, told me, "The Department of Defense didn't like our research because the exposure limits that we might recommend would curtail their activities."

Industry influence appears to have permeated even the purest international watchdogs, such as the World Health Organization. Slesin unearthed a hoard of documents showing that hundreds of thousands of dollars from the cell-phone industry was doled out to WHO personnel working on wireless health effects. Some of the heaviest pressure falls on the Federal Communications Commission, for obvious reasons. In 2005 the specially appointed thirty-member Technological Advisory Council to the FCC sought to look into EM effects on human beings. According to one member of the TAC who

spoke anonymously, officials at the FCC "told us we couldn't talk about that. They would not give us any reason. The FCC people were embarrassed and terrified."

If all this sounds like some abandoned *X-Files* script, consider the history of suppression of evidence in the major issues of consumer health over the past half century. Big Tobacco hid the dangers of smoking and the addictiveness of nicotine, supporting its position with countless deceptive studies. Asbestos manufacturers hid evidence that the mineral was dangerous even as tens of thousands of workers died from exposure; the makers of DDT and Agent Orange stood behind their products even as it became clear that the herbicides caused cancer. That the cell-phone industry, which last year posted revenues in the hundreds of billions of dollars, has an incentive to shut down research showing the dangers of cell-phone use is not a radical notion.

CELL TOWERS, AS YOU'D IMAGINE, also emit EM radiation in the microwave spectrum, and while the science is much less exhaustive than that associated with handsets, the installations have nonetheless incited violence in various places around the globe. In Spain and Ireland, saboteurs have taken to destroying cell towers, cheered on by the communities living in their shadows. In Sydney, Australia, a retired telecom worker, convinced that cell towers had sickened him, hijacked a tank in the summer of 2007 and rammed six towers to the ground before police were able to leap into the vehicle and subdue him. In Israel, which has the seventh-highest per capita use of mobile phones in the world, attacks on towers have become a regular occurrence in recent years in both Jewish and Arab communities. Two years ago in Galilee, a Druze community protested the erection of a new tower, claiming that the towers already in their midst had caused cancer rates to skyrocket. The tower was built anyway; soon after, local teenagers burned it down. When the police came for them, the Druze rioted, injuring more than twenty-five officers.

Here, in the U.S., there's been very little resistance to the march of the cell towers. In fact, in Congress there's been almost nothing but support. The Telecommunications Act of 1996—a watershed for the cell-phone industry—was the result, in part, of nearly $50 million in political contributions and lobbying largesse from the telecom industry. The prize in the TCA for telecom companies branching into wireless was a rider known as Section 704, which specifically prohibits citizens and local governments from stopping placement of a cell tower due to health concerns. Section 704 was clear: There could be no litigation to oppose cell towers because the signals make you sick.

When President Bill Clinton signed the TCA into law in February 1996, the rollout of "personal communication services," marketed as PCS, was in full swing. By the end of the year, telecom companies had paid the federal government more than $8 billion to purchase portions of the microwave-frequency sequence. (According to the FCC, fees paid for allocation of spectrum as of 2009 amounted to $52 billion.) Almost immediately, cell-phone antennas sprang up across the country, appearing on church steeples and apartment buildings, in parks and along highways, on streetlights and clock towers and flagpoles. One industry estimate tallied 19,850 such installations in the U.S. in 1995. Today there are 247,000, most hosting multiple antennas.

In a study by researchers associated with the venerable Karolinska Institute in Stockholm, which hands out the Nobel Prize for medicine, the massive expansion of digital PCS in Sweden during 1997 was found to have coincided with a marked but subtle decline in the overall health of the population. Might it be, the Karolinska researchers asked, that Swedes fell victim to the march of the first big microwave PCS systems? The number of Swedish workers on sick leave, after declining for years, began to rise abruptly in late 1997, according to the study, doubling during the next five years. Sales of antidepressant drugs doubles during the same period. The number of deaths from Alzheimer's disease rose sharply in 1999 and had nearly doubled by 2001. The authors of the study—Olle Johansson, a neuroscientist, and Örjan Hallberg, a former environmental manager for Ericsson, the Swedish telecommunications company—"found that for all individual counties in Sweden there was a similar precise time" when health worsened. It occured, they said, almost simultaneously with the rollout of the new digital service. Correlation does not mean causation, but epidemiologists I

spoke with say the data are strongly suggestive and need to be followed up. (In other studies at the Karolinska Institute, Johansson has posited that adverse reactions to cell-phone radiation may develop only after long periods of exposure, as the immune system fails, much in the way that allergies develop.)

ALL OF THESE concerns—the danger of microwaves issuing from the phones we place next to our skulls, the danger of waves emitted by the cell towers that dot our landscapes—also apply to the Wi-Fi networks in our homes and libraries and offices and cafés and parks and neighborhoods. Wi-Fi operates typically at a frequency of 2.4 gigahertz (the same frequency as microwave ovens) but is embedded with a wider range of modulations than cell phones, because we need it to carry more data. "It never ceases to surprise me that people will fight a cell tower going up in their neighborhoods," Blake Levitt, author of *Electromagnetic Fields: A Consumer's Guide to the Issues and How to Protect Ourselves*, told me. "They they'll install a Wi-Fi system in their homes. That's like inviting a cell tower indoors."

In the summer of 2006, a super-Wi-Fi system known as WiMAX was tested in rural Sweden. Bombarded with signals, the residents of the village of Götene—who had no knowledge that the transmitter had come online—were overcome by headaches, difficulty breathing, and blurred vision, according to a Swedish news report. Two residents reported to the hospital with heart arrhythmias, similar to those that, more than thirty years ago, Allen Frey induced in frog hearts. This happened only hours after the system was turned on, and as soon as it was powered down, the symptoms disappeared.

Today, Sprint Nextel and Clearwire are set to establish similar technology across the U.S., with a $7.2 billion government broadband stimulus speeding the rollout. A single WiMAX system would provide Internet coverage for an area of up to 75 square miles. "This means an even denser layer of radio-frequency pollution on top of what has developed over the last two decades," Blake Levitt says. "WiMAX will require many new antennas."

The concern about Wi-Fi is being taken seriously in Europe. In April 2008, the national library of France, citing possible "genotoxic effects," announced it would shut down its Wi-Fi system, and the staff of the storied Library of Sainte-Geneviève in Paris followed up with a petition demanding the disconnection of Wi-Fi antennas and their replacement by wired connections. Several European governments are already moving to prohibit Wi-Fi in government buildings and on campuses, and the Austrian Medical Association is lobbying for a ban of all Wi-Fi systems in schools, citing the danger to children's thinner skulls and developing nervous systems.

I DROVE DOWN to Annapolis, Maryland, recently to visit with Allan Frey. He was preparing to set out on his forty-foot sailboat for a month at sea, so we talked at a restaurant near the marina. After retiring from full-time research in 1985, Frey, now 75, took up the philosophy of science as an avocation, looking at the question of how science progresses, how it fails to progress, how new ideas are birthed or aborted, how a shift in paradigm is a rare thing. The failure to look squarely at the dangers of microwave radiation is a case study in frozen paradigms, he said, a worldview that can't keep pace with reality.

To illustrate what he meant, Frey held up a glass of water. "We're all just big teacups, bags of water that you can heat up—that's the paradigm," he said. It's the engineer's paradigm, the mind-set of people who had no training in the complexity of living systems. The branches of the military, the major defense contractors, the manufacturers of microwave ovens, the telecom companies, were happy to embrace the engineer's paradigm. The thinking was simple and easy to understand, and most important, it indemnified their operations from liability.

"It's a very primitive mind-set," said Frey. "Plato said we don't see the reality; we see shadows on the cave walls. We've got a lot of people who are seeing shadows and saying this is the reality." He nodded at his water glass. "We now know a human being isn't a bag of water. A human being is a complex organization of electrical fields. Electroencephalograms and electrocardiograms, for example, measure these fields. Every cell has an electrical field across the cell membrane,

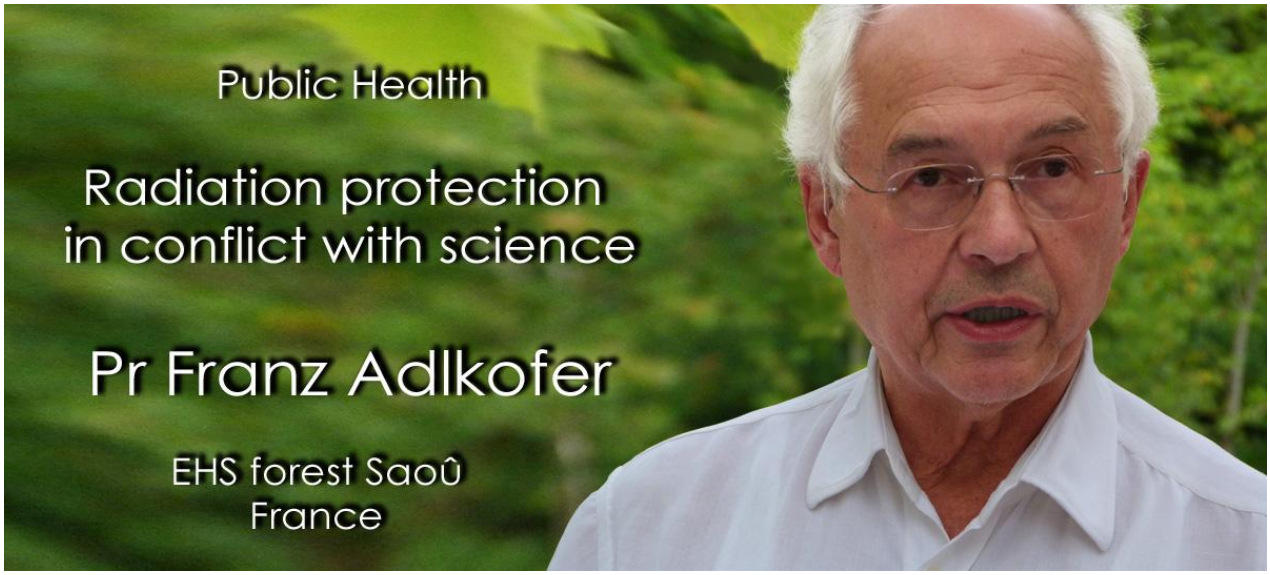
which is a regulatory interface and controls what goes into and out of the cell. All nerve signals are electric. And between the nucleus and the membrane there is an electrical field, you can measure voltages of individual cells! Electricity drives biology. We evolved in a particular electromagnetic environment"—the magnetic fields from the earth's iron core, the terrestrial magnetism from lodestones, visible light, ultraviolet frequencies, lightning—"and if we change that environment as we have, we either adapt or we have trouble."

Later, after Frey and I parted, I walked around Annapolis and took note of the number of cell towers poised atop the buildings, the number of people who talked on their cell phones. They were everywhere, and after a while I stopped counting. At one point, I watched two women pacing in a parking lot, heads bent against their microwave transmitters. They talked and talked and aimlessly circled. When I got home, I looked up a line from Orwell that I couldn't quite remember as I watched them, about the power that machine technology would exert over mankind. "The machine has got to be accepted, but it is probably better to accept it rather as one accepts a drug—that is, grudgingly and suspiciously," Orwell wrote. "Like a drug, the machine is useful, dangerous and habit-forming. The oftener one surrenders to it the tighter its grip becomes."

Modern society, needless to say, is in the grip of wireless technology. All you have to do to understand this is step outside your door. "It just so happens," Frey had told me, "that the frequencies and modulations of our cell phones seem to be the frequencies that humans are particularly sensitive to. If we had looked into it a little more, if we had done the real science, we could have allocated spectrums that the body can't feel. The public should know if they are taking a risk with cell phones. What we're doing is a grand world experiment without informed consent." As for Louis Slesin's question—what will it take to change the paradigm?—Frey shook his head. "Until there are bodies in the streets," he said, "I don't think anything is going to change."

CHRISTOPHER KETCHAM *is a reporter in New York City.* *Research support for this article was provided by the Investigative Fund at The Nation Institute.*

Industry Influence; Radiation Protection in Conflict With Science;
Dr. Franz Adlkofer PhD.; 2011



An Area for the EHS – Forest Saoû France 17 09 2011

Radiation protection in conflict with science

Pr Franz Adlkofer
Pandora - Foundation for Independent Research, Berlin

There is no technology like wireless communication that made its way so fast and so extensive into people's daily life. Within only 20 years the number of mobile phone users increased world-wide from about zero to 4.6 billions. The youngest users are hardly older than three years of age. From the scientific view this development causes a serious problem: The state of knowledge on the biological effects of radiofrequency electromagnetic fields (RF radiation) with low intensity is still rather poor. The currently valid exposure limits are based on the assumption that they reliably protect the human organism, because RF radiation is ineffective as long as it does not raise the temperature in the tissue. This assumption, however, is contrary to the results of an increasing number of studies which altogether show that biological effects occur already far below these exposure limits. Yet, these results are neither considered by the wireless communication industry nor by the government, which in anyway is responsible for the protection of the people against health risks. Thus, we can say that today the most extensive multiracial biophysical experiment of mankind is under way with an uncertain outcome.

Exposure limits

Exposure limits indicate the maximum values allowed for harmful substances, e.g. in drinking water and air or for noise levels in residential areas, which must not be exceeded in order to protect people. Exposure limits for RF radiation guarantee that the energy absorption in the human body or in parts of it, especially in the head, is so low that health damages through generation of heat are excluded. Exposure limits are laid down according to the actual state of scientific research. Whoever controls this state of research takes over the responsibility for the protection of the people. Already before World War II the necessity of exposure limits for RF radiation had been discussed. Since the outbreak war, when the technical use especially for military purposes became increasingly relevant, health risks that had been pointed to in previous observations were ignored. After the War military and industry, which in the meantime highly esteemed the technical potential of RF radiation, both for decades took care that this view maintained. They were supported by politics.

In Europe, an important milestone to assure economic interests with fixing exposure limits was the establishment of the International Commission on Non-Ionizing Radiation Protection (ICNIRP) in 1992. It was founded at Dr. Mike Repacholi's instigation, at that time head of the so-called EMF Project of the WHO. ICNIRP, a private association, received with the help of Repacholi official recognition from the WHO, the EU, and several member states such as France and Germany. In 2006 Repacholi was hired is a consultant by the American power utilities. In line with the industry's position ICNIRP took over the view that there are no other effects of RF radiation but thermal ones. As safety limits it proposed for 900 MHz fields 4.5 W/m^2, for 1800 MHz fields 9.0 W/m^2, and for 2100 MHz fields 10.0 W/m^2. These proposals [1], which only exclude short-term and direct health damages caused by RF radiation but do not consider long-term effects such as the development of cancer and neurodegenerative disorders have been accepted by the WHO and the EU in 1998, and application was recommended to theira member states. See [2] for detailed information.

REFLEX study

For the wireless communication industry the REFLEX study was quite a nuisance because its results speak against the safety of the current exposure limits. REFLEX was carried out between 2000 and 2004 by 12 research teams from seven European countries, mainly funded by the EU Commission and organized and coordinated by me. Results obtained at the Medical University of Vienna showed that low-frequency as well as RF electromagnetic fields own a gene-damaging potential. Genotoxic effects such as DNA strand breaks were observed in isolated human fibroblast exposed to UMTS radiation already at a special absorption rate (SAR) of 0.05 W/kg, thus only one-fortieth of the currently valid exposure limit. Under GSM radiation and otherwise identical experimental conditions a SAR value of 0.3 W/kg, that is one-sixth of the currently valid exposure limit, was necessary to significantly increase the rate of DNA strand breaks. Prof. Alexander Lerchl, at that time member and since 2009 head of the Committee on Non-ionizing Radiation of the German Commission on Radiological Protection (SSK) of the Federal Office for Radiation Protection (BfS) and, thus, responsible for the protection of the people in Germany came to the dramatic conclusion: *Should the research results from Vienna be confirmed this might be the beginning of the end of wireless communication.* If on his own or encouraged by the wireless communication industry, he decided to act – and he was not shy in using unusual means. See [3] for detailed information.

A smear campaign against the REFLEX study

It is well-known and has been proven many times, that publications with results such as the ones from the REFLEX study are met with scepticism and disapproval by the wireless communication industry and its helpers in science. My idea to make the REFLEX results the basis for a new grant application to the EU Commission, in which RF radiation was to be investigated not in test tubes but in living humans, must have indeed provoked resistance. Lerchl decided – as I assume in accordance with his clients – to take action against the publications from Vienna and their authors in his very own fashion. Statistical calculations conspicuous to him were an opportunity to claim that the REFLEX results are faked. He did find the necessary support for his campaign in Prof. Wolfgang Schütz, rector of the Medical University of Vienna. The main goal of their joint activities was to enforce the retraction of two publications from the scientific literature, which reported on the gene-damaging effects of RF radiation. The moral execution of the authors of the alarming results was approvingly accepted. The shameless attempts were thwarted by the fact that two committees for ethics in science, which were ordered to investigate the case, despite making any effort did not succeed to prove the alleged fake. However, the results, although still available in the scientific literature, are irreparably damaged according to the wording: *Something always sticks.* That, in the meantime, they have been proven several times is obviously ignored – also by the International Agency for Research on Cancer (IARC) in Lyon [4,5].

The International Agency for Research on Cancer

In the end of May 2011, the International Agency for Research on Cancer (IARC) of the WHO in Lyon classified RF electromagnetic fields, to which wireless communication radiation belongs, as "possibly carcinogenic". The decision is based on a vote by 30 scientists from 14 countries that had been invited by IARC to Lyon between May 24 and 31, 2011, to discuss the cancer risk of humans exposed to RF radiation. The recent results of epidemiological studies, especially parts of the IARC-coordinated INTERPHONE study and studies by Lennart Hardell from the Swedish university at Orebro had been decisive for the "possibly carcinogenic" classification. These studies observed an increased risk for glioma (malignant brain tumours) and acoustic neuroma (benign tumours of the hearing nerve) after long-term (>10 years) and intensive use of mobile phones. Results from animal experiments were at least considered supportive of a carcinogenic effect of radiofrequency radiation. Results from basic research with proven changes in structure and functions of genes after the exposure of isolated human and animal cells, but also from exposed animals itself, that would have lend weight to the epidemiological observations were, however, not at all considered. Had these results been taken into account according to their significance the classification would not have been "possibly carcinogenic" but rather "probably carcinogenic". Obviously, the IARC wanted to spare such a step, although asked for by a few participants, to the wireless communication-friendly governments that finance WHO and to the powerful wireless communication industry, too. After all, politics and industry still jointly believe in the harmlessness of wireless communication radiation. Despite the recent warning by IARC common interests will probably prevail for quite a while. To defend their interests further they certainly will not be reluctant in their choice of means, just as Prof. Lerchl's defamation of the REFLEX study showed.

Pandora - Foundation for Independent Research

History teaches that science is often misused by government and industry for selfish purposes, and that more than enough scientists are willing to let themselves misuse in return for professional and/or material benefits. The Pandora Foundation was established to point at the serious harm brought by this attitude on the European citizens and to counteract with information and clarification. The deficiencies, that need to be eliminated, arise mostly from the incorrect information of the public about the true state of knowledge. This misguidance is the task of compliant scientists who are first upgraded to "experts" and then posted in national and international boards in charge of providing advice to the decision-making governments. In this position it is their responsibility to constantly review the scientific progress made in the various areas of research. While they routinely discriminate results from critical scientists, they are in no way shy of using their own results, quite often produced by industry- and government-funded pseudo-research, as the guiding principles for their actions. This kind of dealing with science is contrary to the system of values European nations feel obliged to. The Pandora Foundation will prevent that decision-makers in politics and industry who betray ethic principles by misusing science at the cost of the societies get away with impunity.

Prof. Lennart Hardells grant application to the Pandora Foundation

As one of the participants, Lennart Hardell from the Department of Oncology at the University Hospital in Orebro, Sweden, contributed with his epidemiologic research data essentially to the IARC classification. Because of the short period of time that elapsed from the introduction of the new communication technology till the completion of his studies, these data are still burdened with a high uncertainty. Hardell's grant application shows that he in the meantime has available data from Swedish men and women diagnosed with a brain tumour between 2007 and 2009 [6]. With a high probability the evaluation of these data will show that the risk of brain tumours increases with the duration of mobile phone use. This comes very near to a final prove that RF radiation is a carcinogenic risk.

For months now, Hardell tried to raise the funds necessary for the statistical evaluation of his data. As IARC's classification is already now quite a nuisance to for industry, there is obviously no interest to further substantiate the voiced suspicion of a brain tumour risk caused by RF radiation.

Due to its economic impact the classification in the next higher category “probably carcinogenic” should obviously be avoided by all means. This is the reason why a support of Hardell's research work is refused by government and industry. I am aware that I should not ask you to financially support the research project as you urgently need the means yourselves to be able to finally survive in a hostile environment. What is needed, however, is your moral support. Continue your fight as long as necessary, until you are heard by those who are responsible that the truth in this area of research is suppressed. .

Electromagnetic hypersensitivity (EHS)

It is a real tragedy that thousands of people in Europe, who suffer from effects of various forms of electromagnetic fields (EMF), are considered to be mentally ill only because science is not able yet to understand the basic mechanisms leading to EHS. Medical doctors, who are consulted by more and more people with symptoms which do not fit to any known disease, feel as helpless as their patients do, who suffer in a way that their hardship cannot be ignored anymore. This should be reason enough for our societies to take care that these people can lead a life as normal as possible. For decades, politics and industry dominated EMF-research aimed at protecting their economic interests. Thus, our current knowledge about the risks for men and nature through electromagnetic fields is very poor compared to other environmental hazards. These shortcomings in science resulting from the fact that research is not concentrating on human needs, but economic profits are the main reason for your problems. Nescience is the cause why people suffering from EHS is done injustice, and nobody is made responsible for this. As long as industry and politics succeed in defending their principle that there are no relevant biological effects below the valid exposure limits the legal situation of the EHS affected will probably not change. What we need is independent research. that is funded by private persons in case the governments refuse to do so. The current situation, in which the beneficiaries of this technology make huge profits, while the burden is shouldered an unfortunate minority, is absolutely intolerable.

Conclusion

Looking back at my experience with the wireless communication industry, politics, and media, while organizing and coordinating the REFLEX project, I can state today that under the current circumstances the truth about the biological effects of RF radiation is heavily suppressed with all means – including criminal ones. As it is a rule in democracies that the law, rights, and regulations stand above power and their owners and as this rule in our case has been severely violated at the disadvantage of the people, there is nothing more important in a democratic society than to insist on its compliance.

This is what I want to encourage you to do.

References

1. ICNIRP (1998) Guidelines for Limiting Exposure to Time-Varying Electric, Magnetic, and Electromagnetic Fields (up to 300 GHz). Health Physics 74 (4):494-522.
2. only in German: Warum Grenzwerte schädigen, nicht schützen – aber aufrecht erhalten werden. Beweise eines wissenschaftlichen und politischen Skandals. Schriftenreihe der Kompetenzinitiative e.V., Heft 4
3. How Susceptible Are Genes to Mobile Phone Radiation? State of the Research – Endorsements of Safety and Controversies – Self-Help Recommendations. With Articles by Franz Adlkofer, Igor Y. Belyaev, Karl Richter, Vladislav M. Shiroff. Competence Intitiative e.V., Brochure 3
4. soon also in English: Strahlenschutz im Widerspruch zur Wissenschaft. Eine Dokumentation. Schriftenreihe der Kompetenzinitiative e.V., Heft 5
5. http://www.pandora-foundation.eu/documents/ruthless-attacks-on-scientific-results.html
6. http://www.pandora-foundation.eu/projects/hardell-project/index.html

US Agencies; Letter from the FCC's OET Dept.
to Dr. Shuren of the FDA, March 22, 2019

Federal Communications Commission
Washington, D.C. 20554

March 22, 2019

Dr. Jeff Shuren, MD, JD
Director
Center for Devices and Radiological Health
U.S. Food and Drug Administration
White Oak Building 66
10903 New Hampshire Ave
Silver Spring, MD 20993

Dear Dr. Shuren:

As you may recall, the Federal Communications Commission (FCC) issued in 2013 a Notice of Inquiry soliciting comments on radiofrequency (RF) exposure limits, among other things. The FCC is not a health and safety agency and we defer to other organizations and agencies such as yours to interpret the biological research necessary to assess the health impact of RF emissions. We appreciate the continuing dialogue among the staff at the FCC and the FDA regarding the ongoing research into the possible health effects of RF emissions.

We are aware that the final reports of the National Toxicology Program (NTP) Study and your public statements that NTP's experimental findings should not be applied to human cell phone usage, that the available scientific evidence to date does not support adverse health effects in humans due to exposures at or under the current limits, and that the FDA is committed to protecting public health and continues its review of the many sources of scientific literature on this topic.

There has been strong interest for the FCC to address the standards matter, particularly as new technologies such as 5G are introduced. Given that existing studies are continually being evaluated as new research is published, and that the work of key organizations such as IEEE and ICNIRP is continuing, we ask FDA's guidance as to whether any changes to the standards are appropriate at this time.

You may contact Aspa Paroutsas, Chief of Staff of our Office of Engineering and Technology, at Aspasia.Paroutsas@fcc.gov or by telephone at (202) 418-7285.

Sincerely,

Julius P. Knapp
Chief
Office of Engineering and Technology

US Agencies: Letter from Dr. Shuren of the FDA
to the FCC's OET Dept.,Apr. 24, 2019

ET 13-84
19-226

DEPARTMENT OF HEALTH AND HUMAN SERVICES

Food and Drug Administration
Silver Spring, MD 20993

April 24, 2019

Mr. Julius Knapp
Chief
Office of Engineering and Technology
U.S. Federal Communications Commission
445 12th St., NW
Washington, D.C. 20554

Dear Mr. Knapp:

Thank you for your recent letter dated March 22, 2019 on behalf of the Federal Communications Commission's (FCC). Your letter requests our guidance on standards matter, particularly as new technologies such as 5G are introduced. Previously, in a letter dated February 4, 2014, you also had requested our guidance on standards related to the radiofrequency (RF) exposure principles or guidelines under which FCC should consider the newer wireless power transfer (WPT) devices that operate at frequencies for which exposure limits have not yet been specified in the FCC's rules. In light of the new technologies, you also requested FDA to identify any risks of interference to medical devices due to the use of WPT equipment.

Currently, the FCC specifies specific absorption rate (SAR) limits down to 100 kHz and maximum permissible exposure limits for electric field, magnetic field, and power density down to 300 kHz. We agree that with the increase in technology that uses frequencies below 300 kHz and even below 100 kHz, setting human exposure limits below 300 kHz and 100 kHz would better ensure the protection of the general public. The biological response to frequencies in the range below 300 kHz is complex. At the lower end of this range, electrostimulation (nerve stimulation) and induced currents predominate; at the upper end, heating is the predominant effect. Electrostimulation is a rapid biological response; therefore, the long averaging times associated with thermal-based SAR limits are not appropriate. Although they are not identical in their specifications, both the IEEE C95.1-2005 and the ICNIRP Guidelines (Health Physics, 2010) are adequate to protect the general public in this frequency range. Either of these would be an adequate model for the FCC to adopt for their rules below 300 kHz.

Regarding your request to identify any risks of interference to medical devices due to use of WPT equipment. Several types of active medical devices (e.g., implantable cardiac pacemakers, implantable deep brain stimulators (DBS), spinal cord stimulators, implantable drug infusion pumps, and body worn insulin pumps) are known to be susceptible to

electromagnetic interference (EMI) due to low frequency sources such as metal detectors, electronic anti-theft systems, and radio frequency identification (RFID) systems.[1,2,3] However, the potential for interference is greatly affected by the type of modulation and field strength. Part of the concern, regarding exposure to the lower frequency range, is that the prevailing consensus standards for external medical devices specify only limited immunity testing below 150 kHz. With the exception of testing for interference with power line magnetic fields at 50 Hz and 60 Hz, most non-implanted medical devices have not been tested for immunity below 150 kHz. Additionally, present implantable pacemakers are typically tested to the human exposure limits specified in the ICNIRP 1998 Guidelines (Health Physics 1998). Any emitter that exceeds the ICNIRP 1998 levels would be a potential source of interference to active implanted devices. Adoption of higher emissions levels may expose patients to unnecessary risk. Therefore, the most effective mitigation against EMI to active medical devices from the emissions of WPT devices is to reduce the WPT emissions and thus medical device exposure. The methods to reduce exposure should include limits on the WPT output power, designing the WPT with safety interlocks (i.e., designing the WPT source so that it can detect the presence of humans or animals and shut off or greatly reduce power output), creating exclusion zones, and recommending separation distances between the WPT emitter and any active medical devices.

With your inquiry related to safety standards, particularly as new technologies such as 5G are introduced, as you are aware, FDA is responsible for the collection and analysis of scientific information that may relate to the safety of cellphones and other electronic products. As a part of our ongoing monitoring activities, we have reviewed the results and conclusions of the recently published rodent study from the National Toxicology Program in the context of all available scientific information, including epidemiological studies, and concluded that no changes to the current standards are warranted at this time. As we have stated publicly, NTP's experimental findings should not be applied to human cell phone usage, that the available scientific evidence to date does not support adverse health effects in humans due to exposures at or under the current limits, and that the FDA is committed to protecting public health and continues its review of the many sources of scientific literature on this topic.

In summary, for standards related matter for WPT, either of IEEE C95.1-2005 and the ICNIRP Guidelines would be an adequate model for the FCC to adopt for their rules below 300 kHz.

Thank you for contacting us concerning this matter. If we can be of further assistance, please let us know. If you need any additional information, you may contact Bakul Patel, Director

[1] FDA guidance for industry, "Labeling for Electronic Anti-Theft Systems." August 15, 2000. http://www.fda.gov/downloads/MedicalDevices/DeviceRegulationandGuidance/GuidanceDocuments/ucm070913.pdf.

[2] "Important Information on Anti-Theft and Metal Detector Systems and Pacemakers, ICDs, and Spinal Cord Stimulators", FDA Center for Devices and Radiological Health Letter to Cardiologists, Cardiac Surgeons, Neurosurgeons, and Emergency Physicians, September 28, 1998. http://www.fda.gov/MedicalDevices/Safety/AlertsandNotices/PublicHealthNotifications/ucm062288.htm.

[3] S. Seidman, K. Kainz, J. Casamento, and D. Witters, "Electromagnetic Compatibility Testing of Implantable Neurostimulators Exposed to Metal Detectors," in The Open Biomedical Engineering Journal, pp. 63-70, 2010.

for Digital Health of the Center for Devices and Radiological Health, at Bakul.Patel@fda.hhs.gov or by telephone at (301) 796-5528.

Sincerely,

Jeffrey Shuren, M.D., J.D.
Director
Center for Devices and
Radiological Health

US Agencies - Radiation Sickness; US Access Board Acknowledgment of Radiation Sickness (Electromagnetic Sensitivities), 2002

Federal Register

Tuesday,
September 3, 2002

Part II

Architectural and Transportation Barriers Compliance Board

36 CFR Parts 1190 and 1191

Americans With Disabilities Act (ADA) Accessibility Guidelines for Buildings and Facilities; Final Rule

Americans With Disabilities Act (ADA) Accessibility Guidelines for Buildings and Facilities; Architectural Barriers Act (ABA) Accessibility Guidelines; Recreation Facilities; Supplemental Notice of Proposed Rulemaking

ARCHITECTURAL AND TRANSPORTATION BARRIERS COMPLIANCE BOARD

36 CFR Part 1191

[Docket No. 98–5]

RIN 3014–AA16

Americans With Disabilities Act (ADA) Accessibility Guidelines for Buildings and Facilities; Recreation Facilities

AGENCY: Architectural and Transportation Barriers Compliance Board.

ACTION: Final rule.

SUMMARY: The Architectural and Transportation Barriers Compliance Board (Access Board) is issuing final accessibility guidelines to serve as the basis for standards to be adopted by the Department of Justice for new construction and alterations of recreation facilities covered by the Americans with Disabilities Act (ADA). The guidelines include scoping and technical provisions for amusement rides, boating facilities, fishing piers and platforms, golf courses, miniature golf, sports facilities, and swimming pools and spas. The guidelines will ensure that newly constructed and altered recreation facilities meet the requirements of the ADA and are readily accessible to and usable by individuals with disabilities.

DATES: The guidelines are effective October 3, 2002. The incorporation by reference of certain publications listed in the guidelines is approved by the Director of the Federal Register as of October 3, 2002.

FOR FURTHER INFORMATION CONTACT: Peggy Greenwell, Office of Technical and Information Services, Architectural and Transportation Barriers Compliance Board, 1331 F Street, NW., suite 1000, Washington, DC 20004–1111. Telephone number (202) 272–0017 (Voice); (202) 272–0082 (TTY). E-mail address: *greenwell@access-board.gov.*

SUPPLEMENTARY INFORMATION:

Availability of Copies and Electronic Access

Single copies of this publication may be obtained at no cost by calling the Access Board's automated publications order line (202) 272–0080, by pressing 2 on the telephone keypad, then 1, and requesting publication S–43 (Recreation Facilities Final Rule). Persons using a TTY should call (202) 272–0082. Please record a name, address, telephone number and request publication S–43. This document is available in alternate formats upon request. Persons who want a copy in an alternate format should specify the type of format (cassette tape, Braille, large print, or ASCII disk). This document is also available on the Board's Internet site *(http://www.access-board.gov/recreation/final.htm).*

Background

The Americans with Disabilities Act recognizes and protects the civil rights of people with disabilities.[1] Titles II and III of the ADA require, among other things, that newly constructed and altered State and local government facilities, places of public accommodation, and commercial facilities be readily accessible to and usable by individuals with disabilities. Recreation facilities are among the types of facilities covered by titles II and III of the ADA.

The ADA designates the Access Board as the agency responsible for developing minimum accessibility guidelines to ensure that new construction and alterations of facilities covered by titles II and III of the ADA are readily accessible to and usable by individuals with disabilities.[2] The Access Board initially issued the Americans with Disabilities Act Accessibility Guidelines (ADAAG) in 1991.[3] Current ADAAG contains general scoping and technical provisions (ADAAG 1 to 4) that apply to all types of facilities, and special application sections (ADAAG 5 to 12) that include additional scoping and technical provisions for certain types of facilities.[4] As discussed in more detail below, this final rule will amend section 4, and create a new section 15 (Recreation Facilities).

The Department of Justice is responsible for issuing regulations to implement titles II and III of the ADA. The regulations issued by the Department of Justice must include accessibility standards for newly constructed and altered facilities covered by titles II and III of the ADA. The standards must be consistent with the minimum accessibility guidelines issued by the Access Board. The Department of Justice has adopted ADAAG as the Standard for Accessible Design for title III of the ADA.[5]

This final rule amends ADAAG by adding a new special application section for amusement rides, boating facilities, fishing piers and platforms, golf courses, miniature golf, sports facilities, and swimming pools and spas. This rulemaking has had a long history. In 1993, the Access Board established an advisory committee of 27 members to make recommendations on guidelines for recreation facilities. The Recreation Access Advisory Committee met from July 1993 to May 1994 and submitted a report to the Board, ''Recommendations for Accessibility Guidelines: Recreational Facilities and Outdoor Developed Areas''. After receiving the committee's report, the Board published it as an advance notice of proposed rulemaking (59 FR 48542, September 21, 1994). Over 600 comments were received on the report and questions asked in the advance notice. To obtain additional information for this rulemaking, the Board also sponsored research on access to swimming pools in 1995; held informational meetings and conducted site visits on access to miniature golf facilities in September 1996; and held informational meetings and conducted site visits on accessible amusement rides in December 1999 and March and April 2000.

A notice of proposed rulemaking (NPRM) was published in the **Federal Register** on July 9, 1999. (64 FR 37326, July 9, 1999). The comment period was originally scheduled to close on November 8, 1999, but was extended until December 8, 1999 to allow more time for the public to submit comments. These comments were submitted electronically, in writing, and as oral testimony received during two public hearings held in Dallas, TX (August 26,

[1] *See* 42 U.S.C. 12101 *et seq.* (*http://www.usdoj.gov/crt/ada/pubs/ada.txt*).

[2] The Access Board is an independent Federal agency established by section 502 of the Rehabilitation Act whose primary mission is to promote accessibility for individuals with disabilities. The Access Board consists of 25 members. Thirteen are appointed by the President from among the public, a majority of whom are required to be individuals with disabilities. The other twelve are heads of the following Federal agencies or their designees whose positions are Executive Level IV or above: The Departments of Health and Human Services, Education, Transportation, Housing and Urban Development, Labor, Interior, Defense, Justice, Veterans Affairs, and Commerce; General Services Administration; and United States Postal Service.

[3] *See* 36 CFR part 1191, Appendix A (*http://www.access-board.gov/adaag/html/adaag.htm*).

[4] The special application sections cover the following facilities: restaurants and cafeterias (ADAAG 5); medical care facilities (ADAAG 6); business, mercantile and civic (ADAAG 7); libraries (ADAAG 8); transient lodging (ADAAG 9); transportation facilities (ADAAG 10); judicial, legislative, and regulatory facilities (ADAAG 11); and detention and correctional facilities (ADAAG 12). ADAAG 13 is reserved for housing and ADAAG 14 is reserved for public rights-of-way.

[5] *See* 28 CFR part 36, Appendix A (*http://www.usdoj.gov/crt/ada/reg3a.html*). The Department of Justice standards currently include ADAAG 1 to 10. State and local governments currently have the option of using ADAAG or an earlier standard, the Uniform Federal Accessibility Standards (UFAS), when constructing or altering facilities under the Department of Justice regulations for title II of the ADA. *See* 28 CFR 35.151(c) (*http://www.usdoj.gov/crt/ada/reg2/html*). The Department of Justice has issued a notice of proposed rulemaking to eliminate this option. 59 FR 31808 (June 20, 1994).

1999) and Boston, MA (November 17, 1999). Over 200 people attended these hearings and approximately 54 people provided testimony. The Board received approximately 300 comments during the public comment period.

The Access Board created an ad hoc committee of Board members to review the comments received on the proposed rule. The ad hoc committee discussed significant issues associated with the comments and made recommendations to the full Board for the final rule. In an effort to provide the public with more opportunities for input into the provisions for the final rule, on July 21, 2000 the Board published a summary of the ad hoc committee's recommendations and put the summary in the rulemaking docket for public review (65 FR 4533, July 21, 2000). The comment period on the summary closed on September 19, 2000. Approximately 70 comments were received during the public comment period. Afterwards, the Board held informational meetings on the summary in Washington, DC (August 21–22, 2000) and San Francisco, CA (September 6–7, 2000).

General Issues

Incorporating the Final Rule on Recreation Facilities Into Future Revisions to ADAAG

A complete review of ADAAG has been underway for several years. ADAAG was first published on July 26, 1991. The Board is committed to ensuring that ADAAG continues to reflect technological developments and is improved in terms of usability. Efforts also include coordination with changes in national standards and model code organizations and reconciling differences between ADAAG and national consensus standards, where possible. The Board published a notice of proposed rulemaking on November 16, 1999 with proposed revisions to ADAAG. The Board plans to issue final changes to ADAAG in the near future.

The Board is issuing the final guidelines for recreation facilities prior to the publication of the final ADAAG revision. The Board then plans to incorporate these final guidelines into the final revisions to ADAAG. To effectively incorporate these guidelines into the new format, some minor formatting changes will be made. For instance, the revised ADAAG will include a new format and numbering system. This rule will need to be formatted to fit that system. Some of the provisions will also be modified slightly to avoid redundancy. No substantive changes to the text are planned. Once incorporated, the Board will develop a guide to assist users with the new ADAAG.

The incorporation of the final recreation guidelines into the revised ADAAG will enhance the usability of the accessibility guidelines for architects, designers, manufacturers, operators and others using ADAAG. For example, accessibility guidelines for accessible parking spaces, toilet rooms, amusement rides, swimming pools, and exercise facilities will be combined into one document. Other improvements in the format of ADAAG will reduce redundancy through the use of basic technical provisions known as ''building blocks,'' which will provide consistent dimensions for clear spaces, turning spaces, and knee and toe clearances for elements. These basic technical provisions will apply unless otherwise modified in the section containing accessibility guidelines for recreation facilities. For example, handrail requirements for sloped entries into swimming pools modify the requirements otherwise required in the ramp provisions (ADAAG 4.8.5).

Multiple Chemical Sensitivities and Electromagnetic Sensitivities

Individuals with multiple chemical sensitivities and electromagnetic sensitivities submitted a substantial number of written comments and attended the public information meetings on the draft final rule. They reported that chemicals used in recreation facilities, such as chlorine used in swimming pools and spas, and pesticides and synthetic fertilizers used on golf courses, are barriers that deny them access to those facilities. They requested the Board to include provisions in the final rule to make recreation facilities accessible for them.

The Board recognizes that multiple chemical sensitivities and electromagnetic sensitivities may be considered disabilities under the ADA if they so severely impair the neurological, respiratory or other functions of an individual that it substantially limits one or more of the individual's major life activities. The Board plans to closely examine the needs of this population, and undertake activities that address accessibility issues for these individuals.

The Board plans to develop technical assistance materials on best practices for accommodating individuals with multiple chemical sensitivities and electromagnetic sensitivities. The Board also plans to sponsor a project on indoor environmental quality. In this project, the Board will bring together building owners, architects, building product manufacturers, model code and standard-setting organizations, individuals with multiple chemical sensitivities and electromagnetic sensitivities, and other individuals. This group will examine building design and construction issues that affect the indoor environment, and develop an action plan that can be used to reduce the level of chemicals and electromagnetic fields in the built environment.

Neither the proposed rule nor the draft final rule included provisions for multiple chemical sensitivities or electromagnetic sensitivities. The Board believes these issues require a thorough examination and public review before they are addressed through rulemaking. The Board does not address these issues in the final rule.

Existing Recreation Facilities

The Board received a significant number of comments related to the impact of these accessibility guidelines on existing facilities. Some commenters interpreted the proposed rule and the draft final rule to require all existing recreation facilities or elements of these facilities to be modified to meet the new accessibility guidelines. They expressed concern that the guidelines would have a significant economic impact on existing recreation facilities.

To clarify, ADAAG and the final accessibility guidelines for recreation facilities apply to newly designed or newly constructed buildings and facilities and to existing facilities when they are altered. ADAAG and the Department of Justice regulations address whether a change to a building or facility is considered an alteration. The publication of this final rule does not require that all existing facilities be modified to meet these guidelines. State and local governments who provide recreation facilities have a separate obligation under title II of the ADA to provide program accessibility which may require the removal of architectural barriers in existing facilities. *See* 28 CFR 35.150 (*http://www.usdoj.gov/crt/ada/reg2.html*). Private entities who own, lease (or lease to), or operate recreation facilities have a separate obligation under title III of the ADA to remove architectural barriers in existing facilities where it is readily achievable (*i.e.*, easily accomplishable and able to be carried out without much difficulty or expense). *See* 28 CFR 36.304 (*http://www.usdoj.gov/crt/ada/reg3a.html*).

Federal tax credits and deductions are available to private entities for architectural barrier removal in existing facilities. Federal funds also are available through the Community Development Block Grant Program to

remove architectural barriers in existing facilities. State and local governments may use Community Development Block Grant funds to remove architectural barriers in publicly and privately operated facilities. Entities requesting guidance on their obligations for existing facilities should contact the Department of Justice.

Equivalent Facilitation

Commenters addressing various sections of the recreation rule indicated the need for flexibility in designing and constructing accessible recreation facilities and elements. Commenters wanted to ensure that alternative designs would be permitted for providing accessibility with some of the unique elements and facilities addressed in this rule. Specific concerns were raised in comments related to accessible amusement rides and miniature golf courses.

The Board recognizes that many of the facilities and elements addressed in this rule are unique and supports the need for flexibility in making them accessible. Section 2.2 of ADAAG currently permits ''departures from particular technical and scoping requirements of this guideline by the use of other designs and technologies * * * where the alternative designs and technologies used will provide substantially equivalent or greater access to and usability of the facility.'' This provision applies to all facilities and elements addressed by ADAAG, including recreation facilities.

Section-by-Section Analysis

This section of the preamble contains a concise summary of the final rule and an analysis of the comments the Board received on each section. The final rule amends several existing sections of ADAAG and adds a new special application section. Section 4 of ADAAG has been amended to include provisions addressing miscellaneous sports facilities and elements as explained below.

Miscellaneous Sports Facilities and Elements

The accessibility guidelines for recreation facilities are primarily set forth in Section 15. Several changes, however, were also required within ADAAG section 4 to adequately address some of the unique sports facilities and elements.

Section 3.5 Definitions ''Area of Sport Activity''

An area of sport activity is defined as ''that portion of a room or space where the play or practice of a sport occurs.'' The term is defined in order to clarify the requirements for connecting an accessible route with this type of space. The term is used broadly to define spaces where the play or practice of a sport occurs. It includes, but is not limited to, field sports such as softball, football, lacrosse, baseball, and soccer; court sports such as tennis, racquetball, and volleyball; and other sports such as gymnastics.

Comment. A few commenters suggested that further clarification would be helpful in the use of the term ''sport'' and ''practice'' of a sport.

Response. Providing an exhaustive list of sports is not practical, since it may inadvertently omit a sport, or fail to recognize an emerging sport of the future. The ''area of sport activity'' will vary from sport to sport. Exceptions to technical provisions in ADAAG 4.1.2 (3) and (4) and 4.1.3 (2) and (3) clarify that accessibility is not required in the ''area of sport activity.'' This is consistent with the recommendations of the Recreation Access Advisory Committee and supports access to each ''area of sport activity,'' while not affecting the nature of the sport.

Section 4.1.1(5)(b) General Exceptions

The following recreation facilities or portions of recreation facilities are exempt from accessibility requirements: Raised structures used for refereeing, judging, or scoring a sport; water slides; animal containment areas not for public use; and raised boxing rings and wrestling rings.

Comment. The proposed rule exempted structures used solely for refereeing a sport. A commenter questioned whether structures used for ''judging'' or ''scoring'' a sport would also be considered exempt.

Response. The exception has been modified in the final rule to include the term ''judging'' and ''scoring.'' The Board considers the structures used for these activities to be consistent with the intent of this exception.

Comment. The proposed rule did not include any specific requirements for access to water slides. Question 4 in the proposed rule requested comments on this issue. Most of the commenters did not support providing access to the top of water slides. A few commenters suggested that access be required to the top of smaller water slides with an exemption for larger slides.

Response. An exception has been added in the final rule exempting water slides, including the structure supporting the water slide, from the guidelines. Providing access to water slides would require extensive ramping or elevators which would make the slides cost prohibitive. Designers and operators are encouraged to provide access to smaller water slides, where possible. Recent designs for ''leisure pools'' have incorporated an accessible route to the top of water slides using the different elevations on a site. These designs provide increased access for individuals with disabilities.

Comment. The proposed rule did not specifically address access to ''life guard stands.'' A few commenters recommended that structures such as life guard stands be addressed.

Response. ADAAG 4.1.1(5)(b) specifically exempts life guard stands and was added during a rulemaking for State and local government facilities (63 FR 2000, January 13, 1998).

Comment. The proposed rule included exceptions to technical provisions for accessible routes in animal containment areas. The International Association of Amusement Parks and Attractions expressed concern about general requirements for accessibility in animal containment areas that are not open to the public and are specifically limited to animal handlers.

Response. An exception has been added in the final rule to clarify that accessibility is not required to animal containment areas that are not for ''public use.'' Where animal containment areas are open to public use such as petting farms, the provisions of ADAAG 4.3 apply. Several exceptions to the provisions of ADAAG 4.3 in animal containment areas are also included in the final rule.

Comment. The proposed rule exempted raised boxing rings from accessibility. A few commenters suggested that raised wrestling rings be added to this exception.

Response. The exception has been modified in the final rule to add wrestling rings to the exemption.

Section 4.1.2(2)(b) and 4.1.3(1)(b) Accessible Routes for Court Sports

These sections are amended to require an accessible route complying with ADAAG 4.3 to directly connect both sides of the court in court sports.

Comment. The proposed rule required an accessible route to connect both sides of the court in court sports. The American Institute of Architects (AIA) was concerned that an accessible route connecting the two sides of a court may not be a direct route and could require one to go around a multitude of courts to get to the other side of the court where a sport requires changing sides. This is especially critical in sports such as tennis, where changing sides of the court is part of the game.

Response. The accessible route must be a direct route from one side of the court to the other side. Requiring players on one side of the court to traverse through or around another court to get to the other side is not permitted.

Section 4.1.2(3) and 4.1.3(2) Protruding Objects in Areas of Sport Activity

Areas of sport activity are exempt from the requirements of ADAAG 4.4 (Protruding Objects).

No substantive comments were received and no changes have been made for the final rule.

Section 4.1.2 (4) and 4.1.3(3) Ground Surfaces in Areas of Sport Activity and Animal Containment Areas

Two exceptions are added to these sections which require ground surfaces along accessible routes and in accessible spaces to comply with ADAAG 4.5. ADAAG 4.5 requires ground and floor surfaces along accessible routes to be stable, firm, and slip resistant. ADAAG 4.5 also addresses changes in level (ADAAG 4.5.2), carpet (ADAAG 4.5.3), and gratings ADAAG (4.5.4). Exception 1 exempts areas of sport activity from all requirements of ADAAG 4.5. Exception 2 exempts animal containment areas designed and constructed for public use from the requirements of ADAAG 4.5.2 and from providing a stable, firm, and slip resistant ground or floor surface.

Comment. The proposed rule required an accessible route to connect to each area of sport activity. A commenter questioned the feasibility of this requirement when connecting multiple sand volleyball courts on a beach.

Response. The final rule requires an accessible route to each area of sport activity in newly constructed facilities. For example, where a new sports field is planned with multiple fields, an accessible route is require to each field.

With respect to sand volleyball courts located at beaches, the Board plans to more specifically address the accessible route requirement in a future rulemaking on outdoor facilities, including trails, picnic and camping facilities, and beaches. It is expected that this future rule will address accessible routes on beaches, including their location to various elements on a beach.

Comment. The proposed rule exempted animal containment areas for hoofed animals from the requirements of a stable, firm, and slip resistant surface. Commenters questioned why the exception was limited to ''hoofed'' animal containment areas. Others suggested that other provisions such as ADAAG 4.5.2 (Changes in Level) not apply within these areas.

Response. This exception has been amended in the final rule to include all animal containment areas and is not limited to those for ''hoofed'' animals. The Board agrees that there often are areas where many different types of animals are contained and are not limited solely to hoofed animals. Exemption from the requirements to ADAAG 4.5.2 (Changes in Level) has also been included since absorbent surfaces used to ensure the care and health of animals may conflict with this provision. As previously discussed, an exception has been added to ADAAG 4.1.1(5)(b) to clarify that accessibility is not required in animal containment areas that are not for public use.

Section 4.1.3(5) Exception 4(f) Platform Lifts for Team or Player Seating Areas

An exception is added to this section permitting the use of a platform lift in new construction as a means of providing access to team or player seating areas serving areas of sport activity.

Comment. The proposed rule did not include an option to use a platform lift in new construction to provide access to team or player seating areas. The AIA and several architects representing a firm that specializes in sports facilities commented that platform lifts should be an option. They were particularly concerned about providing access to dugouts and other recessed team player seating areas in major league stadiums. They believed that providing a ramp parallel to the playing field presents a dangerous tripping and falling hazard for players attempting to field foul balls. Other groups representing persons with disabilities commended the Board for not allowing platform lifts in this environment in new construction. Among other issues, they cited the problems associated with relying on a mechanical device to provide access in newly constructed buildings and facilities.

Response. The final rule includes an option to use a platform lift as part of an accessible route connecting team or player seating areas. While the Board includes this as an option in new construction, it is recommended that where possible, ramps be utilized. This will reduce reliance for persons with disabilities on a mechanical device when providing access. Several minor league stadiums have incorporated a ramp into their design in recent years. It is the Board's understanding that there have been no reported incidents of accidents related to the ramps. Information on major league stadiums is not available since ramps have not been incorporated into their designs.

Section 4.1.3(12)(c) Lockers

This section is amended to require that where lockers are provided, at least 5 percent, but not less than one, of each type of locker, must comply with ADAAG 4.25.

No substantive comments were received and no changes have been made for the final rule.

Section 4.1.3(13) Controls and Operating Mechanisms for Exercise Equipment and Machines

An exception is added to this section to exempt exercise machines from the requirements of ADAAG 4.27 (Controls and Operating Mechanisms).

No substantive comments were received and no changes have been made for the final rule.

Section 4.1.3(19)(c) Team or Player Seating Areas

This section is amended to require that where team or player seating areas contain fixed seats and serve an accessible area of sport activity, the seating area must contain the number of wheelchair spaces required by ADAAG 4.1.3(19)(a), but not less than one space. Wheelchair spaces must comply with ADAAG 4.33.2, 4.33.3, 4.33.4, and 4.33.5.

An accessible route is required to connect to the team player seating areas. An accessible route is also required to connect to the area of sport activity which is defined as ''that portion of a room or space where the practice or play of a sport occurs.'' For the most part, the requirement is intended to provide access to the boundary of where the sport is played. In some cases, this will provide for a ''level'' entry to the area of sport activity such as a softball field or football field. In other cases, there may be changes in level and non-accessible surfaces. The Board recognizes that the accessible route requirement may, in some cases, not ensure access directly onto the area of sport activity. Where possible, designers are encouraged to provide for a smooth transition to the area of sport activity. This requirement is not intended to change the nature of the sport to provide access.

Comment. The AIA questioned how wheelchair spaces in team or player seating areas could meet the requirements of ADAAG 4.33.3. ADAAG 4.33.3 requires, among other things, that the wheelchair spaces provide a choice of admission prices or lines of sight

comparable to those afforded members of the general public.

Response. An exception has been added in the final rule exempting the wheelchair spaces in team or player seating areas from requirements related to choice of admission price or lines of sight comparable to those for members of the general public. Section 4.1.3(19)(c) is intended to ensure that at least one wheelchair space is provided in team or player seating areas. This can easily be accomplished through clear space adjacent to a fixed bench, for example. Bench seating will also serve as companion seating. Where designers and operators are planning facilities to serve a variety of wheelchair sports, it is recommended that the minimum be exceeded to more adequately accommodate wheelchair sports team.

Exception 2 is added to clarify that the requirements for accessible team or player seating does not apply to bowling lanes that are not required to be on an accessible route. Section 15.7.3 requires 5 percent, but not less than one, of each type of bowling lane to be served by an accessible route. Only those team or player seating areas that serve the bowling lanes required to be on an accessible route must have accessible team or player seating.

Comment. The proposed rule included an exception to ADAAG 4.1.3(19) for assembly seating in amusement facilities. The exception permitted use of a transfer seat complying with 15.1.4 where the motion of the seats is an integral part of the amusement experience. A few commenters questioned why this was permitted and recommended that wheelchair spaces be designed so as to provide the same general experience or effects as other seats.

Response. This exception has been deleted in the final rule. The Board is aware of amusement facilities where the various effects provided within the show are also provided at the wheelchair space. Many of the effects, such as misting or smoke, may be easy to incorporate into the wheelchair space. Others effects, such as aggressive seat motion, may be extremely difficult to incorporate and may possibly be unsafe. The Board expects that designers will provide the same effects for the wheelchair space as other seats, to the extent possible. An appendix note also recommends that providing companion seats with removable armrests will provide an option for persons using wheelchairs to transfer into the seat in these venues, if desired.

Section 4.1.3(21) Dressing, Fitting, or Locker Rooms

This section requires that where dressing, fitting, or locker rooms are provided, the rooms must comply with ADAAG 4.35. An exception permits 5 percent, but not less than one, of the rooms to be accessible when they are provided in a cluster.

No substantive comments were received and no changes have been made for the final rule.

Section 4.1.3(22) Saunas and Steam Rooms

This section requires where saunas and steam rooms are provided, the rooms must comply with ADAAG 4.36. An exception permits 5 percent, but not less than one, of the rooms to be accessible when they are provided in a cluster.

No substantive comments were received and no changes have been made for the final rule.

Section 4.35 Dressing, Fitting, and Locker Rooms

Section 4.35.1 General

This section requires dressing, fitting, and locker rooms required to be accessible by ADAAG 4.1 to comply with ADAAG 4.35 and to be on an accessible route.

No substantive comments were received and no changes have been made for the final rule.

Section 4.35.4 Benches in Accessible Dressing Rooms, Fitting Rooms, and Locker Rooms

This section requires benches complying with ADAAG 4.37 in accessible dressing, fitting, and locker rooms.

No substantive comments were received and no changes have been made for the final rule.

Section 4.36 Saunas and Steam Rooms

Section 4.36.1 General

This section requires saunas and steam rooms required to be accessible by ADAAG 4.1 to comply with ADAAG 4.36.

Comment. Several commenters questioned whether an operator would be required to provide a heat resistant wheelchair in accessible saunas and steam rooms.

Response. The provision of heat resistant chairs is an operational issue and outside the jurisdiction of the Board. Questions regarding the operational issues related to the use of accessible facilities and elements will be addressed by the Department of Justice when it adopts accessibility standards for recreation facilities.

Section 4.36.2 Wheelchair Turning Space

This section requires wheelchair turning space complying with ADAAG 4.2.3 to be provided within a sauna or steam room. An exception permits the wheelchair turning space to be obstructed by readily removable seats.

Comment. The proposed rule permitted the maneuvering space to be ''temporarily'' obstructed by readily removable seats. Commenters questioned what would be considered ''temporary''.

Response. The term ''temporarily'' has been deleted in the final rule. The intent of the provision is to permit a seat or bench to be located within the required maneuvering space within a room, provided that it can be readily removed. The focus of the exception is on the seat being ''readily removable'' to enable persons using wheelchairs to avail themselves of smaller saunas and steam rooms.

Section 4.36.3 Sauna and Steam Room Bench

This section requires that where seating is provided in a sauna or steam room, at least one bench complying with ADAAG 4.37 must be provided. An exception permits the clear floor space required by ADAAG 4.37.1 to be obstructed by readily removable seats.

Comment. The proposed rule permitted readily removable seats to ''temporarily'' obstruct the clear floor space and commenters questioned what would be considered ''temporary''.

Response. As discussed above, the term ''temporarily'' has been deleted in the final rule.

Section 4.36.4 Door Swing

This section requires that doors shall not swing into any part of the clear floor space required at an accessible bench.

No substantive comments were received and no changes have been made for the final rule.

Section 4.37 Benches

Section 4.37.1 General

Benches required to be accessible by 4.1 must comply with 4.37. No substantive comments were received and no changes have been made for the final rule.

Section 4.37.2 Clear Floor or Ground Space

This section requires clear floor or ground space complying with ADAAG 4.2.4 to be provided and be positioned for a parallel approach to a short end of

a bench seat. An exception permits the clear floor or ground space required by 4.37.2 to be obstructed by readily removable seats in saunas and steam rooms.

No substantive comments were received and no changes have been made to this provision in the final rule.

Section 4.37.3 Size

The final rule requires benches to be fixed and have seats that are 20 inches minimum to 24 inches maximum in depth and 42 inches minimum in length.

Comment. A few comments questioned whether a portable bench would meet the requirements for accessible benches.

Response. This provision has been modified in the final rule to include the term ''fixed''.

Section 4.37.4 Back Support

This section requires benches to have back support that is 42 inches minimum in length and that extends from a point 2 inches maximum above the seat to a point 18 inches minimum above the bench.

Comment. The proposed rule included the requirement for back support under ADAAG 4.37.2 (Size). Commenters expressed confusion over the requirements for back support for benches and some questioned whether back support was required.

Response. Back support is required for an accessible bench in a sauna or steam room, or a dressing room. To clarify this requirement, the technical provisions that were part of ADAAG 4.37.2 in the proposed rule have been included in a separate provision, ADAAG 4.37.3, in the final rule.

Section 4.37.5 Seat Height

This section requires benches to be 17 inches minimum to 19 inches maximum above the floor or ground.

No substantive comments were received and no changes have been made for the final rule.

Section 4.37.6 Structural Strength

This section requires that benches be strong enough to withstand a vertical or horizontal force of 250 pounds applied at any point on the seat, fastener, mounting device, or supporting structure.

No substantive comments were received and no changes have been made for the final rule.

Section 4.37.7 Wet Locations

This section requires that where installed in wet locations, the surface of benches must be slip-resistant and shall not accumulate water.

No substantive comments were received and no changes have been made for the final rule.

Section 10.5 Boat and Ferry Docks

This section is deleted in the final rule.

Comment. The proposed rule applied the accessibility guidelines for recreational boating facilities to boat and ferry docks located at transportation facilities, covered by ADAAG Section 10. This section of the proposed rule received little comment.

Response. The Board is concerned that those involved in the design and construction of boat and ferry docks may not have been fully aware of the proposed rule and therefore may not have evaluated its impact on such facilities. In addition, through the proposed rule, the Board sought information to establish access provisions for gangways based on the size of vessels using floating piers. Few commenters responded to the question, and none provided the type of information the Board was seeking.

The Board is not addressing commercial boat and ferry docks at transportation facilities at this time. In the future, the Board will consider whether such transportation facilities should be treated differently than recreational boating facilities covered by 15.2. As a result, ADAAG 10.5 has been deleted.

Section 15 Recreation Facilities

Section 15 has been added to ADAAG and contains accessibility guidelines for amusement rides, boating facilities, fishing piers and platforms, golf courses, miniature golf courses, exercise equipment and machines, bowling lanes, shooting facilities, and swimming pools and spas. Unless otherwise modified in section 4 or specifically addressed in 15, all other ADAAG provisions apply. For example, special technical provisions have not been included in section 15 for toilet rooms or for accessible parking. In this case, other appropriate provisions in ADAAG 4.22 and ADAAG 4.6 apply. The accessibility guidelines for play areas, which were issued on October 18, 2000 (65 FR 62498) are reprinted in Section 15.

Comment. A few commenters suggested that the term ''recreation facilities'' be defined. They suggested that the lack of definition leaves some doubt about how to apply the provisions in this section. They questioned whether locker rooms for a professional sports team, for example, would be considered a ''recreation facility''.

Response. Recreation facilities is not defined in the final rule. The term is used generally to address the types of elements and facilities covered by this section. The term is inclusive and applies to buildings and facilities designed and constructed for recreation, as well as elements and spaces located in a facility. For example, section 15.7.1 would apply to exercise equipment and machines located in an office building as a part of employee health club. Also, these provisions would apply to locker rooms for professional and other sports teams.

Section 15.1 Amusement Rides

Significant comment on amusement ride accessibility was received on the proposed rule. The proposed rule would have required that one wheelchair space and one transfer seat be provided for each 100 seats on new amusement rides and proposed technical provisions for the wheelchair spaces and transfer seats. The majority of comments were from amusement park operators, and amusement ride manufacturers and designers. The Board also received comments from groups representing persons with disabilities.

Overall, commenters did not support the provisions in the proposed rule for access to amusement rides. The commenters stated that the proposed rule lacked flexibility, making it impossible for most rides to comply with the guidelines given the uniqueness of this industry. They also raised concern about the lack of available manufactured rides that would meet the proposed provisions. Most rides are manufactured outside the United States where there is an absence of accessibility requirements. The ride manufacturers in the United States indicated significant hardship on their businesses to retool to meet some of the proposed technical provisions. Amusement park operators interpreted the proposed rule to require operators to modify manufactured rides. Most indicated that they were either unwilling or unable to modify a ride in a way that would differ from the manufacturer's specifications because they were not willing to accept the liability associated with modifying the ride or did not have sufficient engineering expertise to do so.

Additionally, several groups representing persons with disabilities expressed concern that some rides, such as walk through attractions and fun houses, would be exempt along with rides in traveling carnivals. They wanted the accessibility guidelines to encourage ride manufacturers to make all rides accessible. The Eastern

Paralyzed Veterans Association (EPVA) wanted the number of accessible amusement rides to be doubled from the proposed rule.

Because of these comments, the Board held several information meetings with representatives from the amusement industry and others to gather additional information. Site visits were also made to several amusement parks to better understand the issues raised. The information gained from these meetings and site visits have shaped the amusement ride section of the final rule.

Based on this information, the final rule differs significantly from the proposed rule. The final rule makes major changes in the number of accessible spaces per ride and in the options for providing access. It also includes different requirements for wheelchair spaces and for ride seats designed for individuals to transfer from their wheelchair or other mobility device. The final rule provides the flexibility requested by commenters in this unique environment, while still providing a high level of accessibility to persons with disabilities.

Since this is the first time national accessibility guidelines have been established for amusement rides, the Board intends to monitor the implementation of these guidelines. As with other accessibility guidelines developed by the Board, future updates and revisions are planned to ensure that the guidelines reflect new designs and technology.

Section 3.5 Definitions

Three terms are defined for amusement rides.

An ''amusement ride'' is a system that moves persons through a fixed course within a defined area for the purpose of amusement. Editorial changes are made in the final rule to be consistent with terms used within the amusement industry.

Comment. A few commenters questioned whether this section would apply to a ski lift, tram, or a gondola. Trams and gondolas are provided at some amusement parks.

Response. Section 15.1 is not intended to apply to ski lifts, trams, or gondolas. These devices are designed primarily for the purpose of transporting people from one point to another. While a ride on a ski lift or tram may be enjoyable, it is not designed primarily for the ''purpose of amusement''. Trams and similar vehicles are already addressed in the ADA Accessibility Guidelines for Transportation Vehicles (Vehicle Guidelines). *See* 36 CFR 1192.179.

An ''amusement ride seat'' is defined as a seat that is built-in or mechanically fastened to an amusement ride intended to be occupied by one or more passengers. This is a new term which has been added to the final rule. ''Amusement ride seats'' are referenced in several of the technical provisions.

Comment. The proposed rule did not include the term ''amusement ride seat.'' Several commenters including those representing the International Association of Amusement Parks and Attractions (IAAPA) questioned the differences between the transfer seat and the amusement ride seat in the proposed rule. Questions were also raised about the application of the guidelines to rides without seats or those designed with a variety of riding postures, such as toboggan style.

Response. A definition for amusement ride seats is added to the final rule. The Board intends the guidelines to apply to amusement rides with seats. Specific technical provisions included in this section address clear floor or ground space and maneuvering space requirements for amusement ride seats where transfer access is provided. Technical provisions focus on ensuring that people can transfer from their wheelchairs or mobility aids to the ride seats. With respect to the various riding postures, the Board intends these guidelines to apply to those amusement rides with ride seats, including toboggan style, but not to those amusement rides where the rider is expected to be in the prone position or standing. In these cases, however, an accessible route complying with ADAAG 4.3 is required to the load and unload area.

A ''transfer device'' is defined as equipment designed to facilitate the transfer of a person from a wheelchair or other mobility device to and from an amusement ride seat. Several new scoping and technical provisions included in the final rule specify a ''transfer device.'' An appendix note provides additional information on available transfer devices, including ways to provide equipment that will provide for a safe and independent transfer from a wheelchair or other mobility device.

Section 15.1.1 General

Newly designed or newly constructed and altered amusement rides are required to comply with 15.1.1. Four exceptions are included in the final rule. Under Exception 1, portable or mobile amusement rides are not covered by the guidelines. Exceptions 2, 3, and 4 clarify that amusement rides that are controlled or operated by the rider; amusement rides designed primarily for children, where children are assisted on and off the ride by an adult; and amusement rides without amusement ride seats are only required to comply with 15.1.4 and 15.1.5, which requires an accessible route to and maneuvering space in the load and unload areas.

Comment. Amusement park operators requested clarification regarding how the guidelines apply to existing rides.

Response. As previously mentioned, the final rule is significantly different from the proposed rule. The term ''new'' is included in 15.1.1 to clarify that this section applies to ''new'' rides and not to existing rides. The Department of Justice has the rulemaking authority to address existing rides.

A custom manufactured ride is new upon its ''first use'', which is the first time amusement park patrons take the ride. With respect to amusement rides purchased from other entities, ''new'' refers to the first permanent installation of a ride, whether the ride is used ''off the shelf'' or is modified before it is installed. The application of these guidelines to existing amusement rides that are altered is discussed elsewhere in this preamble. The final rule provides operators with the requested flexibility. Providing opportunities for access for persons with disabilities may be accomplished under the final rule without modifying the ride itself.

Comment. The preamble of the proposed rule explained that the guidelines applied to permanent amusement rides with fixed seats that are set up for a long duration and are not regularly assembled and disassembled. Amusement rides set up for short periods of time such as rides that are part of traveling carnivals, State and county fairs, festivals, and other special events are not addressed by these guidelines. The majority of amusement ride manufacturers supported this approach and considered it appropriate given the uniqueness of these rides. However, the commenters were concerned that the proposed rule did not specifically exempt temporary rides. Others suggested that a time frame be attached to this concept of ''temporary'' to clarify specifically what is meant. They suggested a 90 day or less time frame be used to define how long such rides can operate at the same location. Several groups representing persons with disabilities believed that temporary rides should also be accessible. They believed that manufacturers should be encouraged to make temporary rides as accessible as permanent rides.

Response. Exception 1 is added to specify that mobile or portable amusement rides are not covered by

15.1. The Department of Justice is authorized to determine the applicable requirement for these rides.

While mobile rides are not specifically addressed by these guidelines, other ADA requirements including general nondiscrimination obligations, program accessibility, and barrier removal provisions of the ADA apply to covered entities operating mobile or portable amusement rides. Mobile amusement rides are subject to a variety of site conditions that affect the load and unload areas. Because the rides are transported over the road, their size and weight is also restricted. This can limit the size available for the load and unload areas along with the accessible route to the ride.

Ride operators and manufacturers are encouraged to apply the provisions of this section to mobile amusement rides, where possible. Mobile rides are available that provide roll-on access and others may be close to providing transfer access with some minor adaptations in the load and unload areas. The Board will, upon request, work with interested manufacturers to provide guidance on providing either roll-on access or transfer access for someone using a wheelchair or mobility device.

Exception 2

Comment. The proposed rule excluded from the definition of amusement rides, those rides which are controlled or operated by the rider such as bumper cars and go-carts. A few commenters suggested that these types of rides also be addressed by this section. Several commenters requested guidance on whether making a ride turn faster or shake faster would be considered ''control''.

Response. An exception has been added to the final rule for rides that are controlled by the rider requiring such rides to only provide an accessible route to the ride and maneuvering space in the load and unload areas. The Board plans to gather additional information for making these rides accessible for potential rulemaking in the future. In the interim, designers and operators may use the applicable provisions in ADAAG and this final rule as a guide in providing access.

With respect to the issue of control, the exception is not intended to apply to those rides where patrons may affect some incidental movements of the ride, but otherwise have no control.

Exception 3

Comment. The proposed rule did not distinguish between those rides designed for adults and those designed for young children, also known as ''kiddie rides.'' Many amusement park operators and ride manufacturers commented that ''kiddie rides'' should be exempt from compliance with the provisions of 15.1.1. Most indicated that size restrictions will prohibit compliance with several of the provisions.

Response. Because of their size restrictions, an exception has been added to the final rule for ''kiddie'' rides requiring such rides to only provide an accessible route to and maneuvering space in the load and unload area. The requirement for an accessible route will provide access for adults and family members assisting children on and off these rides. An amusement industry definition for ''kiddie rides'' includes rides designed for children up to the age of 12. The Board does not support an exemption for rides designed for children up to age 12. Rather, the exception is limited to those rides designed ''primarily'' for children, where children are assisted on and off the ride by an adult. The Board intends that this exception be limited to those rides designed for children and not for the occasional adult user.

Exception 4

Comment. Some commenters interpreted the proposed rule to apply to amusement rides without seats.

Response. Section 15.1 of the proposed rule limited the application of this section to rides ''containing fixed seats''. Exception 4 is added in the final rule to further clarify that 15.1 does not apply to amusement rides without ride seats. Amusement rides without seats are required to be served by an accessible route and connect to accessible load and unload areas.

Section 15.1.2 Alterations to Amusement Rides

Section 15.1 applies to amusement rides that are altered. This section clarifies that a modification to an existing amusement ride is an alteration if one or more of the following conditions apply: (1) The amusement ride's structural or operation characteristics are changed to the extent that the ride's performance differs from that specified by the manufacturer or the original design criteria; or (2) the load and unload area of the amusement ride is newly designed and constructed.

Comment. The majority of commenters questioned how the proposed rule applied to existing amusement rides. Many commenters believed that the guidelines require that all existing amusement rides be accessible. Others inquired about the requirements for existing rides that are modified and the type of modification that would trigger the alteration provisions.

Response. The final rule addresses alterations to existing amusement rides. *See* the discussion at the beginning of this preamble for further information on ADA obligations for existing amusement rides.

Where an existing amusement ride is modified in a way that does not change the ride's structural or operational characteristics to the extent that the ride's performance differs from that specified by the manufacturer's or original design criteria, the amusement ride is not required to comply with 15.1.1. Routine maintenance, painting, and changing of story boards are examples of activities that do not constitute an alteration.

As with other elements or facilities subject to the alterations provisions in ADAAG, ''technical infeasibility'' applies to alterations of amusement rides. In this case, compliance with the technical provisions is required except where the nature of the existing ride makes it virtually impossible to comply fully. In these circumstances, the alteration should provide the maximum accessibility feasible.

Comment. Commenters requested clarification regarding how the guidelines apply where amusement rides are moved.

Response. In response to this question, a provision has been added that requires a ride to be accessible when a new load and unload area is designed and constructed for the ride. This provision applies where a ride is moved either within a park or to another park and a new load and unload area is designed and constructed. The ride must comply with 15.1.1. Operators have a choice of providing either a wheelchair space, ride a seat designed for transfer, or a transfer device. In most cases with an existing amusement ride, providing a transfer device may be the most appropriate. This option does not require modification to the ride. Where an amusement ride is moved and the load and unload area is not modified, the provisions of 15.1.1 do not apply. In this case, the on-going obligations of ''readily achievable barrier removal'' or ''program accessibility'' will apply.

Section 15.1.3 Number Required

This section requires each amusement ride to provide at least one wheelchair space complying with 15.1.7, or at least one amusement ride seat designed for transfer complying with 15.1.8, or at least one transfer device complying with 15.1.9.

Comment. The proposed rule required one wheelchair space per 100 fixed seats and one transfer seat per 100 fixed seats to be provided on each amusement ride. An exception permitted two transfer seats in lieu of a wheelchair space where a wheelchair space is not operationally or structurally feasible. Significant comment was received on this provision during the comment period. Amusement park operators stated that the number of accessible spaces (both wheelchair and transfer seats) was too high. Several amusement park operators cited safety concerns with respect to evacuation where more than one wheelchair user may be on a ride at one time. Others expressed concern about lengthening the load and unload time. Groups representing persons with disabilities were concerned that the number of wheelchair spaces and transfer seats in the proposed rule was too low. The Eastern Paralyzed Veterans Association (EPVA) wanted the number doubled from the proposed rule, potentially requiring two wheelchair spaces and two transfer seats per ride.

Response. The final rule requires that each ride provide: (1) A wheelchair space, or (2) a ride seat designed for transfer, or (3) a device to facilitate the transfer of a person in a wheelchair from the load or unload area to a ride seat. This represents a decrease in the number of accessible spaces from the proposed rule and is no longer dependent on the number of seats per ride. Designers and operators have the choice of deciding which of the three types of access is appropriate for a given ride. Where a manufactured ride does not permit space for a wheelchair, for example, a ride seat designed for transfer or a transfer device may be provided to help an individual transfer into the ride seat.

The Board is aware of amusement rides in certain parks that currently exceed this minimum and provide more than one wheelchair space on a given ride. In these cases, more persons with disabilities and their families are able to ride at the same time. Amusement park operators are encouraged to exceed the minimum with their new rides.

Section 15.1.4 Accessible Route

This section requires that, when in the load and unload position, amusement rides with wheelchair spaces, or ride seats designed for transfer, or transfer devices, must be served by an accessible route complying with ADAAG 4.3. Any part of an accessible route serving amusement rides with a slope greater than 1:20 is considered a ramp and must comply with ADAAG 4.8. The accessible route is required only to the wheelchair space or transfer loading station, and not to all stations. This route can deviate from the main route in order to access the particular station designated.

Three new exceptions to 15.1.4 are provided in the final rule. Exception 1 exempts ramps from the maximum slope specified in ADAAG 4.8.2, where compliance with 4.8.2 is structurally or operationally infeasible, provided that the slope of the ramp may not exceed 1:8. Exception 2 exempts the requirements for handrails on the accessible route where compliance is structurally or operationally infeasible. Exception 3 permits that use of limited-use/limited-application elevators and platform lifts complying with ADAAG 4.11 to be part of an accessible route serving the load and unload area.

Comment. The proposed rule required an accessible route to connect the portion of the load and unload area serving each accessible amusement ride and to provide a maneuvering space with a slope not greater than 1:48. Commenters questioned whether the 1:48 slope applied to the accessible route on the ride and the appropriateness of this requirement for those rides where a transfer seat was provided.

Response. The requirements for an accessible route are maintained in the final rule, but are modified to clarify that at least one accessible route requirement applies when the ride is in the load and unload position. The requirement for a maneuvering space is moved to 15.1.4, which addresses the load and unload areas. The provision also clarifies that where the running slope serving the amusement ride or transfer devices is greater than 1:20, the provisions of ADAAG 4.8 apply.

Comment. Operators expressed concerns with the requirements of ADAAG 4.8 with respect to the maximum slope (1:12) and the maximum rise (30 inches) for the accessible route. They described rides where space limitations will prohibit long ramps and where fundamental changes to amusement rides would be necessary to comply with ADAAG 4.8.2.

Response. An exception is added in the final rule that exempts the accessible route serving accessible rides from the maximum slope specified in ADAAG 4.8.2, provided that the slope may not exceed 1:8. The exemption only applies where compliance with ADAAG 4.8.2 is ''structurally or operationally'' infeasible. The exception for structural or operational limitations is limited to that portion of the accessible route connecting the load and unload areas with the amusement ride. There is no exception for other portions of the accessible route, such as the queue line leading to the load and unload areas.

Comment. Ride operators and designers also stated that the requirement for handrails was not practical on the portion of the accessible route connecting the load and unload areas and the ride. They again cited space limitations especially where ramps are integrated into the ride and folded out of the way when the ride is in use.

Response. An exception from the requirement for handrails is added in the final rule. Similar to exception 2, this exception is limited to circumstances where compliance with the handrail requirement is structurally or operationally infeasible.

Comment. The proposed rule did not include a provision permitting the use of a limited-use/limited-application elevator or a platform lift as a part of the accessible route in providing access to load and unload areas. The American Institute of Architects (AIA) and others in the amusement industry recommended their use in connecting these areas, especially in connecting elevated load and unload areas and those that cross tracks.

Response. An exception is provided in the final rule permitting the use of limited-use/limited-application elevators and platform lifts complying with ADAAG 4.11. The Board has included this option in the final rule to address some of the unique designs and elevated loading areas used within an amusement park. Where platform lifts are used, they must comply with ADAAG 4.11. Future revisions to ADAAG will include technical provisions for limited-use/limited-application elevators. At that time, appropriate provisions will be referenced for these elevators. Currently available design and safety standards should be applied in the interim.

Comment. Some commenters questioned whether moving turnstiles and walkways can serve as part of an accessible route connecting amusement rides.

Response. The Board has not specifically addressed moving turnstiles and walkways, since they are always capable of stopping or slowing to accommodate guests needing additional time. At this time there is not sufficient information to suggest a consistent safe speed for use for all persons with disabilities. Some individuals will be able to maneuver within the speed and time provided on the moving walkway or turnstile, while others will need additional time. Operators may need to

adjust the speed accordingly to reasonably accommodate guests with disabilities.

Section 15.1.5 Load and Unload Areas

This section requires load and unload areas serving amusement rides required to comply with 15.1 to provide a maneuvering space complying with ADAAG 4.2.3. The maneuvering space must have a slope not steeper than 1:48. The maneuvering space is permitted to overlap the accessible route and the required clear floor spaces.

No substantive comment was received and no changes have been made for the final rule.

Section 15.1.6 Signage

This section requires signage to be provided at the entrance of the queue or waiting line for each amusement ride to identify the type of access provided (*e.g.*, wheelchair access or transfer access). Where an accessible unload area also serves as the accessible load area, signage must be provided at the entrance to the queue or waiting line indicating the location of the accessible load and unload area. This is important to avoid unnecessary backtracking when patrons begin the process of waiting in line for a particular ride. No substantiative comments were received and no changes have been made to this provision in the final rule.

Section 15.1.7 Amusement Rides With Wheelchair Spaces

This section contains technical provisions for amusement rides with wheelchair spaces.

Comment. Several amusement ride designers and manufacturers raised concerns about technical provisions for wheelchair spaces on amusement rides. Most commenters believed that the space required was too large and boxy, and would significantly limit the number of amusement rides that could incorporate such a space. Some recommended that knee and toe clearances be incorporated into the space. In general, designers and operators requested more flexibility with wheelchair spaces on amusement rides.

Response. The Board has significantly modified the requirements for wheelchair spaces on amusement rides. The final rule includes changes which address the commenters concerns, while still requiring a minimum space that would serve most mobility devices on an amusement ride. The Board recommends that where possible, designers and manufacturers exceed the minimum space. Providing additional space will greatly enhance the ease in loading and unloading and accommodate a greater variety of mobility devices.

Section 15.1.7.1 Floor and Ground Surface

This section contains technical provisions for floor or ground surface of wheelchair spaces.

Comment. The proposed rule required wheelchair spaces to comply with several provisions of ADAAG 4.5 (4.5.1, 4.5.3, 4.5.4). Commenters expressed some confusion over these references and sought clarification.

Response. Rather than referencing ADAAG 4.5, the final rule incorporates these provisions into 15.1.7.1 for clarity. Other editorial changes are also made within this section.

Section 15.1.7.1.1 Slope

This section requires the floor or ground surface of wheelchair spaces to have a maximum slope of 1:48 when in the load and unload position and to be firm and stable.

Comment. Commenters questioned the appropriateness of requiring the clear space to be level when the amusement ride is in motion.

Response. The section is modified to clarify that the maximum 1:48 slope is only required when the amusement ride is in the load and unload position.

Section 15.1.7.1.2 Gaps

This section requires floors of amusement rides with wheelchair spaces and floors of load and unload areas to be coordinated so that when the amusement rides are at rest in the load and unload position, the vertical difference between the floors must be within plus or minus 5/8 inches and the horizontal gap should be no greater than 3 inches under normal passenger load conditions. An exception permits that where it is not operationally or structurally feasible to meet the horizontal or vertical difference requirements, ramps, bridge plates, or similar devices complying with the applicable requirements of 36 CFR 1192.83(c) (the Board's vehicle accessibility guidelines) must be provided.

Comment. No substantive comment was received on this section. Several representatives from the amusement industry, however, recommended that the Board reference an ASTM Standard Practice for the Design and Manufacture of Amusement Rides and Devices where ramps, bridge plates, lifts, or similar devices are used.

Response. The Board carefully examined the suggested ASTM Standard Practice and determined that it was designed as a safety standard rather than a standard that provides guidance on the minimum access requirements for ramps, bridge plates, lifts, and similar devices. Operators and manufacturers are not precluded from also following the standards in the ASTM Standard Practice for the operation of these elements. The applicable requirements of 36 CFR 1192.83(c) (ADA Accessibility Guidelines for Transportation Vehicles—Light Rail Vehicles and Systems—Mobility Aid Accessibility) are available on the Board's Web site at *www.access-board.gov/transit/html/vguide.htm#LRVM.*

Section 15.1.7.2 Clearances

This section requires clearances for wheelchair spaces to comply with 15.1.7.2. Three new exceptions are added. Exception 1 permits securement devices, where provided, to overlap the required clearances of the wheelchair space. Exception 2 permits the wheelchair space to be mechanically or manually repositioned. Exception 3 permits departure from the requirements of ADAAG 4.4.2 (Head Room) for the wheelchair space.

Comment. The proposed rule did not specifically address securement devices in wheelchair spaces. Commenters questioned whether securement devices could be located within the minimum clear space requirements for wheelchair spaces on amusement rides. They noted that while the proposed rule did not specifically address or require these devices, many operators have provided them where wheelchair spaces are provided on amusement rides.

Response. The final rule adds an exception to 15.1.7.2 to permit securement devices to overlap required clearances for wheelchair spaces on amusement rides. However, the final rule does not require securement devices. The decision about whether securement devices are needed is left up to the designer or manufacturer. Where provided, these devices may overlap the required clearances for wheelchair spaces.

Comment. As previously discussed, the Board received a significant number of comments from representatives in the amusement industry on the need for more flexibility. Several operators of large parks demonstrated ways that wheelchair spaces were provided on rides through the use of a turntable. This permits the space to be orientated for a forward approach and later turned to be in line with the direction of the motion of the amusement ride. Commenters did not consider repositioning to be an option under the proposed rule.

Response. Exception 2 has been added to the final rule and permits the wheelchair space on an amusement ride to be either manually or mechanically repositioned.

Comment. A few amusement park designers raised concern about the head clearance requirements of ADAAG 4.4 (Protruding Objects) for the wheelchair space located on an amusement ride. Amusement rides are often designed to move through confined spaces in order to enhance the amusement experience. Since most of these rides are designed for seated patrons, designers requested exemption from this requirement.

Response. Exception 3 is added in the final rule and exempts wheelchair spaces on rides from ADAAG 4.4.2 (Head Room). This exception applies to circulation space and clear space requirements on the ride. It does not apply to circulation areas and accessible routes in the queue line or the load and unload areas.

Section 15.1.7.2.1 Width and Length

This section requires wheelchair spaces to have a width of 30 inches minimum and a length of 48 inches minimum measured 9 inches minimum above the ground or floor surface.

Comment. The proposed rule required the wheelchair space to be a minimum of 36 inches in width. This width was based on the minimum 30 inch width needed for a stationary wheelchair with the additional 6 inches necessary for repositioning in confined spaces which allows space for the front casters of a wheelchair to turn and move when backing up. Designers expressed significant concern over the 36 minimum width and questioned why it was necessary where the space is reached in a forward direction. They further cited designs where the space is manually or mechanically repositioned and therefore should not require further maneuvering. Some commenters also suggested that the depth of the clear space could be 48 inches in all cases.

Response. The minimum width of the wheelchair space is reduced to 30 inches in the final rule. While the Board has decreased the minimum width, it recommends that designers and manufacturers exceed the minimum where possible to allow for increased maneuvering space.

Section 15.1.7.2.2 Wheelchair Spaces—Side Entry

This section requires that where the wheelchair space can be entered only from the side, the ride must be designed to permit sufficient maneuvering space for individuals using a wheelchair or mobility device to enter and exit the ride.

Comment. A few commenters questioned what the minimum space requirements would be for a ride entered from the side. They questioned whether a 32 inch side opening leading to a 30 inch wide by 48 inch long space would be sufficient.

Response. Section 15.1.7.2.2 is added to address rides with side entries. A center opening of 32 inches combined with a minimum space of 30 inches wide and 48 inches long is not adequate space for maneuvering. Designers must consider the position of the opening in relation to the minimum space. In some cases, additional clear space and larger openings will be necessary to allow for maneuvering a wheelchair on the ride. An appendix note is included to provide further guidance.

Section 15.1.7.2.3 Protrusions in Wheelchair Space

This section permits protrusions in the wheelchair spaces on amusement rides. Objects are permitted to protrude a distance of 6 inches maximum along the front of the wheelchair space where located 9 inches minimum and 27 inches maximum above the wheelchair space. Objects are also permitted to protrude a distance of 25 inches maximum along the front of the wheelchair space where located more than 27 inches above the wheelchair space.

Comment. As previously noted, amusement ride designers and operators commented that the wheelchair space clearances in the proposed rule were too restrictive and did not permit knee and toe clearances. They suggested that the clearances could be reduced without compromising the minimum space requirements.

Response. The final rule permits protrusions in the wheelchair space on amusement rides.

Section 15.1.7.3 Openings

This section requires that where openings are provided to access wheelchair spaces on amusement rides, the entry must provide a 32 inch minimum clear opening.

Comment. The proposed rule did not specify a minimum opening space where wheelchair spaces are provided on amusement rides. Commenters requested guidance on this dimension.

Response. A provision is added in the final rule to address the minimum width of openings where wheelchair spaces are provided on an amusement ride. This is consistent with minimum width requirements for doors and other passageways that are part of an accessible route.

Section 15.1.7.4 Approach

This section requires one side of the wheelchair space to adjoin an accessible route.

No substantive comment was received on this provision.

Section 15.1.7.5 Companion Seats

This section requires that where the interior of an amusement ride is greater than 53 inches in width, seating is provided for more than one rider, and the wheelchair is not required to be centered within the amusement ride, a companion seat must be provided for each wheelchair space.

Comment. The proposed rule required companion seating where seating for more than one rider is provided. Ride manufacturers commented that providing companion seating may not be possible on rides where the center of gravity is critical to its operation. They noted that providing space for an individual seated in a wheelchair and a seated companion may increase and change the weight distribution on a ride. They supported a provision with limits that are linked to the minimum width of the ride, whether or not seating is provided for more than one rider, and whether the wheelchair space is centered on the ride.

Response. This section is modified in the final rule to address the concerns raised. Consistent with the proposed rule, companion seating is required only where seating is provided for more than one rider. Additionally, companion seating is required only where the interior of an amusement ride is greater than 53 inches in width and the wheelchair is not required to be centered within the amusement ride.

Section 15.1.7.5.1 Shoulder-to-Shoulder Seating

This section requires that where an amusement ride provides shoulder-to-shoulder seating, companion seats must be shoulder-to-shoulder with the adjacent wheelchair space.

Comment. Commenters suggested that in some circumstances, shoulder-to-shoulder seating may not be possible. They cited examples of water rides where the rider's center of gravity is critical. Adding two riders side by side can alter the balance of the ride.

Response. An exception is added in the final rule that shoulder-to-shoulder companion seating is required only to the maximum extent feasible, where compliance is not operationally or structurally feasible.

Section 15.1.8 Amusement Ride Seats Designed for Transfer

This section requires that amusement rides with ride seats designed for transfer must comply with 15.1.8 when positioned for loading and unloading.

Comment. Significant comment was received on the technical provisions addressing transfer seats. Some interpreted the proposed rule to require a ''special seat'' in addition to other ride seats. Others believed that the technical provisions did not provide sufficient flexibility, especially given the diversity of rides and ride seats.

Response. The final rule requires that each ride provide: (1) A wheelchair space, or (2) an amusement ride seat designed for transfer, or (3) a system to facilitate the transfer of a person in a wheelchair from the load or unload area to a ride seat. Where ride seats are designed for transfer, this section applies. For the most part, the technical provisions for space and other features are applied to both the ride seat and the transfer device since both elements are designed for an individual to transfer from their wheelchair or mobility device to an element. A ride seat designed for transfer is usually a seat that is a permanent part of the ride itself.

Section 15.1.8.1 Clear Floor Space

This section requires clear floor space complying with ADAAG 4.2.4 to be provided in the load and unload area adjacent to amusement ride seats designed for transfer.

Comment. The proposed rule required the clear floor space to comply with ADAAG 4.2.4 and be positioned with the longer dimension parallel to the unobstructed side of the transfer seat. The space was also required to be located within 3 inches maximum of the transfer seat. Commenters supported the basic clear floor space requirement of 30 inches by 48 inches. Several commenters however, believed that the requirements for the orientation of the clear space were too stringent for two reasons. First, the orientation required in the proposed rule was potentially limited to a side transfer. Many individuals choose to transfer using a diagonal or front approach. Second, they were concerned about the variety of amusement rides and load and unload areas. They recommended that the orientation of the clear space with respect to its location to the ride seat be left up to the designer.

Response. The final rule requires a 30 inch wide by 48 inch deep clear space to be adjacent to the ride seat designed for transfer. The position of the clear space is not specified in the final rule. Designers will decide its location based on what is best suited for transfer on a particular ride.

Section 15.1.8.2 Transfer Height

This section requires the height of ride transfer seats to be located 14 inches minimum to 24 inches maximum measured above the load and unload surface.

Comment. The proposed rule required the transfer seat to be between 17 and 19 inches based on other elements within ADAAG where individuals using wheelchairs and other mobility devices are expected to transfer. Commenters requested the range to be greater.

Response. The final rule provides a greater range in the height of the ride seat designed for transfer. Providing a greater range in this height should reduce reliance on transfer devices and have the effect of decreasing the number of transfers to get from one's wheelchair or mobility device to a ride seat. The Board recognizes that amusement rides have unique designs. The increase in the transfer height range is limited to amusement rides because of their unique designs. The goal is to provide designs that afford the least amount of transfers for the least amount of distance. The Board recognizes that providing a greater range in the transfer height may make transfers more difficult for some people with disabilities. Based on this concern, and the fact that the transfer height for amusement rides is new, the Board will closely monitor how well the range provides access to amusement rides. Where possible, designers are encouraged to locate the transfer seat between 17 inches and 19 inches above the load and unload surface.

Section 15.1.8.3 Transfer Entry

This section requires that where openings are provided to transfer to amusement ride seats, the space must be designed to provide clearance for transfer from a wheelchair or other mobility device to the amusement ride seat.

Comment. The proposed rule required the transfer entry on the amusement ride to be a minimum of 36 inches wide. The entry was also required to be positioned parallel and adjacent to the longer dimension of the clear floor space. Amusement ride designers and manufacturers commented that the 36 inch width was excessive and believed that few rides, if any, could comply with this dimension. They further explained that openings are generally kept to a minimum since the sides of the ride often serve as a part of the restraint or securement system for the ride.

Response. Due to the large variance of amusement rides and the potential interference with the securement system, the final rule requires a space to be designed to provide clearance for transfer from a wheelchair or mobility device to the amusement ride seat. Specific dimensions for the opening are not provided in the final rule.

Section 15.1.8.4 Wheelchair Storage Space

This section requires wheelchair storage spaces complying with ADAAG 4.2.4 to be provided in or adjacent to unload areas for each required amusement ride seat designed for transfer. The space must not overlap any required means of egress or accessible route.

Comment. Some commenters interpreted the provision to require some type of constructed storage space.

Response. Clear space is needed in the load and unload areas for individuals to leave their wheelchairs when they transfer onto amusement rides. ADAAG 4.2.4 specifies a minimum 30 inch by 48 inch space for a stationary wheelchair. For safety reasons, the space must not overlap any required means of egress or accessible route. This provision does not require a constructed element for storage, only a space. Most current designs used for load and unload areas will include sufficient space to comply with this provision.

Section 15.1.9 Transfer Devices for Use With Amusement Rides

This section requires that transfer devices for use with amusement rides must comply with 15.1.9 when positioned for loading and unloading.

Comment. As previously discussed, significant comment was received on the technical provisions addressing transfer seats. Some interpreted the proposed rule to require a ''special seat'' in addition to other ride seats. Others believed that the technical provisions did not provide sufficient flexibility, especially given the diversity of rides and ride seats.

Response. The final rule requires that each ride provide: (1) A wheelchair space, or (2) an amusement ride seat designed for transfer, or (3) a system to facilitate transfer of a person in a wheelchair from the load or unload area to a ride seat. This section applies where transfer devices are used to provide access to an amusement ride seat. A transfer device can be provided as an integral part of the ride, or as a permanent or temporary part of the facility. Significant flexibility is provided for ride designers or park

operators to develop these transfer devices. Transfer devices may include lifts, ramps, transfer platforms and steps, or other similar systems and do not require modification to manufactured rides. Information is provided in the appendix to assist operators in selecting from different types of transfer devices.

Section 15.1.9.1 Clear Floor Space

This section requires clear floor space complying with ADAAG 4.2.4 to be provided in the load and unload area adjacent to transfer devices.

Consistent with the clear space requirement for ride seats designed for transfer, the position of the clear space adjacent to the transfer devices is not specified in the final rule. Designers will decide its location based on what is best suited for transfer on a particular transfer device.

Section 15.1.9.2 Transfer Height

This section requires the height of transfer device seats to be located 14 inches minimum to 24 inches maximum measured above the load and unload surface.

The Board has applied the same range established for amusement ride seats designed for transfer to transfer devices. As previously stated, the goal is to provide designs that afford the least amount of transfers for the least amount of distance.

Where possible, designers are encouraged to locate the transfer device between 17 inches and 19 inches above the load and unload surface. Further guidance related to maximum heights for vertical movements when transferring within a transfer device is provided in the appendix.

Section 15.1.9.3 Wheelchair Storage Space

This section requires wheelchair storage spaces complying with ADAAG 4.2.4 to be provided in or adjacent to unload areas for each required transfer device and must not overlap any required means of egress or accessible route.

Comment. Some commenters interpreted the provision to require some type of constructed storage space.

Response. Clear space is needed in the load and unload areas for individuals to leave their wheelchairs when they transfer onto transfer devices. ADAAG 4.2.4 specifies a minimum 30 inch by 48 inch space for a stationary wheelchair. For safety reasons, the space must not overlap any required means of egress or accessible route. This provision does not require a constructed element for storage, only a space. Most current designs used for load and unload areas will include sufficient space to comply with this provision.

Other Issues

Accessible Routes in Temporary Places of Amusement

Comment. The proposed rule requested comment on providing accessible routes on sites used for fairs, carnivals, and other temporary places of amusement. Usually a site such as a field or parking lot may be used for a short period of time for temporary places of amusement.

Response. The Board received few comments on this issue. The final rule does not include any provisions for accessible routes in temporary places of amusement. The Department of Justice has the authority to address this issue. Given the diversity of sites and complexity of agreements involved when using sites on a temporary basis, one set of guidelines is not practical. State and local government entities covered by title II may not, in determining the site or location of a facility, make selections that have the effect of excluding individuals with disabilities (28 CFR 35.130(b)(4)). Where a site is altered by installing some type of surface, that surface must be stable, firm, and slip resistant and meet other requirements in ADAAG 4.3 for the accessible route. Temporary structures are covered by ADAAG 4.1.1(4) and are required to comply with ADAAG. As with other alterations, ''technical infeasibility'' permits departure from technical provisions where existing physical or site constraints prohibit modification or addition of elements, spaces, or features.

Section 15.2 Boating Facilities

Section 3.5 Definitions

This section defines five terms for boating facilities.

A ''boat launch ramp'' is a sloped surface designed for launching and retrieving trailered boats and other water craft to and from a body of water.

A ''boat slip'' is that portion of a pier, main pier, finger pier, or float where a boat is moored for the purpose of berthing, embarking, or disembarking.

A ''boarding pier'' is a portion of a pier where a boat is temporarily secured for purposes of embarking and disembarking.

A ''gangway'' is a variable-sloped pedestrian walkway linking a fixed structure or land with a floating structure. This definition does not apply to gangways which connect to vessels.

A ''transition plate'' is a sloping pedestrian walking surface located at the end(s) of a gangway.

Comment. The proposed rule included definitions for boat launch ramp, boat slip, design high point, and gangway. Commenters recommended rewording these definitions. Commenters also recommended that additional definitions be added, such as handrail, landings, pier, main pier, finger pier, boarding pier, fixed and floating piers, mooring space, transient slips, and transition plate.

Response. The final rule provides five definitions. Definitions for boat launch ramp, boat slip, and gangway, have been retained but have been changed to improve clarity. Definitions for boarding pier and transition plate have been added, and the definition for design high point has been removed. Additional terms suggested by commenters were not added since they were not used in the technical or scoping provisions of the boating section.

Section 15.2.1 General

This section requires newly designed or newly constructed and altered boating facilities to comply with 15.2.

Comment. Some commenters did not want the rule to apply to each boating facility. They noted that designers and facility managers needed flexibility to provide reasonable accommodations in an environment which may contain extreme physical conditions. Several commenters requested that where two of more boating facilities are located within 10 miles of each other, only one facility should be accessible. Other commenters assumed that all existing facilities would have to immediately conform to the final rule.

Response. These guidelines apply to each newly designed or newly constructed boating facilities. Altered facilities must conform to the guidelines to the degree required by ADAAG 4.1.6. Where an existing facility is not being altered, the guidelines do not require that alterations be performed.

Comment. Commenters requested clarification on the term ''recreational boating facility.''

Response. This section primarily applies to piers and docks typically found at marinas where recreational boats are moored for embarking and disembarking occupants, but will apply in other non-marina settings. Where a vessel is primarily used for recreation, generally piers and docks designed and constructed to provide mooring and other services for such vessels would be covered by this section. Recreational boats range in size from small canoes to

large sailboats and power boats. The final rule is not intended to cover piers used solely by ferries or other commercial vessels, such as freighters, ocean supply vessels, and commercial fishing vessels.

Boating facilities covered by this final rule vary in size. Some contain as few as one boat slip (for example, a small campground with a short non-demarcated pier) and others are large enough to contain several thousand boat slips (for example, a large marina with many boat basins). Some have piers and boat launch ramps, while others only have piers. A boating facility may only contain a single launch ramp with no boarding pier or may contain multiple launch ramps with multiple boarding piers. In some cases, a site (such as a State park with a large lake) may contain more than one boating facility. In other cases, several boating facilities may be located in the same waterfront area, each operated by different operators.

Section 15.2.2 Accessible Route

This section requires that accessible routes, including gangways that are part of an accessible route, comply with ADAAG 4.3. ADAAG 4.1.2(2) requires that at least one accessible route connect accessible buildings, facilities, elements, and spaces on the same site. Therefore, an accessible route must connect accessible boat slips with other accessible elements on the same site. Eight exceptions, discussed below, have been added which modify the accessible route requirements as they relate to connecting floating piers.

No exceptions have been provided for accessing fixed piers. Therefore, accessible routes serving fixed piers must meet all the requirements of ADAAG 4.3.

Exception 1 Alterations to Existing Gangways

Exception 1 permits the replacement and alteration of existing gangways or series of gangways without triggering an increase in the length of the gangways, unless required by ADAAG 4.1.6(2).

Comment. Commenters noted that for maintenance or safety reasons, gangways are sometimes replaced or altered without any other changes being made to the floating piers and land based features located at the ends of the gangways. Under ADAAG's requirements for alterations, a replaced gangway would have to meet the requirements of section 15.2.2. The primary difficulty typically involves meeting slope requirements, rather then meeting handrail and transition plate requirements. In many cases, compliance with section 15.2.2 would require longer gangways to be installed. To install a longer gangway, changes to adjacent structures may be needed and such changes could also lead to reductions in the number of boat slips available. Available water sheet may also prevent lengthening of the gangways in an existing boating facility.

Response. The final rule includes an exception that does not require an increase in the length of the gangway, where gangways are replaced or altered. However, under ADAAG 4.1.6(2), alterations to areas containing primary functions may require existing gangways and adjacent structures to be brought into conformance with section 15.2.2. ADAAG 4.1.6(2) provides that, when an area containing a primary function is altered, an accessible path of travel must be provided to the altered area unless the cost and scope of the alterations to provide an accessible path of travel is disproportionate to the overall alterations as determined under criteria established by the Department of Justice. The Department of Justice regulations for title III of the ADA deem alterations to provide an accessible path of travel to be disproportionate when the cost exceeds 20 percent of the cost of the overall alterations.[6]

Exceptions 2 and 3 Maximum Gangway Rise and Slope

Exception 2 permits gangways or series of gangways to exceed the maximum rise specified in ADAAG 4.8.2. Exception 3 permits gangways to exceed the maximum slope specified in ADAAG 4.8.2, where the total length of the gangways serving as part of a required accessible route is at least 80 feet.

Comment. One of the most difficult issues relating to accessibility in floating boating facilities is gangway slopes. The proposed rule permitted gangway slopes to exceed a maximum slope of 1:12 at such times as when the distance between the design high point and water level exceeded a specific value depending on the size of the pier. In addition, the proposed rule exempted gangways from the maximum rise in ADAAG 4.8.2.

Over 60 organizations and individuals responded to the above proposals. Most indicated that they did not support the provisions. The comments raised concerns about how to calculate the pier square footage and what was considered a ''pier.'' Some asked whether levees, boardwalks, or retaining walls are fixed piers and how to measure the square footage. Others asked about private operators using floating piers and leasing space at a city pier. They questioned whether the square footage of the city pier is included in the calculations for determining access to the privately owned floating pier. One commenter noted that facility size determinations based on square footage may tend to drive entities to reduce pier widths which could compromise safety and stability.

A few commenters questioned how the design high point was selected. They questioned whether this point was the 100 year flood line, mean high tide, extreme high tide, ordinary high water, or high pool water line. One commenter noted that what is a safe and practical upper limit is not constant and easily determined.

Some commenters were concerned that facilities located where water level fluctuations are over 40 feet, would end up with no access or only limited access. A number of commenters suggested that a maximum gangway slope be established for most conditions, if not all conditions. Recommended slope maximums ranged from 5 percent to 15 percent.

At least 10 commenters noted that the requirements should ideally be site specific because of the varying logistical problems and differing geographic conditions at locations where water level fluctuations range from a few inches to over 100 feet. These commenters said that the table in the proposed rule would create hardships for existing facilities where space limitations are present, by requiring reductions in boat slip counts and by discouraging operators from upgrading their facilities. A number of commenters recommended that accessible gangways only be required where they serve 100 or more boat slips.

Using recommendations made by a number of commenters and combined with an effort to reduce the complexity of the final rule, the Board published a summary of a draft final rule for comment. In this draft, the Board indicated that the slope of a gangway would be permitted to exceed the maximum slope of 1:12 where the linear feet of mooring space along the perimeter of the piers at a facility was less than 1,000 feet (approximately 20–30 slips) and the water fluctuation was more than one foot. The provision, which was a general exception from the maximum slope requirement, was intended to provide regulatory relief for smaller boating facilities where an extensive gangway system may be cost prohibitive. Linear feet of mooring space was used instead of the square footage

[6] *See* 28 CFR 36.403(f)(1) (*http://www.usdoj.gov/crt/ada/reg3a.html*).

of a facility to more effectively measure the size of usable space where boats can dock rather than other spaces at a boating facility.

The draft final rule also required that where the linear feet of mooring spaces along the perimeter of the piers at a facility was less than 3,000 feet (approximately 50–70 slips) and the water fluctuation was more than 5 feet, the maximum gangway slope would be permitted to be 1:8 maximum. This exception allowed for a steeper slope than generally provided in ADAAG.

Lastly, the draft final rule stated that where the water fluctuation was more than 10 feet, gangways would be permitted to exceed the maximum slope of 1:12. Providing complying gangway slopes where the water fluctuation exceeds 10 feet requires extensive gangway systems and supporting facilities. It was noted in the draft final rule that although the gangway slope was permitted to be any slope, the gangway was not allowed to consist of stairs, since stairs are not permitted to be part of an accessible route.

During two public information meetings and from written comment received on the summary of the draft final rule, commenters generally supported simplifying the rule. Some expressed concerns about allowing a 1:8 slope on gangways, and others objected to using linear feet to determine the size of smaller facilities. A few commenters noted that the maximum feasible length of a gangway is between 60 and 70 feet. These commenters indicated that providing longer gangways, or providing two or more shorter gangways as part of a gangway and ramp system, dramatically increased the costs, complexity, and maintenance of the structure. Some commenters pointed out that because gangways often depart from a landside connection which is positioned at least 3 to 4 feet above high water, a 120-foot gangway provided to handle a 10-foot water level change actually needs to be at least 156 to 168 feet long (or a series of gangways and ramps with the same aggregate length).

Response. It is recognized that many factors which vary throughout the country add to the complications of providing larger gangway and ramp systems to handle greater changes in water fluctuation and elevation. Factors include water level changes, distance of gangway departure points above high water marks, available water sheet to construct within, location of shipping channels into which piers and gangways cannot project, wind load on floating structures as they get bigger, types of mooring systems, dead and live loads of gangways and the size of floating facilities to support them, currents, boat wakes, and the ability to remove floating structures when bodies of water freeze over. In the proposed rule, the Board attempted to define the level of access based on the size of a facility (*i.e.*, pier square footage). Comments noted that many other factors besides facility size, play a role in determining what is feasible. Because factors vary throughout the country and could vary between adjacent sites and adjacent facilities, selecting one factor or a list of factors to measure for determining appropriate gangway slope is not feasible.

In an effort to provide a simplified rule and establish a starting point for determining gangway access, the final rule focuses on a maximum feasible gangway length. In response to the draft final rule, a recommendation was developed by the California Department of Boating and Waterways, Oregon State Marine Board, Clean Harbor Action, and Revitalize Our Waterways (and supported by over 20 other commenters). This recommendation showed that it would be feasible in new construction to provide up to 80-foot gangways. From this comment (which also contained recommendations for different gangway slopes for varying changes in elevation), the Board developed the final rule which is based only on gangway length. Exception 3 requires that an entity either (1) provide a gangway (or series of gangways) at least 80 feet in total length, or (2) provide a gangway (or series of gangways) which does not exceed a maximum slope of 1:12. The final rule also retains the exception permitting gangways to be any length without a landing. As these exceptions only apply to gangways, ramps constructed on floating piers and ramps providing access to landside connections of gangways are not permitted to use these exceptions. Since the final rule does not use water level change as a mechanism for determining gangway accessibility, the definition for design high point was removed. The appendix includes the following two examples.

Example 1. Boat slips which are required to be accessible are provided at a floating pier. The vertical distance an accessible route must travel to the pier when the water is at its lowest level is 6 feet, although the water level only fluctuates 3 feet. To comply with exceptions 2 and 3, at least one design solution would provide a gangway at least 72.25 feet long which ensures the slope does not exceed 1:12.

Example 2. A gangway is provided to a floating pier which is required to be on an accessible route. The vertical distance is 10 feet between the elevation where the gangway departs the landside connection and the elevation of the pier surface at the lowest water level. Exceptions 2 and 3, which modify 4.8.2, permit the gangway to be at least 80 feet long. Another design solution would be to have two 40-foot continuous gangways joined together at a float, where the float (as the water level falls) will stop dropping at an elevation five feet below the landside connection.

Comment. A number of commenters expressed concern that steeper gangway slopes and the absence of level landings every 30 feet created barriers for persons with disabilities. Some commenters also noted that State and local governments should be held to a higher standard than private entities.

Response. As water levels rise and fall, gangway slopes also rise and fall. In some areas, there will be times that a gangway slope is less than 1:20 and at other times it will be greater than 1:12. The Board has attempted to balance the needs of persons with disabilities with the cost of providing access in an environment that can vary dramatically throughout the country. The Board also decided against providing different requirements for boating facilities operated by State and local government or private entities. As this is the first time Federal accessibility guidelines have been developed to address these types of facilities, the Board plans to closely monitor how well the guidelines provide access and what new technologies are developed to provide equivalent or better access.

Comment. A few commenters representing passenger vessel owners were concerned that the gangway provisions would also apply to gangways serving passenger vessels.

Response. The gangway provisions of this rulemaking only apply to gangways which access floating piers from the land or fixed structures. The Board is working on a separate rulemaking which will address passenger vessel access. A statement has been added to the gangway definition indicating that the definition does not apply to gangways which connect to vessels.

Exception 4 Small Boating Facilities With Less Than 25 Boat Slips

Exception 4 permits gangways to exceed the maximum slope specified in ADAAG 4.8.2, where a facility contains less than 25 boat slips and where the total length of the gangway, or series of gangways, serving as part of a required accessible route is at least 30 feet.

Comment. Commenters were concerned about how the gangway requirements would impact smaller facilities.

Response. The proposed rule and the draft final rule lessened the impact on

smaller boating facilities based on pier square footage or linear feet. Most commenters recommended using number of boat slips. Since the final rule does not address piers used by transportation vessels covered by ADAAG 10.5, which are more likely to contain a limited number of very large slips, basing the exception on boat slip numbers is appropriate.

Exception 5 Transition Plates

Exception 5 permits transition plates to be located at the ends of gangways instead of the landings specified by ADAAG 4.8.4.

Comment. The proposed rule permitted gangways to have transition plates at the top and bottom. Comments ranged from noting the need for a definition, setting out maximum lengths and slopes, and having them meet gangway requirements.

Response. In the final rule, a definition for transition plate has been added to ADAAG 3.5. Where transition plates are part of an accessible route, the transition plates must comply with ADAAG 4.3, unless one of the exceptions in 15.2.2 applies. For example, ADAAG 4.3.7 and 4.8.2 would prohibit transition plates from having a slope greater than 1:12. Where the requirements of ADAAG 4.8 apply (because the slope is greater than 1:20), the transition plates must have landings complying with ADAAG 4.8.4 at the non-gangway end.

Exception 6 Handrail Extensions

Exception 6 does not require handrail extensions, where gangways and transition plates connect and both are required to have handrails. In addition, the exception provides that where handrail extensions are provided on gangways or transition plates, the extensions are not required to be parallel with the ground or floor surface.

Comment. The proposed rule did not require handrail extensions on gangways or landings where they connect to transition plates and did not require handrail extensions at transitions plates. Although some commenters supported the exception, others noted that handrail extensions were needed, particularly on gangways when the transition plate had no handrail. Commenters also noted the difficulty in complying with ADAAG 4.8.5, which requires handrail extensions to be parallel with the ground or floor surface. As gangway slopes change, handrails extensions at the end of gangways and transition plates are no longer parallel. Other commenters requested that transition plates always have handrails and questioned whether gangway handrails had to be connected or continuous with landing handrails.

Response. The exception has been rewritten to address most of the concerns raised. The determination of whether a transition plate is required to have a handrail will be triggered by the requirements of ADAAG 4.3.7 and 4.8.5. Regarding connections to landing handrails, gangways required to comply with ADAAG 4.8.5 are required to have continuous handrails on both sides. When gangway handrail extensions are required, subject to exception 5 exclusions, the extensions would overhang landings and transition plates 12 inches minimum. ADAAG contains no requirement that these extensions connect handrails which might be provided on landings or guardrails which also may be provided.

Exception 7 Cross Slope

Exception 7 permits the cross slope of gangways, transition plates, and floating piers that are part of an accessible route to be 2 percent maximum measured in the static position.

Comment. Commenters representing State recreational boating agencies expressed concern about constructing floating piers and gangways which must conform to a 2 percent maximum cross slope 100 percent of the time in all weather and water conditions.

Response. Exception 7 was added to address this concern by specifying that the maximum cross slope is measured in the static condition. Gangways and piers which are part of an accessible route are expected to be designed and constructed to meet the 2 percent maximum cross slope. Once they are placed in the water, measurements absent live loads are to be made from a static condition without motion or wave action. Where floating piers are grounded out due to low water conditions, the slope requirements would not apply to such floating piers and associated gangways and transition plates.

Exception 8 Limited-Use/Limited-Application Elevators and Platform Lifts

Exception 8 permits limited-use/limited-application elevators or platform lifts complying with ADAAG 4.11 to be used in lieu of gangways complying with ADAAG 4.3.

Comment. One commenter pointed out that other methods, such as platform lifts and elevators should be used to provide access to a floating pier. Another commenter noted that a product, similar to a platform lift, had been developed for accessing floating piers. They believed that the final rule should encourage technological developments in this area.

Response. ADAAG 4.3 and 15.2 allow accessible routes to consist of elevators, ramps, and (when accessing floating piers) gangways. However, under ADAAG 4.1.3(5), Exception 4, the use of a platform lift to access a pier (floating or fixed) would be prohibited in new construction. In alterations to existing facilities, this restriction does not apply. (*See* ADAAG 4.1.6(3)(g) regarding platform lift usage in alterations.) Exception 8 was added to allow more flexibility in providing access to floating piers and to encourage the development of other methods of access using mechanical means. This exception modifies the requirements of ADAAG 4.1.3(5) and allows the use of platform lifts and limited-use/limited-application elevators in new construction as part of an accessible route connecting floating piers.

Section 15.2.3 Boat Slips: Minimum Number

This section requires that where boat slips are provided, accessible boat slips complying with section 15.2.5 must be provided in accordance with Table 15.2.3. Boarding piers at boat launch ramps are not counted for this purpose. Where the number of boat slips is not identified, each 40 feet of boat slip edge provided along the perimeter of the pier shall be counted as one boat slip for purposes of this section.

Comment. The proposed rule required that where boat slips are provided, at least 3 percent of all boat slips, but not less than one boat slip, be accessible. Comments varied between supporting a range from 1 percent to 4 percent. Some comments recommended that the number of accessible boat slips be the same as the number of required accessible vehicle parking spaces. One commenter recommended that one of each type of slip be accessible. A facility operator noted that at large facilities, a 3 percent scoping provision would require more accessible boat slips than a similar number of vehicle parking spaces. Several commenters questioned whether the need for accessible slips was as high as the need for accessible parking.

Response. The Board is not convinced that the scoping for accessible boat slips needs to be the same as the scoping for accessible vehicle parking spaces and is concerned that the proposed 3 percent would require more accessible slips in larger facilities than a similar number of parking spaces. The final rule modifies the scoping by reducing the percentage of accessible boat slips in larger facilities. A table is added to the final

rule to show the required number of accessible boat slips. The table starts with 3 percent and reduces down to 1 percent as the number of boat slips increase. For example, a 100-slip marina would need 3 accessible slips, and a 1,450-slip marina would need 17 accessible slips. Since this is the first time Federal guidelines have addressed the minimum number of accessible boat slips, the Board plans to closely monitor how the numbers meet the needs of individuals with disabilities.

Comment. The proposed rule also required that where the number of slips cannot be identified, each 40 feet of mooring space provided along the perimeter of a pier be counted as one boat slip for the purpose of applying this section. Most commenters supported the requirement. A few commenters noted that most recreational boats are less than 40 feet in length and recommended a number less than 40 feet.

Response. Although most recreational boats are less than 40 feet, the final rule seeks to increase the likelihood that accessible slips at non-demarcated piers are long enough to accommodate most types of common recreational boats. For this reason, the final rule has retained using 40 feet as the distance for determining the number of slips at piers where slips are not demarcated. (*See* section 15.2.4.1 regarding lengths of boarding piers at launch ramps.) The following two examples are included in the appendix.

Example 1. A site contains a new boating facility which consists of a single 60-foot pier. Boats are only moored parallel with the pier on both sides to allow occupants to embark or disembark. Since the number of slips cannot be identified, section 15.2.3 requires each 40 feet of boat slip edge to be counted as one slip for purposes of determining the number of slips available and determines the number required to be accessible. The 120 feet of boat slip edge at the pier would equate with 3 boat slips.

Table 15.2.3 would require 1 slip to be accessible and comply with 15.2.5. Section 15.2.5 (excluding the exceptions within the section) requires a clear pier space 60 inches wide minimum extending the length of the slip. In this example, because the pier is at least 40 feet long, the accessible slip must contain a clear pier space at least 40 feet long which has a minimum width of 60 inches.

Example 2. A new boating facility consisting of a single pier 25 feet long and 3 feet wide is being planned for a site. The design intends to allow boats to moor and occupants to embark and disembark on both sides, and at one end. As the number of boat slips cannot be identified, applying section 15.2.3 would translate to 53 feet of boat slip edge at the pier. This equates with two slips. Table 15.2.5 would require 1 slip to be accessible. To comply with 15.2.5 (excluding the exceptions within the section), the width of the pier must be increased to 60 inches. Neither (15.2.3 nor 15.2.5) requires the pier length to be increased to 40 feet.

Comment. The proposed rule counted boat launch ramp boarding piers as boat slips for determining the number of accessible slips required at a facility. The proposed rule also required at least one additional accessible boat slip to be provided adjacent to accessible launch ramps, where boarding piers were provided. Some commenters thought that this requirement would cause confusion. A few commenters questioned whether boat slips should be provided on boarding piers because boat slips are rented, leased or purchased, but boarding piers are used in a short-term manner. A number of commenters believed the provision required that launch ramps must have boarding piers.

Response. To avoid confusion, the final rule addresses scoping requirements for launch ramp boarding piers separately from boat slips. A definition has been added to ADAAG 3.5 for boarding piers.

Comment. Many commenters expressed concern that accessible slips had to be reserved only for persons with disabilities similar to how vehicle parking spaces are reserved.

Response. Accessible boat slips are not ''reserved'' for persons with disabilities in the same manner as accessible vehicle parking spaces. Rather, accessible boat slip use is comparable to accessible hotel rooms. The Department of Justice is responsible for addressing operational issues relating to the use of accessible facilities and elements. The Department of Justice currently advises that hotels should hold accessible rooms for persons with disabilities until all other rooms are filled. At that point, accessible rooms can be open for general use on a first come, first serve basis. This information has also been included in the appendix.

Section 15.2.3.1 Dispersion

This section requires that accessible boat slips be dispersed throughout the various types provided. It does not require an increase in the minimum number of boat slips required to be accessible.

Comment. Commenters expressed concern about how many accessible gangways would be required due to this dispersion requirement. Commenters noted that some facilities have several floating piers, each connected by an individual gangway. If accessible slips must be placed on more than one pier (due to the dispersion requirement), more than one accessible gangway system would be required.

Response. This provision does not prohibit accessible boat slips from being grouped at one or more piers, where such grouping does not reduce the number of type of slips that are required to be accessible. In cases where relocation of types of accessible boat slips to one pier is not possible, this dispersion provision will require more than one conforming gangway system.

Comment. Commenters requested more information on the different ''types'' of boat slips.

Response. Features to be considered in determining types of boat slips include the size of the boat slips, whether there are single berths or double berths, shallow water or deep water, transient, longer-term lease, covered or uncovered, and whether slips are equipped with features such as telephone, water, electricity, and cable connections. Because the term ''boat slip'' is intended to cover any pier area where passengers or occupants embark or disembark, unless classified as a launch ramp boarding pier, other piers not typically thought of as containing ''boat slips'' are covered by this dispersion requirement. Therefore, for example, a fuel pier used on a short term basis may contain boat slips, and this type of slip would be included in determining compliance with section 15.2.3.1. This information has also been included in the appendix.

Comment. The proposed rule required that accessible boat slips be located nearest to the amenities provided in the boating facility. Some commenters noted that adding this requirement to the dispersion provision increased the difficultly in providing accessible slips in existing facilities. It also tended to require more accessible gangways even in new construction. Commenters also questioned how to identify an amenity and if it is desirable to be located nearest an amenity. For example, being located near the toilet room might be desirable for one person but not for someone sensitive to noise and odors. Likewise, having an accessible slip located nearest the fuel pier may be beneficial for one person and not desired by others. One commenter noted that at existing facilities, corner slips are already accessible, but may not be closest to amenities.

Response. The ''amenities'' section has been removed from the final rule, because the rule intends to allow accessible boat slips to be grouped on one or more piers. In addition, the provision was removed due to comments which questioned whether being closest to an amenity is desirable.

Section 15.2.4 Boarding Piers at Boat Launch Ramps

This section requires where boarding piers are provided at boat launch ramps, at least 5 percent, but not less than one, of the boarding piers must comply with 15.2.4 and be served by an accessible route complying with ADAAG 4.3.

Exception 1 permits accessible routes serving floating boarding piers to use the exceptions in section 15.2.2. Exception 2 permits gangways to exceed the maximum slope and rise specified by ADAAG 4.8.2, where the total length of the gangways serving as part of a required accessible route is greater than 30 feet. Lastly, exception 3 indicates that where the accessible route serving a floating boarding pier or skid pier is located within a boat launch ramp, ADAAG 4.8 does not apply to the portion located within the boat launch ramp.

Comment. As noted above, some commenters thought that the proposed rule required that an accessible slip or boarding pier had to be provided at boat launch ramps.

Response. The proposed rule did not require that accessible boarding piers be provided at every facility with a launch ramp. Where boarding piers are provided, the proposed rule required that at least one accessible boat slip be provided adjacent to the launch ramp to ensure that at least one boarding pier complied with the pier clearance requirements. By using the term ''boat slip'', the Board did not intend to ensure that a rented, leased, or purchased mooring space would be available at the launch ramp, as some commenters concluded.

Comment. The proposed rule required that where boat launch ramps are provided with boarding piers, at least one accessible slip be provided adjacent to a boat launch ramp. A few commenters suggested that 50 percent, but not less than one boarding pier, be accessible.

Response. The final rule requires 5 percent, but not less than one, of boarding piers to be accessible. Most facilities with launch ramps only have one or two launch ramps. Compliance with this provision would translate to 100 percent or 50 percent access, assuming each launch ramp had its own boarding pier. Since some facilities have more than 20 launch ramps, the provision is consistent with how ADAAG addresses some conditions where multiple features are provided for the same use.

Comment. Some commenters were concerned that to serve an accessible floating boarding pier, the accessible route would have to run down the launch ramp and would require the slope of the launch ramp to be 1:12 maximum. Such a slope would dramatically effect the ability to launch and retrieve trailered boats. A few commenters noted that in designs using a string of boarding piers connected together, as water levels decline, the boarding piers end up resting on the launch ramp surface. Therefore, they would match the slope of the launch ramp which is generally steeper than 1:8. In such a design, some piers actually function as gangways for a period of time.

In another design, a stationary boarding pier (also known as a skid pier) rests on the launch ramp surface, but is repositioned as water levels rise and fall. This design also allows the skid pier to be easily removed where the body of water becomes ice bound and deicing equipment is not practical. An example of a fixed boarding pier was provided which showed two levels connected by handrail equipped ramps. During high water, boaters used the upper level while the lower level and the ramp connecting it were covered by water. At low water, the lower level is used.

One commenter noted the value floating boarding piers provide for persons with disabilities when accessing a boat since the pier remains at a set height above the water. A few pointed out that accessible routes serving boarding piers were not required to run down the launch ramp but could be provided alongside the ramp. Another commenter noted that constructing switchback ramps or any other structure within the area near the shoreline was subject to more environmental limitations and was a problem particularly for providing access at existing launch ramps. Several commenters pointed out that at launch ramps, handrails and guardrails on some gangways (primarily on short gangways) are not provided because they interfere with boat lines as boats are launched or retrieved. One commenter mentioned that providing accessible boarding piers was not a problem, but providing the accessible route to it was a problem. The commenter noted that if the requirements were too difficult, entities would stop providing boarding piers.

Response. Anecdotal information indicates that boarding piers are not provided at all launch ramps. For example, the Michigan Department of Natural Resources reported that of their over 900 boating access sites, approximately half are provided with boarding piers (also known as courtesy piers or docks). Since boarding piers may improve the ability for persons with disabilities to embark and disembark boats at launch ramps, the final rule seeks to not discourage entities from providing them. The Board has identified two areas of concern.

The first concern relates to accessing floating boarding piers. Boarding piers, when provided, tend to be quite small as compared to the square footage of piers used as boat slips. Many boating facilities consist of only one or two launch ramps and maybe a boarding pier, and contain no other boating structures. Providing access to floating boarding piers are subject to many of the same factors as providing access to floating piers which contain boat slips. In the final rule, the Board added exception 1 to section 15.2.4. This exception allows launch ramp boarding piers to use specified exceptions contained in section 15.2.2.

Exception 4 in section 15.2.2 allows boating facilities with less than 25 slips to have shorter gangways. To provide a similar small facility exception for boarding piers, exception 2 was added to 15.2.4. The exception exempts gangways accessing floating boarding piers at launch ramps from complying with the maximum slope requirements of ADAAG 4.8.2 where the gangways are at least 30 feet in length.

The Board's second area of concern focused on the effect of the accessible route requirements on a launch ramp, where the connection to a boarding pier is located within a launch ramp. As noted in the comments, the issue is not only the running slope requirement of an accessible route, but also includes the handrail, landing, and maximum rise requirements.

To address this concern, the Board added exception 3 to this section of the final rule. This exception provides that the requirements of ADAAG 4.8 do not apply to accessible routes located within launch ramps which serve floating boarding piers or skid piers also located within launch ramps. Although ADAAG 4.8 does not apply, other requirements of ADAAG 4.3 are applicable. For example, an accessible route with a minimum width of 36 inches must serve the boarding pier. Large ''V'' shaped groves which are typically provided to increase tire traction would not be allowed by ADAAG 4.3.6 (which references ADAAG 4.5) within the accessible route. Cross slopes requirements of ADAAG 4.3.7 remain 1:50 maximum. It is noted that ADAAG 4.3 does not require the entire launch ramp to meet these requirements, but does apply them to the 36 inch wide minimum accessible

route which shares the launch ramp surface and connects to the boarding pier and accessible elements on the boarding pier. Exception 3 only exempts the ramp requirements contained in ADAAG 4.8, such as maximum slope, maximum rise, handrails, and level landings. The following two examples are included in the appendix.

Example 1. A chain of floats are provided on a launch ramp to be used as a boarding pier which is required to be accessible by 15.2.4. At high water, the entire chain is floating and a transition plate connects the first float to the surface of the launch ramp. As the water level decreases, segments of the chain end up resting on the launch ramp surface, matching the slope of the launch ramp. As water levels drop, segments function also as gangways because one end of a segment is resting on the launch ramp surface and the other end is connecting to another floating segment in the chain.

Under ADAAG 4.1.2(2), an accessible route must serve the last float because it would function as the boarding pier at the lowest water level, before it possibly grounded out. Under exception 3, because the entire chain of floats is part of the accessible route, each float is not required to comply with ADAAG 4.8, but must meet all other requirements in ADAAG 4.3, unless exempted by exception 1. In this example, because the entire chain also functions as a boarding pier, the entire chain must comply with the requirements of 15.2.5, including the 60 inch minimum clear pier width provision.

Example 2. A non-floating boarding pier supported by piles divides a launching area into two launch ramps and is required to be accessible. Under ADAAG 4.1.2(2), an accessible route must connect the boarding pier with other accessible buildings, facilities, elements, and spaces on the site. Although the boarding pier is located within a launch ramp, because the pier is not a floating pier or a skid pier, none of the exceptions in 15.2.4 apply. To comply with ADAAG 4.3, either the accessible route must run down the launch ramp or the fixed boarding pier could be relocated to the side of the two launch ramps. The second option leaves the slope of the launch ramps unchanged, because the accessible route runs outside the launch ramps.

Comment. A few commenters questioned how the accessible route required by ADAAG 4.1.2 should connect a launch ramp which does not have a boarding pier.

Response. In the Recreation Access Advisory Committee, Boating and Fishing Facilities subcommittee report, the subcommittee recommended that the accessible route run to the crown of the launch ramp. In response to the ANPRM, commenters questioned how the ''crown'' would be determined. Because a precise spot at the launch ramp could not be identified to which the accessible route connects, neither the proposed rule nor the final rule addresses this issue. As the final rule does not intend to change the slope of launch ramps, the accessible route required by ADAAG 4.1.2 is required to connect the launch ramp, but the specific point of connection is not set out.

Section 15.2.4.1 Boarding Pier Clearances

This section requires that at boarding piers, the entire length of the piers required to be accessible by section 15.2.4, must comply with section 15.2.5.

Comment. Some commenters questioned if the proposed rule required a minimum length of 40 feet for the accessible boarding piers.

Response. Neither the proposed rule, nor the final rule establishes a minimum length for accessible boarding piers. The accessible boarding pier would have a length which is at least equal to other boarding piers provided at the facility. Where only one boarding pier is provided, it would have a length equal to what would have been provided if no access requirements applied. The entire length of accessible boarding piers would be required to comply with the same technical provisions that apply to accessible boat slips. For example, at a launch ramp, if a 20-foot long accessible boarding pier is provided, the entire 20 feet must comply with the pier clearance requirements in section 15.2.5. Likewise, if a 60-foot long accessible boarding pier is provided, the pier clearance requirements in section 15.2.5 would apply to the entire 60 feet. An advisory note has been added to the appendix which provides similar information regarding lengths of boarding piers.

Section 15.2.5 Accessible Boat Slips

This section sets out requirements for accessible boat slips. Section 15.2.5.2 specifically addresses cleats and other boat securement devices.

Section 15.2.5.1 Clearances

This section requires that accessible boat slips be served by clear pier space 60 inches wide minimum and at least as long as the accessible boat slips. Additionally, every 10 feet maximum of linear pier edge serving the accessible boat slips must contain at least one continuous clear opening 60 inches minimum in width. The provision is unchanged from the proposed rule, although three exceptions have been added.

Exception 1 Reduced Width

Exception 1 allows the width of the clear pier space to be 36 inches minimum for a length of 24 inches maximum, provided that multiple 36 inch wide segments are separated by segments that are 60 inches wide and 60 inches long.

Comment. Some commenters requested piers to be 72 to 96 inches wide to improve safety for persons who use wheelchairs. Others commenters were satisfied with the 60 inch minimum width but wanted the ability to reduce the width down to 36 inches in places to get around objects like supporting piles located within the clear pier space. One commenter requested, in response to the draft final rule, a reduced width because environmental agencies are making it harder to install finger piers wider than 4 feet.

Response. The 60 inch minimum width is consistent with the width required at access aisles for standard accessible parking spaces and was supported in the Recreation Access Advisory Committee, Boating and Fishing Facilities subcommittee report. Because the final rule allows obstructions to be located around the edge of the finger piers where 60 inch openings are available, unlike vehicle access aisles, it is not necessary for the entire pier to have a 60 inches clear width. Exception 1 allows reductions in the width of the pier clearance. The exception was included in the draft final rule and received little comment. An advisory note has been added to the appendix which recommends that clear pier spaces be wider than 60 inches, particularly on floating piers which are less stable, to improve the safety for persons with disabilities.

Comment. A number of commenters recommended that instead of the 60 inch clear width running the length of the slip, only one 60 inch by 60 inch space be required at the accessible boat slip. This space could be placed either alongside the slip or at the head of the slip on the main pier. These commenters also recommended that where finger piers at the facility are longer than 20 feet, a second 60 inch by 60 inch space should be provided at the slip.

Response. As recreational boats vary in shape, size, and layout, it cannot easily be known where persons with disabilities would embark or disembark a boat. By requiring the clear pier space along the entire length of the slip, access options between the boat and the pier are improved. Although the final rule does not require the entire edge of the clear pier space to be unobstructed, by extending the clear pier space the length of the slip, the number of 60 inch continuous clear openings increases which further improves access between the boat and the pier.

Exception 2 Edge Protection

Exception 2 permits edge protection 4 inches high maximum and 2 inches deep maximum at the continuous clear openings.

Comment. The proposed rule required that every 120 inches maximum of linear pier edge serving the accessible boat slips contain at least one continuous clear opening 60 inches minimum. A few commenters noted that the provision would not allow edge protection to be placed within the opening.

Response. In response to the ANPRM, commenters had mixed views on the use of edge protection. Some maintained that edge protection was necessary to protect persons who use wheelchairs from falling off the pier edges. Others maintained that edge protection created a tripping hazard as persons moved between a pier and boat. The proposed rule did not address edge protection at piers but did prohibit its installation at the continuous clear openings at the accessible slips. The Board has not taken a position on whether edge protection should be provided at piers, but has provided exception 2 so as not to prohibit its use at the continuous clear openings. Maximum dimensions are provided to control the size of the edge protection so as not to block the clear openings.

Exception 3 Alterations to Existing Facilities

Exception 3 provides that in alterations to existing facilities, the clear pier space can be located perpendicular to the boat slip and extend the width of the boat slip. This exception is available only if the facility has at least one boat slip complying with section 15.2.5 and where further compliance with 15.2.5 would result in a reduction in the number of boat slips available or result in a reduction in the widths of existing slips.

Comment. Some commenters disagreed with requiring clear pier spaces alongside accessible boat slips where finger piers are not provided within the facility. Others noted that at existing facilities, increasing finger pier widths, on which pier clearances would be provided, may reduce the number of slips available.

Response. Although commenters at the two information meetings on the draft final rule indicated that more recreational boats are designed to be boarded from the stern, many recreational boats still provide for side boarding. To maximize the options for persons with disabilities to board, the requirement that the clear pier space extend the length of the accessible boat slip in newly constructed facilities has not been modified. However, exception 3 has been added to the final rule to reduce the impact of this provision on existing facilities.

Section 15.2.5.2 Cleats and Other Boat Securement Devices

This section clarifies that cleats and other boat securement devices are not required to comply with ADAAG 4.27.3.

Comment. A few commenters noted that at accessible boat slips, controls and operating mechanisms (such as power receptacles, and water and sewage connections) should comply with ADAAG 4.27.

Response. Although section 15.2 contains requirements for recreational boating facilities, other requirements in ADAAG 4.1 still apply. Therefore, ADAAG 4.1.3(13) would require controls and operating mechanisms, such as electrical and water connections, at accessible boat slips to comply with ADAAG 4.27. However, because mooring features used to secure a boat, when raised, exert higher load pressures at the point of pier attachment, the danger of failure increases, particularly on floating piers. For this reason, section 15.2.5.2 was added which states that the reach range requirements of ADAAG 4.27.3 do not apply to boat securement devices.

Section 15.3 Fishing Piers and Platforms

Section 15.3.1 General

This section requires that newly designed or newly constructed and altered fishing piers and platforms comply with section 15.3.

Comment. Commenters questioned how the guidelines would apply to places that people may fish from, but were not constructed for fishing (*e.g.*, a breakwater jetty, a bridge, or a flood control dam).

Response. Structures that have been designed and constructed for purposes other than fishing, even though persons may use the structure for fishing, are not required to comply with this section. However, piers and platforms that are newly designed or constructed and altered for the specific purpose of fishing are required to comply with this section.

Section 15.3.2 Accessible Route

This section requires that accessible routes, including gangways that are part of accessible routes serving fishing piers and platforms comply with ADAAG 4.3. Exception 1 permits the accessible route, serving floating fishing piers and platforms to use exceptions 1, 2, 5, 6, 7, and 8 in section 15.2.2. Exception 2 provides that where the total length of the gangway or series of gangways serving as part of a accessible route is at least 30 feet, the maximum slope specified by ADAAG 4.8.2 does not apply to the gangways.

Comment. The proposed rule required the accessible route connecting to floating fishing piers and platforms to comply with the provisions for accessible routes at boating facilities. This section received only a few comments. One commenter recommended that the square footage values in the proposed rule be reduced for application to floating fishing piers. Another commenter noted that such a requirement would discourage entities from providing fishing piers.

Response. The final rule references exceptions 1, 2, 5, 6, 7 and 8 of 15.2.2 (Boating Facilities) for floating fishing piers and platforms. Exception 4 in section 15.2.2 allows boating facilities with less than 25 slips to have shorter gangways. To provide a similar small facility exception for floating fishing piers, exception 2 was added to section 15.3.2 and is based on a similar exception in section 15.2.4 which applies to floating boarding piers. The following example is included in the appendix.

Example. To provide access to an accessible floating fishing pier, a gangway is used. The vertical distance is 60 inches between the elevation that the gangway departs the landside connection and the elevation of the pier surface at the lowest water level. Exception 2 permits the use of a gangway at least 30 feet long, or a series of connecting gangways with a total length of at least 30 feet. The length of transition plates would not be included in determining if the gangway(s) meet the requirements of the exception.

Comment. One designer questioned whether the proposed rule prohibited gangways which comply with ADAAG 4.8.

Response. ADAAG 4.1.2(2) requires at least one accessible route complying with ADAAG 4.3 to connect accessible buildings, facilities, elements, and spaces that are on a site. ADAAG 4.3.7 requires an accessible route with a running slope greater than 1:20 to comply with the ramp requirements of ADAAG 4.8. Although the final rule contains exceptions which modify the requirements of ADAAG 4.8, the use of these exceptions is not mandatory. Designers are encouraged to provide greater access for gangways and exceed the minimums contained in the exceptions and the minimum requirements of ADAAG 4.8.

Section 15.3.3 Railings

This section requires that where railings, guards, or handrails are provided, they must comply with 15.3.3.

Section 15.3.3.1 Edge Protection

This provision requires edge protection that extends 2 inches minimum above the ground or deck surface. An exception provides that where the railing, guardrail, or handrail is 34 inches or less above the ground or deck surface, edge protection is not required if the deck surface extends 12 inches minimum beyond the inside face of the railing. The toe clearance must be 9 inches minimum above the ground or deck surface beyond the railing and be 30 inches minimum wide.

Comment. The proposed rule did not permit other options for edge protection on floating fishing piers and platforms. Commenters provided designs of fishing stations incorporating an extended deck past the rail or guard that enable a person using a wheelchair or mobility device the opportunity for toe clearance beyond the face of the railing or guard. They felt that this design should be permitted and encouraged the Board to incorporate into the final rule.

Response. The proposed rule required edge protection where railings are provided and did not provide the flexibility designers of fishing piers and platform requested. An exception has been added to the final rule to permit more flexibility in providing a variety of designs that promote increased levels of accessibility to anglers with disabilities.

Section 15.3.3.2 Height

This section requires at least 25 percent of the railings to be a maximum of 34 inches above the ground or deck surface.

The Board sought comment on the height of lowered guards and what steps have been taken to ensure that their use was permitted under applicable building codes and standards. Additionally, in light of concerns that have been raised about safety issues related to lower guards, the Board also sought information on experiences designers or operators have had where guards on floating fishing piers and platforms have been lowered to accommodate individuals using wheelchairs and other mobility devices while fishing.

Comment. Many commenters supported the use of lowered rails or guards to provide persons using wheelchairs or other mobility devices the opportunity to fish. Commenters gave examples of providing lowered rails or guards for many years, in many different applications, with no reported safety or injury problems. Commenters provided descriptions of unique and innovative designs of fishing stations constructed for use by persons with disabilities.

Response. The final rule retains the requirement that, where provided, 25 percent of the railing must be at a lowered height. Current designs, provided by commenters, supported a maximum height of the lowered rail or guard to be at 34 inches above the ground or deck surface. The height requirement for 25 percent of the rail has been changed in the final rule to 34 inches maximum above the ground or deck surface.

Comment. Some commenters believed that the Occupational Safety and Health Administration (OSHA) standards apply to recreational fishing piers and platforms. The OSHA standards apply to places where employment is performed and prescribe a 42 inch high railing along open sides of platforms located 4 feet or more above the floor. 29 CFR 1910.5 and 1910.23 (c) and (e). Other commenters believed that recreational fishing piers and platforms are covered by State and local building codes, which typically prescribe 42 inch high guards along open sides of platforms located more than 30 inches above the floor. These commenters were concerned that requiring at least 25 percent of railings to be a maximum 34 inches high conflicts with the OSHA standards, and State and local building codes.

Response. Recreational fishing piers and platforms are subject to OSHA safety standards only if they are places of work. In some cases there may be both workers and recreational users on a pier. In those cases, OSHA standards would apply, and the pier would be exempted from the height requirements in the final rule, as discussed below.

The International Code Council has advised the Board that recreational fishing piers and platforms are not covered by model building codes unless they are an integral part of a building that is regulated by the adopting State or local authority. To avoid potential conflicts, an exception has been added to the final rule that permits a higher guard to be provided along a recreational fishing pier or platform where the guard complies with the International Building Code (IBC) (2000 edition) requirements for height (not less than 42 inches high) and opening limitations (4 inch diameter sphere cannot pass through any opening up to a height of 34 inches; and 8 inch diameter sphere cannot pass through any opening from a height of 34 inches to 42 inches). This exception can be used if a recreational fishing pier or platform is covered by a State or local building code; or if a design professional believes that a specific location warrants enhanced safety measures; or if an employer provides a 42 inch high railing to comply with OSHA standards.

Section 15.3.3.3 Dispersion

This section requires that lowered railings be dispersed throughout a fishing pier or platform.

Comment. A commenter requested guidance on the criteria used to determine dispersion.

Response. Anglers who stand can fish from any part of a pier or platform and can change location depending on the fishing or water conditions. Where railings, guards, and handrails have been installed on fishing piers and platforms, the height of the railings interfere with fishing and block vision for persons who use wheelchairs and other mobility devices. This provision requires that where railings are provided, the dispersion of the lowered railings provide similar choices to fish from a variety of locations. The distribution of lower railings could include locations of different water depths with some that provide shading or are close to shore, and could take into account the tides or water fluctuations.

Section 15.3.4 Clear Floor or Ground Space

This section requires that at least one clear floor or ground space complying with ADAAG 4.2.4 be provided where the lowered railing height is located. Where no railings are provided, at least one clear floor or ground space complying with ADAAG 4.2.4 must be provided. No substantive comments were received and no changes were made to this provision for the final rule.

Section 15.3.5 Maneuvering Space

This section requires that at least one maneuvering space complying with ADAAG 4.2.3 be provided on a fishing pier or platform. The maneuvering space is permitted to overlap the accessible route and the clear floor space required by 15.3.4. No substantive comments were received and no changes were made to this provision for the final rule.

Golf

Section 3.5 Definitions

Two terms used in this section are added to ADAAG 3.5 (Definitions).

A ''golf car passage'' is defined as a continuous passage on which a

motorized golf car, also known as a golf cart, can operate. Designers and operators sometimes use the term ''golf car path'' to identify what the Board is defining as a ''golf car passage.'' Because the term ''golf car path'' may connote a prepared surface, the term was not used. While a golf car passage must be usable by golf cars, it does not necessarily need to have a prepared surface.

A ''teeing ground'' is the starting place for a hole to be played. This definition is consistent with the United States Golf Association definition, which describes a teeing ground as a rectangular area two club-lengths in depth, with the front and sides defined by the outside limits of two tee-markers.

Section 15.4.1 General

This section requires newly designed or newly constructed and altered golf courses, driving ranges, practice putting greens, and practice teeing grounds to comply with 15.4.

Section 15.4.2 Accessible Route—Golf Courses

This section requires an accessible route to be 48 inches wide minimum, or 60 inches minimum if handrails are provided, to connect accessible elements and spaces located within the boundary of a golf course. Additionally, an accessible route must connect the golf car rental area, bag drop areas, practice putting greens, accessible practice teeing grounds, course toilet rooms, and course weather shelters.

Exception 1 permits the use of a golf car passage complying with section 15.4.7 in lieu of all or part of an accessible route. This exception does not apply to the required accessible route complying with 4.3 when connecting elements and amenities outside of the boundary of the golf course (*i.e.*, accessible vehicle parking spaces with the golf course clubhouse entrance). Exception 2 provides that handrails are not required on accessible routes within the boundary of a golf course. It is hazardous for handrails to be located through a green, or on teeing grounds, because of the danger of golf balls ricocheting off rails. Since course elements could be accessible from golf car passages in lieu of an accessible route, handrails would be of little utility along these routes.

The guidelines recognize that providing an accessible route may be impractical on a golf course for several reasons. First, the route of play for a golfer is dependent on where the ball lands and is therefore unpredictable. Secondly, there is an assumption that on many courses, golfers use a golf car to move throughout the course. Finally, requiring an accessible route throughout a course could alter the slopes within some courses and eliminate some of the challenge of the game. The guidelines permit accessible elements and spaces within the boundary of the course and areas used for practice putting or driving and other course amenities outside the boundary of the course to be connected through either an accessible route or a golf car passage.

The 48 inch minimum width for the accessible route is necessary to ensure passage of a golf car on either the accessible route or the golf car passage. This is important where the accessible route is used to connect the golf car rental area, bag drop areas, practice putting greens, accessible practice teeing grounds, course toilet rooms, and course weather shelters. These are areas outside the boundary of the golf course, but are areas where an individual using an adapted golf car may travel. A golf car passage may not be substituted for other accessible routes, required by ADAAG 4.1.2, located outside the boundary of the course. The following example is included in the appendix.

Example. An accessible route connecting an accessible parking space to the entrance of a golf course clubhouse is not covered by this provision permitting a golf car passage in lieu of an accessible route required by 4.1.2.

Comment. The proposed rule sought comment on the option of using a golf car passage in lieu of an accessible route for smaller courses (*i.e.*, 3 or 6 holes).

Response. Commenters supported the use of the golf car passage on smaller courses. The final rule provides golf course designers and operators the opportunity to choose between providing either a golf car passage or an accessible route for all courses regardless of size.

Comment. Commenters questioned who would be responsible for providing single rider adaptive golf cars. Additionally, commenters questioned if a course could establish criteria for restricting use due to terrain conditions. Others wanted to know if there are plans to create regulations or guidelines for accessible golf cars. Persons with disabilities supported the use of adaptive or single rider golf cars and gave examples of experiences at courses currently permitting or providing access via golf cars to courses.

Response. The Board develops and maintains accessibility guidelines for the built environment. It is outside the jurisdiction of the Board to address the operational and procedural requirements of a golf course. Operational and procedural issues are within the jurisdiction of the Department of Justice.

Comment. The requirements for an accessible route or golf car passage seek to provide access for players with disabilities to either practice or play the game of golf. The Board requested comments on how access should be provided for spectators during golf tournaments and competitions. Commenters provided examples and experiences of current accessibility practices encountered at many levels of tournaments and supported allowing the tournament committees to select holes (teeing areas, fairways, and putting greens) to provide accommodations and transportation to the selected areas throughout the golf course and surrounding areas.

Response. No additional requirements have been included in the final rule for spectators with disabilities attending tournaments or competitions. Facilities hosting tournaments or competitions must comply with all the other requirements of the ADA, including the general obligation to provide an equal opportunity to individuals with disabilities to enjoy the services provided. Additionally, ADAAG requires temporary facilities used during tournaments or competitions to provide access to assembly seating areas, portable restroom facilities, concessions, and all other available amenities. Access to these temporary facilities on a golf course may be achieved through either an accessible route or golf car passage.

Section 15.4.3 Accessible Routes—Driving Ranges

This section provides that an accessible route must connect accessible teeing stations at driving ranges with accessible parking spaces and must be 48 inches minimum in width. Where handrails are provided, the accessible route must be a minimum of 60 inches in width. An exception has also been added which permits a golf car passage to be used at driving ranges instead of an accessible route.

Comment. The proposed rule did not specifically address the accessible route provided at driving ranges. A commenter stated that a person who plays from a golf car would need to practice driving a golf ball from the same position and stance used when playing the game.

Response. The final rule requires both a stand alone driving range and a driving range located at a golf course to provide an accessible route that is 48 inches wide minimum or 60 inches minimum where handrails are provided,

to connect the accessible parking spaces to required accessible teeing stations.

Section 15.4.4 Teeing Grounds

This section requires teeing grounds to comply with section 15.4.4.

Section 15.4.4.1 Number Required

This section requires that where one or two teeing grounds are provided for a hole, one teeing ground must be accessible. Where three or more teeing grounds are provided for a hole, at least two teeing grounds serving a hole must be accessible.

Comment. The proposed rule required that if two teeing grounds were provided both must be accessible. Course designers and operators expressed concerns that if only two teeing grounds are provided at a hole requiring both to be accessible was too restrictive.

Response. The final rule has been revised to require two teeing grounds to be accessible when three or more teeing grounds are provided for a hole. The Board believes that requiring two teeing grounds to be accessible when three or more are provided will provide persons with disabilities with an option to play from different tees appropriate to their skill level and also provide course operators and designers with the flexibility they requested.

Section 15.4.4.2 Forward Teeing Ground

This section requires the forward teeing ground to be accessible. The forward teeing ground need not be accessible in alterations of existing courses when terrain makes compliance infeasible.

Comment. The proposed rule sought comment on the number of accessible teeing grounds that should be required for each hole and, if more than one accessible teeing ground is provided, whether it should be the forward tee. Commenters supported the option to play from different teeing grounds appropriate to player skill levels if multiple teeing grounds are provided per hole. Additionally, golfers with disabilities overwhelmingly supported requiring the forward teeing ground to be accessible regardless of the number of teeing grounds provided.

Response. The final rule provides a choice of teeing grounds for golfers with disabilities when three or more teeing grounds are provided per hole and also provides flexibility to course designers and operators. The final rule also requires that the forward teeing ground be the accessible tee regardless of the number of teeing grounds provided per hole.

Comment. The proposed rule did not provide an exception for alterations of existing teeing grounds from making the forward tee accessible. Commenters stated that requiring access to the forward teeing ground in alterations to existing courses may be too restrictive.

Response. Some teeing grounds on existing courses may be located on steep slopes and it may not be possible to provide a golf car passage to the forward teeing ground. The final rule exempts the forward teeing ground from being accessible in alterations where compliance is not feasible due to terrain.

Section 15.4.4.3 Teeing Grounds

This section requires accessible teeing grounds to be designed and constructed to allow a golf car to enter and exit the teeing ground.

Comment. The proposed rule required teeing grounds to provide a minimum clear area 10 feet by 10 feet with a surface slope not exceeding 1:48 in all directions. Course designers and operators stated that current designs of teeing grounds provide a clear area of at least 10 feet by 10 feet. Additionally, they expressed concern about maintaining a slope no greater than 1:48, and noted that settling of the soil and drainage problems occur with such a minimal slope. Others questioned how the slope of the teeing ground should be measured.

Response. Current design and construction practices for teeing grounds provide the needed space for golf car passages. Designers currently limit the slope of the teeing grounds to provide a level surface from which golfers tee off. The maximum slopes and minimum size requirements have been deleted from the final rule. The final rule requires teeing grounds to be designed and constructed to allow a golf car to enter and exit the teeing ground.

Section 15.4.5 Teeing Stations at Driving Ranges and Practice Teeing Grounds

This section requires that where teeing stations or practice teeing grounds are provided, at least 5 percent, but not less than one, of the practice teeing grounds must be accessible. This provision applies to practice facilities adjacent to a golf course, in addition to stand-alone facilities. No substantive comments were received and no changes have been made for the final rule.

Section 15.4.6 Weather Shelters

This section requires weather shelters that are provided on a golf course to be designed and constructed to allow a golf car to enter and exit and have a clear floor or ground space 60 inches by 96 inches. This space will allow a golf car to be driven directly into a weather shelter. No substantive comments were received and no changes have been made for the final rule.

Section 15.4.7 Golf Car Passage

This section requires openings at least 60 inches wide to be provided at intervals, not exceeding 75 yards, where curbs or other man-made barriers are provided along a golf car passage that would prohibit a golf car from entering a fairway.

Comment. The proposed rule required the 60 inch openings at intervals of 75 yards of golf car passage. Course designers and operators expressed concern that requiring openings at a fixed distance of 75 yards would be too restrictive and would not allow enough flexibility for natural characteristics of the course, hazard placement, and erosion control.

Response. The final rule requires the openings at intervals not to exceed 75 yards. These openings will provide access to the course at reasonable intervals, enabling a golfer using a golf car to play the game without extended travel distances and time requirements and also provide the flexibility the course designer and course operator need.

Section 15.4.7.1 Width

This section requires a golf car passage to be 48 inches wide minimum.

Comment. Commenters supported limited technical requirements for golf car passages. Currently there are no standards that govern the design or construction of golf car passages. Commenters felt that additional requirements would restrict designers and have the potential of altering the game.

Response. The 48 inch minimum dimension for a golf car passage is based on the standard width of gasoline or electric powered golf cars. The golf car passage may at times coincide with the golf car path, however, it is not required to include a prepared surface. The golf car passage is a continuous passage on which a motorized golf car can operate. No additional technical provisions for golf car passages have been included in the final rule.

Section 15.4.8 Putting Greens

This section requires space to allow a golf car to enter and exit the green.

Comment. Substantial comment was received on requiring putting greens and fairways to be accessible to golfers using adaptive single rider golf cars. Course

operators are concerned that allowing golf cars access to the green will cause damage to the greens and potentially cause holes to be closed for extended periods of time. Golfers with disabilities, organizations supporting golfers with disabilities, and golf car manufacturers provided information on current courses that allow for golf car passage on putting greens which showed little or no damage to the putting green surface.

Response. Single rider golf cars adapted for golfers with disabilities are available from about a dozen companies. These golf cars are generally designed to be ''greens friendly'' and have low ground pressure that is evenly distributed on all four tires. Some manufacturers report that the ground pressure of these golf cars is less than the ground pressure of a typically standing person and cause no turf damage even in wet conditions.

Comment. Course operators also raised operational issues such as whether they are required to make single rider adapted golf cars available for rental and whether they can restrict the use of golf cars on fairways and greens for certain weather or agronomic conditions.

Response. These issues go beyond the Board's jurisdiction and the requirements in this final rule. The Board anticipates that the Department of Justice will answer these operational issues when it amends its ADA regulations to incorporate the recreation facilities guidelines as standards.

Section 15.5 Miniature Golf

Section 15.5.1 General

This section requires newly designed or newly constructed and altered miniature golf courses to comply with section 15.5.

Section 15.5.2 Accessible Holes

This section requires at least 50 percent of all holes to be accessible and that the accessible holes be consecutive. With the reduction in the minimum number of accessible holes on a miniature golf course, the Board wants to provide a more socially integrated golfing experience for people using wheelchairs or other mobility devices. An exception also permits one break in the sequence of consecutive accessible holes, provided that the last hole on the miniature golf course is the last hole in the sequence. This exception is provided to allow some flexibility in the layout and design of a miniature golf course.

Comment. Significant comment was received from miniature golf course owners and operators regarding the number of holes required to be accessible. The proposed rule required each hole on a miniature golf course to be accessible, with an exception for 50 percent of elevated holes. Commenters were asked to give the Board guidance on differentiating between level and elevated holes. Few comments were received on definition alternatives. Some owners and operators believed that the requirement for all holes to be accessible would significantly impact course design to the extent that the experience may be ''fundamentally altered.'' Others cited space limitations, concerns about slowing the game down, and having the effect of ''compromising the challenge of the game.''

Response. The Board has significantly reduced the number of holes required to be accessible in newly constructed miniature golf courses to 50 percent of all holes.

Comment. During the comment period following the draft final rule, the Miniature Golf Association recommended that instead of making 50 percent of the holes accessible, miniature golf facilities should have the option of providing tools, equipment, or assistive devices to provide access. They specifically requested that assistive devices such as electric carts be permitted as an alternative to an accessible route. Several other commenters opposed the reduction in the number of accessible holes, expressing concerns about limiting the game for persons with disabilities to only half of the holes.

Response. The Board has maintained the requirement that a minimum of 50 percent of all holes in new construction be accessible. The final rule does not recognize the alternative use of assistive devices for providing access in new construction. Designing miniature golf course holes so electric carts can safely maneuver through the holes is likely to have as great or greater impacts than designing an accessible route. Requiring individuals with disabilities to use electric carts on miniature golf courses is also inconsistent with other provisions of the ADA which require goods, services, and facilities to be afforded in the most integrated setting appropriate.

Given the diversity of layouts and designs of miniature golf courses, the final rule does not distinguish between courses with elevated holes or those with largely level holes. The 50 percent reduction represents a compromise given the concerns presented. Other considerations relate to the accessible route connecting accessible holes. The Board has established this reduction to give relief where courses are designed on small parcels of land with existing terrain limitations. It is recommended that all holes on a miniature golf course be made accessible where space limitations and existing steep terrain are not present.

Section 15.5.3 Accessible Route

This section requires that the accessible route must connect the course entrance with the first accessible hole and the start of play area on each accessible hole. Since accessible holes must be consecutive, this section also requires the course to be configured to allow exit from the last accessible hole to the course exit or entrance. The course must be designed so as not to require an individual to back track through other holes to exit or move around the course. Where the accessible route is located on the playing surface of the accessible hole, five exceptions are permitted and are discussed below.

Comment. Miniature golf course operators were concerned that the surface commonly used on miniature golf course holes would not meet the requirements for accessible carpet. Their concerns were centered around the thickness of the surface. ADAAG 4.5.3 includes a requirement that the maximum pile thickness must be no more than ½ inch and be securely attached with a firm cushion, pad, or backing. Exposed edges must be fastened to floor surfaces and must have trim along the entire length of the exposed edge.

Response. The Board has added Exception 1 which exempts carpet used on miniature golf course holes from the provisions of ADAAG 4.5.3. Surfaces provided as a part of an accessible route, whether on or off the playing surface, must comply with ADAAG 4.5.2. ADAAG 4.5.2 requires the surface to be ''stable, firm, and slip resistant.''

Comment. Commenters raised concern about the use of readily removable curbs permitted in the proposed rule. Operators were concerned that their removable qualities would tempt younger players to use them inappropriately. Persons with disabilities questioned who would actually move the curbs and how problems related to their use would be addressed.

Response. The final rule does not allow the use of ''readily removable curbs''. This option was included to allow for passage on and off the course while containing the ball while in play. As an alternative, Exception 2 has been added which permits a 1 inch curb for an opening distance of 32 inches where the accessible route intersects the

playing surface of a hole. This permits passage of wheelchairs while containing the ball within the hole.

Comment. The proposed rule permitted a maximum slope of 1:4 for a 4 inch rise where the accessible route is located on the playing surface. A few commenters questioned how close together a designer could locate these steeply sloped surfaces. They were concerned about the appropriateness where these steep slopes existed for long distances without areas to rest.

Response. Exception 3 permits a slope of 1:4 maximum for a 4 inch rise where the accessible route is located on the playing surface of a hole. Exception 4 specifically addresses the issue of landings where sloped surfaces are provided. This exception permits the landings to be 48 inches long with slopes no greater than 1:20. ADAAG 4.8.4(3) requires landings to be 48 inches by 60 inches minimum, where ramps change direction. Providing a separation or break from the steeper slopes is necessary for individuals with disabilities to safely maneuver on the hole.

Exception 5 states that where the accessible route is located on the playing surface of a hole, handrails are not required.

Section 15.5.3.2 Accessible Route—Adjacent to the Playing Surface

Where the accessible route is located adjacent to the playing surface, the equirements of 4.3 apply. This provision clarifies that the accessible route may be located on the playing surface of the accessible hole or adjacent to the hole.

Section 15.5.4 Start of Play Areas

This section requires start of play areas required to comply with 15.5.2 to have a slope not steeper than 1:48 and to be 48 inches minimum by 60 inches minimum.

Comment. The proposed rule required the minimum space for the start of play area to be 60 inches by 60 inches. Commenters questioned the need for this space and recommended a reduction where possible especially where space limitations exist. Questions were also raised regarding the appropriateness of overlapping the accessible route with the start of play area.

Response. The final rule reduces the space required since the start of play area will usually not require a person using a wheelchair or mobility aid to make a complete turn. Rather, space is necessary for positioning to take the first shot of the hole. Consistent with ADAAG, unless otherwise specified, the accessible route and the clear space required at the start of play area are permitted to overlap.

Section 15.5.5 Golf Club Reach Range

This section requires all areas within accessible holes where golf balls rest to be within 36 inches maximum of an accessible route having a maximum slope of 1:20.

Comment. The proposed rule required that all level areas within accessible holes where golf balls rest be within 27 inches maximum of an accessible route. A few commenters questioned the appropriateness of the 27 inch dimension. They recommended an increase to include a broader range of skill levels and golf club lengths.

Response. The distance from the level areas has been increased to 36 inches to balance the impact on course design and incorporate the reach of a typical adult size golf club. This is a maximum distance from the accessible route which may be located either on the hole or adjacent to the hole. Where possible, designers should locate the accessible route as close as possible to the level areas on the course. This will improve the ability to reach the golf ball for a variety of users.

Section 15.7 Exercise Equipment and Machines, Bowling Lanes, and Shooting Facilities

Section 15.7.1 General

This section requires all newly designed or newly constructed and altered exercise equipment and machines, bowling lanes, and shooting facilities to comply with section 15.7.

Section 15.7.2 Exercise Equipment and Machines

This section requires at least one of each type of exercise equipment and machines to be provided with clear floor space complying with ADAAG 4.2.4 and be served by an accessible route. Clear floor space must be positioned for transfer or for use by an individual seated in a wheelchair. Clear floor spaces for more than one piece of equipment are permitted to overlap. Permitting clear spaces to overlap should reduce the space requirements within an exercise or health club facility.

Comment. The American Hotel and Lodging Association commented that the requirement for clear space at exercise equipment and machines created a burden for the lodging industry. Similar comments were also received from the International Health, Racquet, and Sport Club Association, who indicated that space limitations present in existing facilities will prohibit compliance with this provision.

Response. These guidelines apply only to newly constructed and altered buildings and facilities. Where exercise equipment and machines are altered or added to a facility, the provisions of 15.7.1 apply to those pieces that are altered or added. In the case of altered exercise equipment or machines, the provisions of ADAAG 4.1.6(1)(j) related to ''technical infeasibility'' will also apply. ADAAG 4.1.6(1)(j) permits departure from the technical provisions where existing physical or site constraints prohibit full compliance. Space limitations may prohibit full compliance with 15.7.2. In this case, designers and operators must comply to the ''maximum extent feasible''.

Requirements for existing buildings and facilities are addressed in the Department of Justice regulations and are subject to the requirements for ''readily achievable barrier removal'' where the facility is covered by title III of the ADA. Facilities covered by title II of the ADA are subject to the requirements for ''program accessibility''. See discussion in the background section of this preamble.

An appendix note is added to provide guidance on exercise equipment and machine layout to maximize space.

Comment. A few commenters requested guidance on what is intended with respect to ''types'' of exercise equipment and machines. Others suggested that the Board should not require access to exercise machines or equipment that require the user to stand such as tread mills or stair climbers.

Response. The final rule is not limited to exercise equipment or machines that do not require standing. Access to the various pieces of exercise equipment serves individuals who use mobility aids such as scooters and wheelchairs. Individuals with ambulatory disabilities including those using walkers, canes, and crutches will also benefit from an accessible route and clear floor space next to a treadmill or stationary bike or other exercise equipment. An appendix note provides guidance on the different types of exercise equipment and machines. It also suggests that owners and operators consider including exercise equipment and machines within their facilities that provide for upper body cardiovascular exercise. This will add to the diversity of exercise options for everyone.

With respect to the issue of ''type'', a stationary bicycle would be considered one type. A rowing machine would also be considered a type. While both provide a cardiovascular exercise, they are considered two different types for purposes of these guidelines. In terms of strength training machines, a bench

press machine is considered a different type than a biceps curl machine. The requirement for providing access to each type is intended to cover the variety of strength training machines. Where operators provide a biceps curl machine and free weights, both are required to meet the provisions in this section, even though an individual may be able to work on their biceps through both types of equipment. Where the exercise equipment and machines are only different in that different manufacturers provide them, only one of each type of machine is required to meet these guidelines. For example, where two bench press machines are provided and each is manufactured by a different company, only one is required to comply.

Section 15.7.3 Bowling Lanes

This section requires that where bowling lanes are provided, at least 5 percent, but not less than one lane of each type must be accessible.

Comment. The Bowlers Proprietors Association expressed concern about requiring 5 percent of bowling lanes to be accessible. Their comments focused on the difficulty of providing ramps to gain access to bowling lanes within existing facilities. They also questioned how to apply the 5 percent minimum requirement where a bowling facility has multiple lanes.

Response. As previously indicated, these guidelines apply to newly constructed and altered facilities. When a bowling facility is altered, the provisions of 15.7.2 will apply to the lane that is undergoing an alteration and does not require all other lanes to be modified unless required by ADAAG 4.1.6 (Path of Travel). Other obligations related to existing facilities covered by titles II and III of the ADA are addressed in the Department of Justice regulations.

Where the required number of accessible elements to be provided is determined by calculations of ratios or percentages and remainders or fractions result, the next greater whole number of such elements should be provided. For example, if 18 lanes of one type are provided, one lane would be required to be accessible in new construction. If 24 bowling lanes of one type are provided in new construction, a minimum of two accessible bowling lanes would be required in new construction.

Comment. The Bowlers Proprietors Association also expressed concern about the number of accessible bowling lanes required in those facilities where different types of bowling is provided. They were also concerned about facilities that provide both ten pin and duck pin bowling. They believed that a 5 percent requirement for both types was excessive and recommended that the requirement be limited to the type that is dominant within a given facility. Further, the Bowlers Proprietors Association questioned what made a bowling lane accessible.

Response. In facilities where both ten pin and duck pin bowling are provided, the 5 percent requirement for each type will typically result in one of each type of lane being accessible.

The final rule does not include any further technical provisions for bowling lanes required to be accessible. Like other areas of sport activity, the requirement is for an accessible route to connect to the area of sport activity, in this case, the bowling lane. Specific exemptions to ADAAG 4.4 (protruding objects) and 4.5 (surfacing requirements) are applied within the area of sport activity. Therefore, bowling lanes which are necessarily waxed to allow the ball to travel, are not required to be slip resistant.

Section 15.7.4 Shooting Facilities

This section requires that where fixed firing positions are provided at a site, at least 5 percent, but not less than one, of each type of firing position must be accessible.

Comment. A few commenters questioned why the Board did not require an accessible route to the target areas as well as the fixed firing positions. Commenters also questioned the application of this section to trap and skeet facilities where the facilities are not entirely fixed. Others questioned what factors should be considered in determining the different types of firing positions.

Response. The Board has not included a requirement for an accessible route to the target areas since targets are often moveable, making it difficult to locate the accessible route effectively. There is also difficulty in defining what is considered the ''target'' area. Where facilities contain a combination of fixed and non-fixed elements, operators should consider the general nondiscrimination requirements of the ADA. Direction on these and other issues related to the use of shooting facilities should be obtained from the Department of Justice. Factors to be considered in determining the types of fixed firing positions include whether covering and lighting is provided, and which shooting events the fixed firing position is intended to support.

Section 15.7.4.1 Fixed Firing Positions

This section requires that accessible fixed firing positions contain a 60 inch diameter space and have a slope not steeper than 1:48. No substantive comments were received and no changes have been made to this provision in the final rule.

Section 15.8 Swimming Pools, Wading Pools, and Spas

Section 3.5 Definitions

The final rule provides a definition for a catch pool which is defined as a pool used as a terminus for water slide flumes.

Comment. The proposed rule did not define the term catch pool. Commenters requested that catch pools be exempt since access is not required for water slides.

Response. The term ''catch pool'' is added to the final rule since it is used in an exception in the final rule. Exception 3 to section 15.8.1 exempts catch pools from complying with the requirements of this section, provided that an accessible route connects to the catch pool edge.

Section 15.8.1 General

This section requires newly designed or newly constructed and altered swimming pools, wading pools, and spas to comply with 15.8. An exception has been added to the final rule that provides that an accessible route is not required to serve raised diving boards or diving platforms provided that an accessible route is provided to the base of the raised diving board or platform.

Section 15.8.2 Swimming Pools

This section requires that at least two means of entry be provided for each public or common use swimming pool. A sloped entry or lift must be one of the primary means of access. The secondary means of access could include a pool lift, sloped entry, transfer wall, transfer system, or pool stairs.

Comment. The proposed rule permitted a moveable floor as a secondary means of entry. Commenters stated that even though moveable floors may have some practical applications they do not provide independent access and often place a person with a disability on display while the pool is evacuated and the floor raised to provide access. Additionally, commenters raised concerns regarding the removal of handrails and other means of egress prior to lifting the pool floor.

Response. The option of using a moveable floor as a secondary means of accessible entry in public or common use swimming pools has been deleted from the final rule.

The Board has also deleted the requirement that the second means of access not duplicate the first means of

access in larger pools in the final rule. This should give designers additional flexibility in choosing between the various means of access. An appendix note recommends that where two means of access into the water are provided, different means are recommended.

Exception 1 Small Pools With Less Than 300 Linear Feet of Pool Wall

Exception 1 permits public or common use swimming pools with less than 300 linear feet of pool wall to only provide one accessible means of entry by either a swimming pool lift or a sloped entry.

Comment. A commenter suggested that Exception 1 should be modified to refer to pool wall that is available for entry into the pool. They explained that pool walls at diving areas and pool decks where there is no available pool entry because of landscaping or adjacent structures should not be counted when determining the number of accessible means of entry required.

Response. Exception 1 is intended to provide small pools with relief from providing more than one accessible means of entry. It was not intended for large pools that could limit the locations of entry with landscaping or other structures from requiring additional accessible means of entry.

Exception 2 Pools Where Access Is Limited to One Area

Exception 2 has been added to the final rule and permits wave action pools, leisure rivers, sand bottom pools, and other pools where user access is limited to only one area, to provide one accessible means of entry by either a swimming pool lift, sloped entry, or a transfer system.

Comment. Commenters from speciality pool operators and leisure river designers expressed concerns for safety, where there is wave action or moving water, when providing additional accessible means of entry in these unique water environments. Wave action pools typically provide a large area of zero grade entry, where everyone enters the water. Providing an accessible means of entry along the high walls could be very dangerous. Leisure rivers are constructed to provide a safe area where staff can assist individuals into the current at one location to control access to and from the moving water.

Response. In response to the safety concerns provided by designers and operators of these moving water experiences, only one accessible means of entry is required in the final rule, when user access is limited to one area.

Exception 3 Catch Pools

Exception 3 exempts catch pools from these requirements, provided that an accessible route connects to the catch pool edge.

Comment. The proposed rule did not include any specific requirements for access to water slides. Comments on the proposed rule and the draft final rule supported not requiring access to the top of water slides.

Response. An exception has been added to the final rule exempting water slides from accessibility. *See* ADAAG 4.1.1 (5) (b) (v). To be consistent with the water slide exception, the final rule also exempts the catch pool at the discharge area of a water slide from providing an accessible means of entry or exit from the catch pool, provided that an accessible route connects to the catch pool edge.

Section 15.8.3 Wading Pools

This section requires at least one accessible means of entry into each wading pool. The means of entry must be a sloped entry.

Comment. The proposed rule required the means of entry into wading pools to be either a sloped entry, transfer wall, or a transfer system. The proposed rule also sought comment on the appropriateness of providing a transfer wall or other transfer system as a means of access into a wading pool. Several commenters expressed concern about the potential dangers to children that may use the transfer walls or systems inappropriately for play or diving.

Response. The final rule limits the accessible means of entry into a wading pool to a sloped entry only. Examination of the different means of access into wading pools found zero grade entry to be the most appropriate and currently most provided means of entry.

Section 15.8.4 Spas

This section requires at least one accessible means of entry into spas. The means of entry must be a pool lift, transfer wall, or transfer system. An exception allows for five percent, but not less than one spa, where spas are provided in a cluster, to be accessible. No substantive comment was received and no changes have been made to this section in the final rule.

Section 15.8.5 Pool Lifts

This section provides the technical requirements for pool lifts.

Section 15.8.5.1 Pool Lift Location

This provision requires pool lifts to be located where the water level does not exceed 48 inches.

Comment. The proposed rule did not specify the location of a pool lift. Commenters with disabilities and individuals who work in environments where people with disabilities use pool lifts expressed concern that pool lifts may be placed in areas where the water depth would not permit assistance in the water if needed. Comments on the draft final rule supported the requirement for a pool lift to be located in a water depth of 48 inches or less whenever possible. Commenters also gave examples of when the location of a pool lift should be allowed in an area where the water depth is greater than 48 inches.

Response. The final rule requires a pool lift to be located where the water level does not exceed 48 inches. Two exceptions have been added to the final rule in response to comments received. Exception 1 permits the use of pool lifts at any location where the entire pool has a depth greater than 48 inches. Exception 2 permits pools with multiple pool lift locations to provide at least one where the water depth does not exceed 48 inches.

Section 15.8.5.2 Seat Location

This section requires the centerline of the seat, when in the raised position, to be located over the deck and 16 inches minimum from the edge of the pool. Additionally, the deck surface between the centerline of the seat and the pool edge must not have a slope greater than 1:48.

Comment. The proposed rule required the centerline of the seat, when in the raised position, to be located over the deck and 20 inches minimum from the pool edge. Comments from lift manufacturers expressed concern about the 20 inch minimum distance. They elaborated on the difficulties associated with providing a lift that places the user away from the pivot point of the lift a distance of 20 inches. Additionally, they commented that aquatic lifts with the centerline of the seat at least 20 inches away from the pool edge may not clear the footrest over the curbing or pool edge provided on some pools.

Response. Based on the concerns of commenters, the distance measured from the centerline of the lift seat to the edge of the pool has been reduced from 20 inches to 16 inches minimum. The location of the seat in relation to the edge of the pool is especially important to facilitate safe transfers. The Board is concerned about locating the seat either over the water or too close to the deck edge for safety reasons. This provision has been modified to address design limitations and incorporate the

maximum distance from the pool edge to ensure safety.

Section 15.8.5.3 Clear Deck Space

This section requires a clear deck space on the side of the seat opposite the water and parallel with the seat. The space is required to be 36 inches wide minimum and to extend forward 48 inches minimum from a line located 12 inches behind the rear edge of the seat. The clear space is specified in relationship to the seat to allow unobstructed space for either side or diagonal transfer. Additionally, the clear deck space must have a slope not greater than 1:48.

Comment. The proposed rule required the clear deck space to be a minimum of 30 inches wide. Commenters requested additional space to permit greater flexibility for transfer position preferences and the varied abilities of persons requiring the use of a pool lift. Commenters expressed a preference that the clear deck space should be required to provide a level surface from which to transfer from a mobility device to the lift seat.

Response. The final rule increases the clear deck space required on the side of the seat opposite the water to be a width of 36 inches minimum and that the clear deck space provide a surface with a slope not greater than 1:48. The additional space will facilitate the maneuvering that may be needed by a person using a mobility device preparing for a transfer to the seat of a pool lift.

Section 15.8.5.4 Seat Height

This section requires the height of a lift seat to be designed to allow a stop at 16 inches minimum to 19 inches maximum measured from the deck to the top of the seat surface when the seat is in the raised (load) position.

Comment. The proposed rule required the height of the lift seat to be 16 inches minimum to 18 inches maximum. Commenters requested a greater range of seat heights to transfer to or from when the lift is in the up position. They suggested a seat height that could accommodate the needs of users of all ages and abilities would be more beneficial.

Response. Information obtained from the Board sponsored research project supported the height requirement of a lift seat while in the upper load position to be at a height between 16 and 18 inches from the deck surface. In response to the comments received, the final rule departs slightly from the proposed rule, by permitting the lift seat to make a stop at the 16 to 19 inch height above the deck surface. The lift could provide additional stops at various heights provided that a stop is provided between 16 and 19 inches above the surface of the deck.

Section 15.8.5.5 Seat Width

This section requires a lift seat to be 16 inches wide minimum. No substantive comment was received and no changes have been made to this section in the final rule.

Comment. The proposed rule sought information on the different types of seats that are available on pool lifts and whether a specific type should be required in the final rule. Commenters did not provide a consensus on either the type of pool lift seat or the type of materials preferred by pool lift users.

Response. The final rule does not specify the type of material or the type of seat to be provided by a pool lift. Persons with disabilities involved in the Board sponsored research project expressed interest in all types of seats. An appendix note provides additional information on pool lift seats.

Section 15.8.5.6 Footrests and Armrests

This section requires footrests to be provided and that they move in conjunction with the seat. Additionally, this provision requires that, if provided, the armrest opposite the water be removable or fold clear of the seat when the seat is in the raised (load) position.

Comment. The proposed rule requested information on the appropriateness of requiring armrests on pool lifts and on their size and location. Commenters supported requirements based on their own personal needs with no consistent guidance on the location or size of armrests on a pool lift. One commenter questioned the appropriateness of providing a footrest on a lift for entry into a spa due to the water depth in some smaller spas.

Response. An exception has been added that provides that footrests are not required on pool lifts that provide an accessible means of entry into a spa. An appendix note encourages the use of a footrest in larger spas where possible and some type of retractable leg support is recommended for pool lifts used in all spas.

Section 15.8.5.7 Operation

This section requires that a pool lift be capable of unassisted operation from both the deck and water levels. This section also requires that controls and operating mechanisms be unobstructed when a lift is in use and comply with ADAAG 4.27.4. That section requires that operating controls not require tight grasping, pinching, or twisting of the wrist or more than 5 pounds of pressure to operate.

Comment. The proposed rule required that the lift controls and operating mechanisms may not require continuous manual pressure for operation. Commenters with disabilities supported the requirement of unassisted operation from both the deck and water levels. They reported the difficulty in finding the responsible person when lifts require assistance, especially in environments where pools are not routinely staffed. Commenters expressed concerns about getting out of the water, if assistance is required, especially where the pool is not staffed. Someone could be stranded in the water for extended periods of time awaiting assistance. Commenters suggested that pool lifts that require continuous manual pressure give the user greater control of their descent into the water and ascent back to the deck. Concern was expressed by a manufacturer of pool lifts that providing unassisted operation encourages individuals to swim alone and the potential dangers of causing injury are greatly increased when using an automatic lift without assistance.

Response. A large percentage of the respondents in the Board sponsored research project noted the importance of using a lift without assistance. Pool facility staff also indicated the importance of a device or design that could be used without pool staff assistance. While this provision requires the lift to be independently operable it does not preclude assistance from being provided. The final rule removes the requirement that pool lifts may not require continuous manual pressure for operation.

Comment. A few commenters expressed safety concerns where pool lifts are provided in pools that are unattended.

Response. Pool lifts have been commercially available for over 20 years. While the Board recognizes that inappropriate use of pool lifts may result in accident or injury, the Board is not aware of any incidents of injury or accidents involving pool lifts. The Board is also not aware of any evidence that shows that pool lifts are any less safe than other components of a pool facility, such as other means of pool entry, when they are used inappropriately. Manufacturers are also incorporating features which are intended to discourage inappropriate use, such as fold-up seats and covers.

Section 15.8.5.8 Submerged Depth

This section requires that a pool lift be designed so that the seat will

submerge to a water depth of 18 inches minimum. This depth is necessary to ensure buoyancy for the person on the lift seat once in the water. No substantive comment was received and no changes have been made to this section for the final rule.

Section 15.8.5.9 Lifting Capacity

This section requires that single person pool lifts provide a minimum weight capacity of 300 pounds. Lifts also must be capable of sustaining a static load of at least one and a half times the rated load.

Comment. The proposed rule required pool lifts to provide a minimum weight capacity of 300 pounds and be capable of sustaining a static load of at least three times the rated load. Several pool lift manufacturers supported the minimum weight requirement of 300 pounds. They questioned requiring a static load of three times the weight limit. They believed it was too excessive and would eliminate viable lifts from being provided. A commenter suggested that the static load requirement reference an international standard for lifts that require a static load of 1.6 times the weight capacity.

Response. The static load requirement has been reduced to one and a half times the weight capacity requirement.

Section 15.8.6 Sloped Entries

This section provides technical requirements for sloped entries designed to provide access into the water. Due to the similarities of this type of entry with ramps used in other buildings and facilities, existing ADAAG requirements have been referenced accordingly.

Section 15.8.6.1 Sloped Entries

This section requires sloped entries to comply with ADAAG 4.3 (Accessible Route), except for slip resistance.

Comment. Commenters questioned the ability of providing a slip resistant surface on a sloped entry that is under water.

Response. The final rule provides an exception for sloped entries from being slip resistant.

Section 15.8.6.2 Submerged Depth

This section requires sloped entries to extend to a depth of 24 to 30 inches below the stationary water level. This section also requires that where landings are required by ADAAG 4.8, at least one landing must be located between 24 and 30 inches below the stationary water level. Since wading pools are typically less than 24 to 30 inches deep, an exception provides that sloped entries are only required to extend to the deepest part of a wading pool. No substantive comment was received and no changes have been made to this section in the final rule.

Section 15.8.6.3 Handrails

This section requires handrails that comply with ADAAG 4.8.5 on both sides of all sloped entries. The clear width between handrails must be between 33 and 38 inches. Exception 1 does not require handrail extensions to be provided at the bottom of a landing serving a sloped entry. Exception 2 does not require the clear width between handrails where a sloped entry is provided for wave action pools, leisure rivers, sand bottom pools, and other pools where user access is limited to one area. Exception 3 exempts sloped entries in wading pools from providing handrails.

Comment. The proposed rule did not specifically address handrails in wading pools. Commenters expressed great concern about the potential dangers from children using handrails to play on or jump into the shallow water or the risk to other children in the wading pool.

Response. The Board is concerned about the potential dangers to children using handrails inappropriately. Exception 3 has been added to the final rule exempting wading pools from providing handrails.

Section 15.8.7 Transfer Walls

This section provides technical requirements for transfer walls.

Section 15.8.7.1 Clear Deck Space

This section requires clear deck space of 60 inches by 60 inches minimum with a slope not steeper than 1:48 to be provided at the base of a transfer wall. Where one grab bar is provided on a transfer wall, the clear deck space must be centered on the grab bar. This allows sufficient space for a transfer on either side of the grab bar. Where two grab bars are provided, the clear deck space must be centered on the clearance between the grab bars. No substantive comment was received and no changes have been made to this section for the final rule.

Section 15.8.7.2 Height

This section requires the height of transfer walls to be 16 to 19 inches measured from the deck below. The height requirement is consistent with pool lift seat heights and similarly addresses the needs of some children. The maximum height above the deck has been changed to 19 inches to be consistent with other transfer heights in ADAAG.

Section 15.8.7.3 Wall Depth and Length

This section requires the depth of a transfer wall to be 12 to 16 inches. As a minimum, the 12 inch depth of the transfer wall provides adequate space for a person to comfortably sit on the surface of the wall. The wall depth is limited to 16 inches maximum so that users are not required to traverse the wall to transfer to the water. The length of the transfer wall must be 60 inches minimum and must be centered on the clear deck space.

Section 15.8.7.4 Surface

This section requires that the surface of a transfer wall must not be sharp and must have rounded edges. Commenters overwhelmingly supported this section and no changes have been made to this section for the final rule.

Section 15.8.7.5 Grab Bars

This section requires at least one grab bar to be provided on a transfer wall. Grab bars are required to be perpendicular to the pool wall and extend the full depth of the wall. The top of the gripping surface must be 4 to 6 inches above the wall. Where two grab bars are provided, clearance between grab bars must be 24 inches minimum. Where one grab bar is provided, clearance must be 24 inches minimum on both sides of the grab bar. Grab bars must comply with ADAAG 4.26.

Comment. The proposed rule required the top of the gripping surface to be a maximum of 4 inches above the wall. Commenters expressed concern that 4 inches maximum above the wall surface, after factoring in the diameter of the grab bar, would not provide sufficient gripping space for persons transferring.

Response. The final rule provides a range from 4 to 6 inches above the wall to the top of the gripping surface. The range will provide greater flexibility and incorporate the diameter of the grab bar in providing users of all ages and abilities with an appropriate gripping surface.

Section 15.8.8 Transfer Systems

This section provides technical requirements for transfer systems used as a means of access into the water. A transfer system consists of a transfer platform, combined with a series of transfer steps that descend into the water. Users must transfer from their wheelchair or mobility device to the transfer platform and continue transferring from step to step.

Section 15.8.8.1 Transfer Platform

This section requires a transfer platform to be 19 inches deep by 24 inches wide. Transfer platforms must be provided at the head of each transfer system. No substantive comment was received and no changes have been made to this section for the final rule.

Section 15.8.8.2 Clear Deck Space

This section requires a clear deck space of 60 by 60 inches minimum with a slope not steeper than 1:48 at the base of the transfer platform. A level unobstructed space at the base of the transfer platform, centered along the 24 inch side, is necessary to facilitate a transfer from a wheelchair or mobility device. No substantive comment was received and no changes have been made to this section for the final rule.

Section 15.8.8.3 Height

This section requires the height of transfer platforms to be 16 to 19 inches measured from the deck. No substantive comment was received and no changes have been made to this section for the final rule.

Section 15.8.8.4 Transfer Steps

This section requires transfer steps to be 8 inches maximum in height. It also requires that transfer steps extend to a water depth of 18 inches minimum.

Comment. The proposed rule required transfer steps to be 7 inches maximum in height. Commenters questioned the inconsistences between the transfer step height of 8 inches required on a play area transfer step (15.6.5.2.2) to that provided in an aquatic setting.

Response. The final rule has been changed to require an 8 inch maximum step height in aquatic settings to be consistent with the play areas transfer step (15.6.5.2.2). An appendix note has been included recommending the height of the transfer step be minimized whenever possible.

Section 15.8.8.5 Surface

This section requires that the surface of a transfer system must not be sharp and provide rounded edges. Similar to other transfer surfaces, this is necessary to reduce the potential for injury. No substantive comment was received and no changes have been made to this section in the final rule.

Section 15.8.8.6 Size

This section requires each transfer step to have a tread depth of 14 to 17 inches and a minimum tread width of 24 inches.

Comment. The proposed rule required a range for the transfer step depth from 12 to 17 inches and a tread width of 22 inches minimum. Commenters pointed out the inconsistencies between the size of the transfer step in the play areas final rule (15.6.5.2.1) and for swimming pools.

Response. In an effort to provide uniformity between the play areas transfer steps and those located at swimming pools, the final rule modifies the transfer step to incorporate a range of 14 to 17 inches in depth and a minimum width of 24 inches.

Section 15.8.8.7 Grab Bars

This section requires one grab bar to be provided on each step and the transfer platform, or a continuous grab bar serving each transfer step and the transfer platform. Where provided on each step, the top of the gripping surface must be 4 to 6 inches above each step. Where a continuous grab bar is provided, the top of the gripping surface must be 4 to 6 inches above the step nosing. Grab bars must comply with ADAAG 4.26 and be located on at least one side of the transfer system. The grab bar located at the transfer platform must not obstruct transfer.

Comment. As previously discussed in section 15.8.7.5, the proposed rule required the top of the gripping surface to be 4 inches above the wall. Commenters expressed concern that 4 inches above the wall surface, after factoring in the diameter of the grab bar, would not provide sufficient space for persons transferring.

Response. The final rule requires the top of the gripping surface to be 4 to 6 inches above the wall. It is believed that the range will provide greater flexibility to users of all ages and abilities with an appropriate gripping surface.

Section 15.8.9 Pool Stairs

This section provides technical requirements for pool stairs used as a means of entry and exit to the water.

Section 15.8.9.1 Pool Stairs

This section requires pool stairs to comply with ADAAG 4.9 (Stairs), except as modified. ADAAG 4.9 has been referenced since stairs in pools are used in a similar manner as stairs elsewhere. No substantive comment was received and no changes have been made to this section in the final rule.

Section 15.8.9.2 Handrails

This section requires the width between handrails to be 20 to 24 inches. To reduce the potential for underwater protrusions, handrail extensions are not required at the bottom landing serving a pool stair.

Comment. The proposed rule required a 22 inch maximum width between handrails on pool stairs. Commenters expressed concern that a maximum distance of 22 inches may be too close for people that are large in size. Commenters with mobility impairments supported the handrail distance of 22 inches for providing the needed support while entering a pool by stairs.

Response. The final rule increases the maximum width between handrails to 24 inches. Separating the handrails more than 24 inches apart would make them too far apart for a larger class of people that require the support on pool stairs.

Section 15.8.10 Water Play Components

This section requires that where water play components are provided, the provisions of 15.6 (Play Areas) and ADAAG 4.3 apply, except where modified by this section.

Comment. The proposed rule sought comment on specific features within aquatic recreation facilities where it may be technically infeasible in new construction to comply with the proposed requirements in 15.8. Manufacturers and designers of water play components expressed concerns about having to provide ramp access to elevated play structures in standing water. Many of these components are at considerable distances from the top of the water surface and ramping would be very challenging and costly. Commenters with disabilities or individuals representing individuals with disabilities expressed a great desire to have access to these unique water experiences.

Response. The final rule requires that where water play components are provided, they must comply with 15.6 (Play Areas) and ADAAG 4.3, except as modified or otherwise provided in this section. The final rule is responsive to manufacturers and designers by providing an exception to providing ramp access, while providing persons with disabilities the opportunity to enjoy this unique family oriented water experience with their family and friends. Exception 1 exempts accessible routes, clear floor spaces, and maneuvering spaces that are submerged from the requirements for cross slope, running slope, and surface. Exception 2 permits transfer systems to be used in lieu of ramps to connect elevated play components.

Regulatory Process Matters

Executive Order 12866: Regulatory Planning and Review

This final rule is a significant regulatory action under Executive Order

12866 and has been reviewed by the Office of Management and Budget. The Board has assessed the benefits and costs of the rule. The assessment has been placed in the public docket and is available for inspection. The assessment is also available on the Board's Internet site (*http://www.access-board.gov*). The assessment is summarized below:

Benefits

The benefits of the final rule are not quantifiable, but are significant and are consistent with the President's New Freedom Initiative. The primary benefit is the fulfillment of civil rights realized by individuals with disabilities. There are 52.5 million Americans with disabilities. Almost one in five adults has some type of disability. Among individuals 15 years old and over, 25 million have difficulty walking or using stairs. The final guidelines will result in newly constructed and altered recreation facilities that are accessible to individuals with disabilities and will enable them to participate in a wide range of recreational opportunities. Individuals with disabilities can also realize significant health benefits by participating in the range of recreational opportunities made accessible as a result of the final guidelines.

Costs

For each type of facility addressed by the final rule, the assessment estimates the number of existing facilities and new facilities constructed annually, identifies the requirements that have cost impacts for new construction and alterations, estimates the unit costs per facility, and calculates the total annual compliance costs. The number of small entities is reported as a percentage of the facilities. To estimate cost impacts, the assessment relies on assumptions where sufficient data is not available. The assumptions are based on interviews with professionals in the affected industries and are disclosed in the assessment. The assumptions cannot be validated and may not reflect the real world. The assumptions may result in under or overestimating the impacts of the final rule. The relevant data for each facility type is presented below.

Amusement Rides

Existing Facilities: 377 amusement parks.

New Construction: 4 new amusement parks per year.

Small Entities: 81 percent of amusement parks.

New Amusement Rides: 343 new rides per year; 68 will be platform type rides with stepped entrances.

New Construction Impacts: New platform type rides with stepped entrances will need a ramp ($4,000 to $6,700 unit cost) or a platform lift ($12,000 to $15,000 unit cost) to provide an accessible route to the load and unload area; and additional space ($1,175 unit cost) in the load and unload area to provide wheelchair turning space and wheelchair storage space if a ride seat designed for transfer or transfer device is provided. For purposes of estimating the costs of providing access to new rides, the assessment assumes that a transfer device ($5,000 unit cost) would be provided for all new rides. New rides will need a sign ($100 unit cost) at the entrance of the queue or waiting line indicating the type of access provided (*e.g.*, wheelchair access or transfer access).

Alterations Impacts: Minimal.

Total Annual Compliance Costs: $2.5 million.

Boating Facilities

Existing Facilities: 12,000 marinas; no data on boat launch ramps.

New Construction: 240 new marinas per year.

Alterations: 600 existing marinas per year.

Small Entities: 99 percent of marinas.

New Construction Impacts: Gangways that are part of an accessible route will need to provide a 1:12 maximum slope or a gangway at least 80 feet long. The unit cost will be site specific. The assessment assumes unit costs will range from $15,000 to $35,000 where the maximum vertical level change is more than 2.5 feet, but less than 10 feet; and $33,000 to $45,000 where the maximum vertical level change is more than 10 feet. The impacts on new accessible boat slips and new accessible boarding piers at new boat launch ramps will be minimal.

Alterations Impacts: Alterations to existing boat slips are a primary function area and may trigger provision of an accessible route, unless the additional cost is disproportionate to the overall costs of the alterations or compliance is technically infeasible. The impacts on altered boat slips will be minimal.

Total Annual Compliance Costs: $10.8 million to $18.0 million.

Fishing Piers and Platforms

Existing Facilities: No data.

New Construction: No data.

Small Entities: No data.

New Construction Impacts: Minimal.

Alterations Impacts: Minimal.

Total Annual Compliance Costs: Minimal

Golf Courses

Existing Facilities: 17,108 golf courses.

New Construction: 377 to 524 new golf courses per year.

Small Entities: 99 percent of golf courses.

New Construction Impacts: Minimal.

Alterations Impacts: Minimal.

Total Annual Compliance Costs: Minimal.

Miniature Golf Courses

Existing Facilities: 7,500 to 10,000 miniature golf courses.

New Construction: 150 new custom design and 170 new modular miniature golf courses per year.

Small Entities: 100 percent of miniature golf courses.

New Construction Impacts: The assessment discusses potential impacts on new custom design courses (low profile courses, challenge courses, and adventure style courses) and new modular courses (indoor courses and outdoor courses). The impacts on new custom design low profile courses will be minimal. For purposes of estimating the costs for making at least 50 percent of the holes on the other custom design courses accessible, the assessment assumes a 10 percent increase in construction costs for new challenge type courses, and a 25 percent increase for new adventure style courses. New indoor modular courses may need to lease additional space to provide an accessible route for at least 50 percent of the holes, and new outdoor modular courses that are not recessed in the ground will have to provide an accessible route for at least 50 percent of the holes. The assessment assumes the additional cost for new modular courses will $5,000 per course.

Alterations Impacts: Minimal.

Total Annual Compliance Costs: $5.4 million.

Exercise Equipment, Bowling Lanes, and Shooting Facilities

Existing Facilities: 17,531 physical fitness facilities; 5,500 bowling centers; and 10,000 shooting facilities. No data on other facilities that provide exercise equipment.

New Construction: 800 to 1,000 new physical fitness facilities; 25 new bowling centers; and 100 new shooting facilities per year.

Small Entities: 99 percent of physical fitness facilities; and 100 percent of bowling centers and shooting facilities.

New Construction Impacts: Minimal.

Alterations Impacts: Minimal.

Total Annual Compliance Costs: Minimal.

Swimming Pools, Wading Pools, and Spas

Existing Facilities: 124,577 pools; no data on spas.

New Construction: 1,245 new pools per year; 565 new spas per year. The assessment assumes 715 new pools per year have less than 300 linear feet of pool wall and will need at least one means of accessible entry into the pool.

Small Entities: Ranges from 15 percent for private hospitals to 100 percent for camps and recreational vehicle parks.

New Construction Impacts: For new pools with less than 300 linear feet of pool wall, the assessment assumes that a pool lift will be provided ($4,000 unit cost). For pools with 300 linear feet or more of pool wall, the assessment assumes 250 of these new pools per year will provide an accessible means of entry in the absence of the final rule and will add a pool lift ($4,000 unit cost). The assessment assumes the other new pools with 300 linear feet or more of pool wall will provide a pool lift ($4,000 unit cost) and pool stairs ($2,500 unit cost). The impacts on wading pools will be minimal. The assessment assumes new spas will provide a pool lift ($4,000 unit cost).

Alterations Impacts: Minimal.

Total Annual Compliance Costs: $8.0 million.

Regulatory Flexibility Act

The final regulatory flexibility analysis has been performed in conjunction with the assessment of the benefits and costs of the final rule required by Executive Order 12866 and the preparation of the preamble for the final rule. The analysis is summarized below.

Need for and Objectives of Guidelines

The Access Board is required to issue accessibility guidelines under the Americans with Disabilities Act (ADA) to ensure that new construction and alterations of facilities covered by the law are readily accessible to and usable by individuals with disabilities. Recreation facilities are among the facilities covered by the ADA. Recreation facilities have unique features that are not adequately addressed by the Americans with Disabilities Act Accessibility Guidelines (ADAAG). The final rule will amend ADAAG to provide supplemental guidelines for making recreation facilities accessible.

Significant Issues Raised During Public Comment Period

The significant comments raised during the public comment period are summarized in the preamble to the final rule, along with the Access Board's assessment of the comments and the reason for selecting the alternative adopted in the final rule. The alternatives considered in the proposed rule and the final rule, and changes made from the proposed rule for each type of recreation facility are presented in the assessment of the benefits and costs of the final rule required by Executive Order 12866.

Numbers of Small Entities Affected by Final Rule

The numbers of small entities affected by the final rule are reported under the summary of the assessment of the benefits and costs of the final rule required by Executive Order 12866.

Reporting and Recordkeeping Requirements

There are no reporting and recordkeeping requirements.

Steps Taken To Minimize Significant Economic Impact on Small Entities

The Access Board has taken steps to minimize the significant economic impact on small entities for each of the different types of recreation facilities addressed in the final rule. These steps are listed below.

- *Amusement Rides*—The final rule allows designers and operators of new amusement rides the choice of providing at least one wheelchair space, or an amusement ride seat designed for transfer, or a transfer device. The final rule limits application of the guidelines to existing rides that are altered. The final rule also allows designers and operators greater flexibility in applying ADAAG to amusement rides.
- *Boating Facilities*—The final rule permits gangways that are part of an accessible route to exceed the 1:12 maximum slope requirement for ramps where the total length of the gangways is at least 80 feet (30 feet for smaller facilities with fewer than 25 boat slips). The final rule reduces the number of boat slips required to be accessible in new construction, and modifies the requirements for accessible boat slips in alterations so no more than one boat slip is lost. The final rule also allows designers and operators greater flexibility in applying ADAAG to boating facilities.
- *Fishing Piers and Platforms*—The final rule permits gangways that are part of an accessible route to exceed the maximum 1:12 requirement for ramps where the total length of the gangways is at least 30 feet. The final rule also exempts guards that comply with certain sections of the International Building Code from the maximum 34 inch height requirement.
- *Golf Courses*—The final rule permits a golf car passage to be provided on golf courses and driving ranges, instead of an accessible route.
- *Miniature Golf Courses*—The final rule requires at least 50 percent of holes on miniature golf courses to be accessible, and permits one break in the sequence of accessible holes provided the last hole in the sequence is the last hole on the course. The final rule also allows designers and operators greater flexibility in applying ADAAG to miniature golf courses.
- *Swimming Pools, Wading Pools, and Spas*—The final rule permits small pools with less than 300 linear feet of pool wall to provide at least one means of access into the water, and permits water play components to use transfer systems to connect elevated water play components.

Technical Assistance

The Access Board will provide technical assistance materials to help small entities understand the accessibility guidelines for recreation facilities. The Access Board also operates a toll-free technical assistance service to answer questions from the public about the guidelines.

Executive Order 13132: Federalism

The final rule adheres to the fundamental federalism principles and policy making criteria in Executive Order 13132. The final rule implements Federal civil rights legislation that was enacted pursuant to the Congress' authority to enforce the fourteenth amendment and to regulate commerce. Ensuring the civil rights of groups who have experienced irrational discrimination has long been recognized as a national issue and a proper function of the Federal government. The ADA was enacted ''to provide a clear and comprehensive national mandate for the elimination of discrimination against individuals with disabilities * * * and to ensure that the Federal government plays a central role in enforcing the standards established in this chapter on behalf of individuals with disabilities.'' 42 U.S.C. 12101(b)(1) and (3). The ADA recognizes the authority of State and local governments to enact and enforce laws that ''provide greater or equal protection for the rights of individuals with disabilities than are afforded by this chapter.'' 42 U.S.C. 12201(b). The final rule establishes minimum guidelines. States and local governments can adopt accessibility standards that provide individuals with

disabilities equal or greater access to recreation facilities.

The Access Board has consulted with State and local governments throughout the rulemaking process. The National Recreation and Park Association, States Organization for Boating Access, New Jersey Department of Community Affairs, San Francisco Department of Public Works, and the Hawaii Disability and Communication Access Board represented the interests of State and local governments on the Recreation Access Advisory Committee. State and local governments participated in the public hearings and information meetings held on the NPRM and the draft final rule, and submitted more than 70 comments. Most of the comments were centered on boating facilities. The California Department of Boating and Waterways, Oregon State Marine Board, and Michigan Department of Natural Resources were actively involved in providing information and alternative proposals for consideration during the rulemaking. Approximately 30 other State and local governments joined in supporting the various proposals submitted by those States.

Unfunded Mandates Reform Act

The Unfunded Mandates Reform Act does not apply to proposed or final rules that enforce constitutional rights of individuals or enforce any statutory rights that prohibit discrimination on the basis of race, color, sex, national origin, age, handicap, or disability. Since the final rule is issued under the authority of the Americans with Disabilities Act, an assessment of the rule's effects on State, local, and tribal governments, and the private sector is not required by the Unfunded Mandates Reform Act.

List of Subjects in 36 CFR Part 1191

Buildings and facilities, Civil rights, Incorporation by reference, Individuals with disabilities, Transportation.

Thurman M. Davis, Sr.,

Chair, Architectural and Transportation Barriers Compliance Board.

For the reasons stated in the preamble, part 1191 of title 36 of the Code of Federal Regulations is amended as follows:

PART 1191—AMERICANS WITH DISABILITIES ACT (ADA) ACCESSIBILITY GUIDELINES FOR BUILDINGS AND FACILITIES

1. The authority citation for 36 CFR Part 1191 continues to read as follows:

Authority: 42 U.S.C. 12204.

2. Appendix A to Part 1191 is amended as follows:

a. By revising the title page and pages i, ii, 1A, 2, 3, 4, 4A, 5 through 11, 58A, and 76 through 81 as set forth below.

b. By removing the blank page following the title page.

c. By adding pages 4B, 11A, 58B, and 82 through 96 as set forth below.

d. In the appendix to Appendix A by revising pages A1, A1A, A16, and A22 through A25 and adding pages A1B, A16A, and A26 through A32 as set forth below.

The additions and revisions read as follows:

Appendix A to Part 1191—Americans With Disabilities Act (ADA) Accessibility Guidelines for Buildings and Facilities

BILLING CODE 8150–01–P

Americans with Disabilities Act (ADA)

Accessibility Guidelines for Buildings and Facilities

U.S. Architectural and Transportation Barriers Compliance Board (Access Board)
1331 F Street, N.W., Suite 1000
Washington, D.C. 20004-1111
(202) 272-0080
(202) 272-0082 TTY
(202) 272-0081 FAX

ADA ACCESSIBILITY GUIDELINES FOR BUILDINGS AND FACILITIES TABLE OF CONTENTS

2.3 Incorporation by Reference.

2.3.1 General. The publications listed in 2.3.2 are incorporated by reference in this document. The Director of the Federal Register has approved these materials for incorporation by reference in accordance with 5 U.S.C. 552(a) and 1 CFR part 51. Copies of the referenced publications may be inspected at the Architectural and Transportation Barriers Compliance Board, 1331 F Street, NW., Suite 1000, Washington, DC; at the Department of Justice, Civil Rights Division, Disability Rights Section,1425 New York Avenue, NW., Washington, DC; or at the Office of the Federal Register, 800 North Capitol Street, NW., Suite 700, Washington, DC.

2.3.2 Referenced Publications. The specific edition of the publications listed below are referenced in this document. Where differences occur between this document and the referenced publications, this document applies.

2.3.2.1 American Society for Testing and Materials (ASTM) Standards. Copies of the referenced publications may be obtained from the American Society for Testing and Materials, 100 Bar Harbor Drive, West Conshohocken, Pennsylvania 19428 (http://www.astm.org).

ASTM F 1292-99 Standard Specification for Impact Attenuation of Surface Systems Under and Around Playground Equipment (see 15.6.7.2 Ground Surfaces, Use Zones).

ASTM F 1487-98 Standard Consumer Safety Performance Specification for Playground Equipment for Public Use (see 3.5 Definitions, Use Zone).

ASTM F 1951-99 Standard Specification for Determination of Accessibility of Surface Systems Under and Around Playground Equipment (see 15.6.7.1 Ground Surfaces, Accessibility).

2.3.2.2 International Code Council (ICC) Codes. Copies of the referenced publications may be obtained from the International Code Council, 5203 Leesburg Pike, Suite 600, Falls Church, VA 22041-3401 (http://www.intlcode.org).

International Building Code 2000 (see 15.3.3.2 Height).

3. MISCELLANEOUS INSTRUCTIONS AND DEFINITIONS.

3.1 Graphic Conventions. Graphic conventions are shown in Table 1. Dimensions that are not marked minimum or maximum are absolute, unless otherwise indicated in the text or captions.

3.2 Dimensional Tolerances. All dimensions are subject to conventional building industry tolerances for field conditions.

3.3 Notes. The text of these guidelines does not contain notes or footnotes. Additional information, explanations, and advisory materials are located in the Appendix.

3.4 General Terminology.

comply with. Meet one or more specifications of *these guidelines*.

if, if ... then. Denotes a specification that applies only when the conditions described are present.

may. Denotes an option or alternitive.

shall. Denotes a mandatory specification or requirement.

should. Denotes an advisory specification or recommendation.

3.5 Definitions.

Access Aisle. An accessible pedestrian space between elements, such as parking spaces, seating, and desks, that provides clearances appropriate for use of the elements.

Accessible. Describes a site, building, facility, or portion thereof that complies with *these guidelines.*

Accessible Element. An *element* specified by *these guidelines* (for example, telephone, controls, and the like).

Accessible Route. A continuous unobstructed path connecting all accessible elements and spaces of a building or facility. Interior accessible routes may include corridors, floors, ramps, elevators, lifts, and clear floor space at fixtures. Exterior accessible routes may include parking access aisles, curb ramps, *crosswalks at vehicular ways*, walks, ramps, and lifts.

Accessible Space. Space that complies with *these guidelines.*

Adaptability. The ability of certain building spaces and elements, such as kitchen counters, sinks, and grab bars, to be added or altered so as to accommodate the needs of *individuals with or without disabilities* or to accommodate the needs of persons with different types or degrees of disability.

Addition. *An expansion, extension, or increase in the gross floor area of a building or facility.*

Administrative Authority. A governmental agency that adopts or enforces regulations and *guidelines* for the design, construction, or *alteration* of buildings and facilities.

Alteration. *An alteration is a change to a building or facility that affects or could affect the usability of the building or facility or part thereof. Alterations include, but are not limited to, remodeling, renovation, rehabilitation, reconstruction, historic restoration, resurfacing of circulation paths or vehicular ways, changes or rearrangement of the structural parts or elements, and changes or rearrangement in the plan configuration of walls and full-height partitions. Normal maintenance, reroofing, painting or wallpapering, or changes to mechanical and electrical systems are not alterations unless they affect the usability of the building or facility.*

Amusement Attraction. *Any facility, or portion of a facility, located within an amusement park or theme park which provides amusement without*

the use of an amusement device. Examples include, but are not limited to, fun houses, barrels, and other attractions without seats.

Amusement Ride. *A system that moves persons through a fixed course within a defined area for the purpose of amusement.*

Amusement Ride Seat. *A seat that is built-in or mechanically fastened to an amusement ride intended to be occupied by one or more passengers.*

Area of Rescue Assistance. *An area, which has direct access to an exit, where people who are unable to use stairs may remain temporarily in safety to await further instructions or assistance during emergency evacuation.*

Area of Sport Activity. *That portion of a room or space where the play or practice of a sport occurs.*

Assembly Area. A room or space accommodating a *group of* individuals for recreational, educational, political, social, civic, or amusement purposes, or for the consumption of food and drink.

Automatic Door. A door equipped with a power-operated mechanism and controls that open and close the door automatically upon receipt of a momentary actuating signal. The switch that begins the automatic cycle may be a photoelectric device, floor mat, or manual switch (see power-assisted door).

Boarding Pier. *A portion of a pier where a boat is temporarily secured for the purpose of embarking or disembarking.*

Boat Launch Ramp. *A sloped surface designed for launching and retrieving trailered boats and other water craft to and from a body of water.*

Boat Slip. *That portion of a pier, main pier, finger pier, or float where a boat is moored for the purpose of berthing, embarking, or disembarking.*

Building. Any structure used and intended for supporting or sheltering any use or occupancy.

Catch Pool. *A pool or designated section of a pool used as a terminus for water slide flumes.*

Circulation Path. An exterior or interior way of passage from one place to another for pedestrians, including, but not limited to, walks, hallways, courtyards, stairways, and stair landings.

Clear. Unobstructed.

Clear Floor Space. *The minimum unobstructed floor or ground space required to accommodate a single, stationary wheelchair and occupant.*

Closed Circuit Telephone. *A telephone with dedicated line(s) such as a house phone, courtesy phone or phone that must be used to gain entrance to a facility.*

Common Use. Refers to those interior and exterior rooms, spaces, or elements that are made available for the use of a restricted group of people (for example, occupants of a homeless shelter, the occupants of an office building, or the guests of such occupants).

Cross Slope. The slope that is perpendicular to the direction of travel (see running slope).

Curb Ramp. A short ramp cutting through a curb or built up to it.

Detectable Warning. *A standardized surface feature built in or applied to walking surfaces or other elements to warn visually impaired people of hazards on a circulation path.*

Egress, Means of. *A continous and unobstructed way of exit travel from any point in a building or facility to a public way. A means of egress comprises vertical and horizontal travel and may include intervening room spaces, doorways, hallways, corridors, passageways, balconies, ramps, stairs, enclosures, lobbies, horizontal exits, courts and yards. An accessible means of egress is one that complies with these guidelines and does not include stairs, steps, or escalators. Areas of rescue assistance or evacuation elevators*

may be included as part of accessible means of egress.

Element. *An architectural or mechanical component of a building, facility, space, or site, e.g., telephone, curb ramp, door, drinking fountain, seating, or water closet.*

Elevated Play Component. *A play component that is approached above or below grade and that is part of a composite play structure consisting of two or more play components attached or functionally linked to create an integrated unit providing more than one play activity.*

Entrance. *Any access point to a building or portion of a building or facility used for the purpose of entering. An entrance includes the approach walk, the vertical access leading to the entrance platform, the entrance platform itself, vestibules if provided, the entry door(s) or gate(s) and the hardware of the entry door(s) or gate(s).*

Facility. *All or any portion of buildings, structures, site improvements, complexes, equipment, roads, walks, passageways, parking lots, or other real or personal property located on a site.*

Gangway. *A variable-sloped pedestrian walkway that links a fixed structure or land with a floating structure. Gangways which connect to vessels are not included.*

Golf Car Passage. *A continuous passage on which a motorized golf car can operate.*

Ground Floor. *Any occupiable floor less than one story above or below grade with direct access to grade. A building or facility always has at least one ground floor and may have more than one ground floor as where a split level entrance has been provided or where a building is built into a hillside.*

Ground Level Play Component. *A play component that is approached and exited at the ground level.*

Mezzanine or Mezzanine Floor. *That portion of a story which is an intermediate floor level placed within the story and having occupiable space above and below its floor.*

Marked Crossing. A crosswalk or other identified path intended for pedestrian use in crossing a vehicular way.

Multifamily Dwelling. Any building containing more than two dwelling units.

Occupiable. *A room or enclosed space designed for human occupancy in which individuals congregate for amusement, educational or similar purposes, or in which occupants are engaged at labor, and which is equipped with means of egress, light, and ventilation.*

Operable Part. A part of a piece of equipment or appliance used to insert or withdraw objects, or to activate, deactivate, or adjust the equipment or appliance (for example, coin slot, push button, handle).

Path of Travel. (Reserved).

Play Area. *A portion of a site containing play components designed and constructed for children.*

Play Component. *An element intended to generate specific opportunities for play, socialization, or learning. Play components may be manufactured or natural, and may be stand alone or part of a composite play structure.*

Power-assisted Door. A door used *for human passage* with a mechanism that helps to open the door, or relieves the opening resistance of a door, upon the activation of a switch or a continued force applied to the door itself.

Private Facility. *A place of public accommodation or a commercial facility subject to title III of the ADA and 28 CFR part 36 or a transportation facility subject to title III of the ADA and 49 CFR 37.45.*

Public Facility. *A facility or portion of a facility constructed by, on behalf of, or for the use of a public entity subject to title II of the ADA and 28 CFR part 35 or to title II of the ADA and 49 CFR 37.41 or 37.43.*

Public Use. Describes interior or exterior rooms or spaces that are made available to the general public. Public use may be provided at a building or facility that is privately or publicly owned.

Ramp. A walking surface which has a running slope greater than 1:20.

Running Slope. The slope that is parallel to the direction of travel (see cross slope).

Service Entrance. An entrance intended primarily for delivery of goods or services.

Signage. *Displayed* verbal, symbolic, *tactile,* and pictorial information.

Site. A parcel of land bounded by a property line or a designated portion of a public right-of-way.

Site Improvement. Landscaping, paving for pedestrian and vehicular ways, outdoor lighting, recreational facilities, and the like, added to a site.

Sleeping Accommodations. Rooms in which people sleep; for example, dormitory and hotel or motel guest rooms or suites.

Soft Contained Play Structure. *A play structure made up of one or more components where the user enters a fully enclosed play environment that utilizes pliable materials (e.g., plastic, netting, fabric).*

Space. *A definable area, e.g., room, toilet room, hall, assembly area, entrance, storage room, alcove, courtyard, or lobby.*

Story. *That portion of a building included between the upper surface of a floor and upper surface of the floor or roof next above. If such portion of a building does not include occupiable space, it is not considered a story for purposes of these guidelines. There may be more than one floor level within a story as in the case of a mezzanine or mezzanines.*

Structural Frame. The structural frame shall be considered to be the columns and the girders, beams, trusses and spandrels having direct connections to the columns and all other members which are essential to the stability of the building as a whole.

TDD. *(Telecommunication Devices for the Deaf). See text telephone.*

TTY (Tele-Typewriter). *See text telephone.*

Tactile. Describes an object that can be perceived using the sense of touch.

Technically Infeasible. *See 4.1.6(1)(j) EXCEPTION.*

Teeing Ground. *In golf, the starting place for the hole to be played.*

Text Telephone (TTY). *Machinery or equipment that employs interactive text based communications through the transmission of coded signals accross the standard telephone network. Text telephones can include, for example, devices known as TDDs (telecommunication display devices or telecommunication devices for deaf persons) or computers with special modems. Text telephones are also called TTYs, an abbreviation for tele-typewriter.*

Transient Lodging.* *A building, facility, or portion thereof, excluding inpatient medical care facilities and residential facilities, that contains sleeping accommodations. Transient lodging may include, but is not limited to, resorts, group homes, hotels, motels, and dormitories.*

Transfer Device. *Equipment designed to facilitate the transfer of a person from a wheelchair or other mobility device to and from an amusement ride seat.*

Transition Plate. *A sloping pedestrian walking surface located at the end(s) of a gangway.*

Use Zone. *The ground level area beneath and immediately adjacent to a play structure or equipment that is designated by ASTM F 1487 Standard Consumer Safety Performance Specification for Playground Equipment for Public Use (incorporated by reference, see 2.3.2) for unrestricted circulation around the equipment and on whose surface it is predicted that a user would land when falling from or exiting the equipment.* **Vehicular Way**. A route intended for vehicular traffic, such as a street, driveway, or parking lot. **Walk**. An exterior pathway with a prepared surface intended for pedestrian use, including general pedestrian areas such as plazas and courts.	

Note: Sections 4.1.1 through 4.1.7 are different from ANSI A117.1 in their entirety and are printed in standard type (ANSI A117.1 does not include scoping provisions).

4. ACCESSIBLE ELEMENTS AND SPACES: SCOPE AND TECHNICAL REQUIREMENTS.

4.1 Minimum Requirements

4.1.1* Application.

(1) General. All areas of newly designed or newly constructed buildings and facilities and altered portions of existing buildings and facilities shall comply with section 4, unless otherwise provided in this section or as modified in a special application section.

(2) Application Based on Building Use. Special application sections provide additional requirements based on building use. When a building or facility contains more than one use covered by a special application section, each portion shall comply with the requirements for that use.

(3)* Areas Used Only by Employees as Work Areas. Areas that are used only as work areas shall be designed and constructed so that individuals with disabilities can approach, enter, and exit the areas. These guidelines do not require that any areas used only as work areas be constructed to permit maneuvering within the work area or be constructed or equipped (i.e., with racks or shelves) to be accessible.

(4) Temporary Structures. These guidelines cover temporary buildings or facilities as well as permanent facilities. Temporary buildings and facilities are not of permanent construction but are extensively used or are essential for public use for a period of time. Examples of temporary buildings or facilities covered by these guidelines include, but are not limited to: reviewing stands, temporary classrooms, bleacher areas, exhibit areas, temporary banking facilities, temporary health screening services, or temporary safe pedestrian passageways around a construction site. Structures, sites and equipment directly associated with the actual processes of construction, such as scaffolding, bridging, materials hoists, or construction trailers are not included.

(5) General Exceptions.

(a) In new construction, a person or entity is not required to meet fully the requirements of these guidelines where that person or entity can demonstrate that it is structurally impracticable to do so. Full compliance will be considered structurally impracticable only in those rare circumstances when the unique characteristics of terrain prevent the incorporation of accessibility features. If full compliance with the requirements of these guidelines is structurally impracticable, a person or entity shall comply with the requirements to the extent it is not structurally impracticable. Any portion of the building or facility which can be made accessible shall comply to the extent that it is not structurally impracticable.

(b) Accessibility is not required to or in:

(i) raised areas used primarily for purposes of security or life or fire safety, including, but not limited to, observation or lookout galleries, prison guard towers, fire towers, or fixed life guard stands;

(ii) non-occupiable spaces accessed only by ladders, catwalks, crawl spaces, very narrow passageways, tunnels, or freight (non-passenger) elevators, and frequented only by service personnel for maintenance, repair, or occasional monitoring of equipment; such spaces may include, but are not limited to, elevator pits, elevator penthouses, piping or equipment catwalks, water or sewage treatment pump rooms and stations, electric substations and transformer vaults, and highway and tunnel utility facilities;

(iii) single occupant structures accessed only by a passageway that is below grade or that is

elevated above standard curb height, including, but not limited to, toll booths accessed from underground tunnels;

(iv) raised structures used solely for refereeing, judging, or scoring a sport;

(v) water slides;

(vi) animal containment areas that are not for public use; or

(vii) raised boxing or wrestling rings.

4.1.2 Accessible Sites and Exterior Facilities: New Construction. An accessible site shall meet the following minimum requirements:

(1) At least one accessible route complying with 4.3 shall be provided within the boundary of the site from public transportation stops, accessible parking spaces, passenger loading zones if provided, and public streets or sidewalks, to an accessible building entrance.

(2) (a) At least one accessible route complying with 4.3 shall connect accessible buildings, accessible facilities, accessible elements, and accessible spaces that are on the same site.

(b)* Court Sports: An accessible route complying with 4.3 shall directly connect both sides of the court in court sports.

(3) All objects that protrude from surfaces or posts into circulation paths shall comply with 4.4.

EXCEPTION: The requirements of 4.4 shall not apply within an area of sport activity.

(4) Ground surfaces along accessible routes and in accessible spaces shall comply with 4.5.

EXCEPTION 1*: The requirements of 4.5 shall not apply within an area of sport activity.

EXCEPTION 2*: Animal containment areas designed and constructed for public use shall not be required to provide stable, firm, and slip resistant ground and floor surfaces and shall not be required to comply with 4.5.2.

(5) (a) If parking spaces are provided for self-parking by employees or visitors, or both, then accessible spaces complying with 4.6 shall be provided in each such parking area in conformance with the table below. Spaces required by the table need not be provided in the particular lot. They may be provided in a different location if equivalent or greater accessibility, in terms of distance from an accessible entrance, cost and convenience is ensured.

TOTAL PARKING IN LOT	REQUIRED MINIMUM NUMBER OF ACCESSIBLE SPACES
1 to 25	1
26 to 50	2
51 to 75	3
76 to 100	4
101 to 150	5
151 to 200	6
201 to 300	7
301 to 400	8
401 to 500	9
501 to 1000	2 percent of total
1001 and over	20 plus 1 for each 100 over 1000

Except as provided in (b), access aisles adjacent to accessible spaces shall be 60 in (1525 mm) wide minimum.

(b) One in every eight accessible spaces, but not less than one, shall be served by an access aisle 96 in (2440 mm) wide minimum and shall be designated "van accessible" as required by 4.6.4. The vertical clearance at such spaces shall comply with 4.6.5. All such spaces may be grouped on one level of a parking structure.

EXCEPTION: Provision of all required parking spaces in conformance with "Universal Parking Design" (see appendix A4.6.3) is permitted.

(c) If passenger loading zones are provided, then at least one passenger loading zone shall comply with 4.6.6.

(d) At facilities providing medical care and other services for persons with mobility

impairments, parking spaces complying with 4.6 shall be provided in accordance with 4.1.2(5)(a) except as follows:

(i) Outpatient units and facilities: 10 percent of the total number of parking spaces provided serving each such outpatient unit or facility;

(ii) Units and facilities that specialize in treatment or services for persons with mobility impairments: 20 percent of the total number of parking spaces provided serving each such unit or facility.

(e)* Valet parking: Valet parking facilities shall provide a passenger loading zone complying with 4.6.6 located on an accessible route to the entrance of the facility. Paragraphs 5(a), 5(b), and 5(d) of this section do not apply to valet parking facilities.

(6) If toilet facilities are provided on a site, then each such public or common use toilet facility shall comply with 4.22. If bathing facilities are provided on a site, then each such public or common use bathing facility shall comply with 4.23.

For single user portable toilet or bathing units clustered at a single location, at least five percent but no less than one toilet unit or bathing unit complying with 4.22 or 4.23 shall be installed at each cluster whenever typical inaccessible units are provided. Accessible units shall be identified by the International Symbol of Accessibility.

EXCEPTION: Portable toilet units at construction sites used exclusively by construction personnel are not required to comply with 4.1.2(6).

(7) Building Signage. Signs which designate permanent rooms and spaces shall comply with 4.30.1, 4.30.4, 4.30.5 and 4.30.6. Other signs which provide direction to, or information about, functional spaces of the building shall comply with 4.30.1, 4.30.2, 4.30.3, and 4.30.5. Elements and spaces of accessible facilities which shall be identified by the International Symbol of Accessibility and which shall comply with 4.30.7 are:

(a) Parking spaces designated as reserved for individuals with disabilities;

(b) Accessible passenger loading zones;

(c) Accessible entrances when not all are accessible (inaccessible entrances shall have directional signage to indicate the route to the nearest accessible entrance);

(d) Accessible toilet and bathing facilities when not all are accessible.

4.1.3 Accessible Buildings: New Construction. Accessible buildings and facilities shall meet the following minimum requirements:

(1) (a) At least one accessible route complying with 4.3 shall connect accessible building or facility entrances with all accessible spaces and elements within the building or facility.

(b)* Court Sports: An accessible route complying with 4.3 shall directly connect both sides of the court in court sports.

(2) All objects that overhang or protrude into circulation paths shall comply with 4.4.

EXCEPTION: The requirements of 4.4 shall not apply within an area of sport activity.

(3) Ground and floor surfaces along accessible routes and in accessible rooms and spaces shall comply with 4.5.

EXCEPTION 1*: The requirements of 4.5 shall not apply within an area of sport activity.

EXCEPTION 2*: Animal containment areas designed and constructed for public use shall not be required to provide stable, firm, and slip resistant ground and floor surfaces and shall not be required to comply with 4.5.2.

(4) Interior and exterior stairs connecting levels that are not connected by an elevator, ramp, or

other accessible means of vertical access shall comply with 4.9.

(5)* One passenger elevator complying with 4.10 shall serve each level, including mezzanines, in all multi-story buildings and facilities unless exempted below. If more than one elevator is provided, each passenger elevator shall comply with 4.10.

EXCEPTION 1: Elevators are not required in:

(a) private facilities that are less than three stories or that have less than 3000 square feet per story unless the building is a shopping center, a shopping mall, or the professional office of a health care provider, or another type of facility as determined by the Attorney General; or

(b) public facilities that are less than three stories and that are not open to the general public if the story above or below the accessible ground floor houses no more than five persons and is less than 500 square feet. Examples may include, but are not limited to, drawbridge towers and boat traffic towers, lock and dam control stations, and train dispatching towers.

The elevator exemptions set forth in paragraphs (a) and (b) do not obviate or limit in any way the obligation to comply with the other accessibility requirements established in section 4.1.3. For example, floors above or below the accessible ground floor must meet the requirements of this section except for elevator service. If toilet or bathing facilities are provided on a level not served by an elevator, then toilet or bathing facilities must be provided on the accessible ground floor. In new construction, if a building or facility is eligible for exemption but a passenger elevator is nonetheless planned, that elevator shall meet the requirements of 4.10 and shall serve each level in the building. A passenger elevator that provides service from a garage to only one level of a building or facility is not required to serve other levels.

EXCEPTION 2: Elevator pits, elevator penthouses, mechanical rooms, piping or equipment catwalks are exempted from this requirement.

EXCEPTION 3: Accessible ramps complying with 4.8 may be used in lieu of an elevator.

EXCEPTION 4: Platform lifts (wheelchair lifts) complying with 4.11 of this guideline and applicable State or local codes may be used in lieu of an elevator only under the following conditions:

(a) To provide an accessible route to a performing area in an assembly occupancy.

(b) To comply with the wheelchair viewing position line-of- sight and dispersion requirements of 4.33.3.

(c) To provide access to incidental occupiable spaces and rooms which are not open to the general public and which house no more than five persons, including but not limited to equipment control rooms and projection booths.

(d) To provide access where existing site constraints or other constraints make use of a ramp or an elevator infeasible.

(e) To provide access to raised judges' benches, clerks' stations, speakers' platforms, jury boxes and witness stands or to depressed areas such as the well of a court.

(f)* To provide access to player seating areas serving an area of sport activity.

EXCEPTION 5: Elevators located in air traffic control towers are not required to serve the cab and the floor immediately below the cab.

(6) Windows: (Reserved).

(7) Doors:

(a) At each accessible entrance to a building or facility, at least one door shall comply with 4.13.

(b) Within a building or facility, at least one door at each accessible space shall comply with 4.13.

(c) Each door that is an element of an accessible route shall comply with 4.13.

(d) Each door required by 4.3.10, Egress, shall comply with 4.13.

(8)* The requirements in (a) and (b) below shall be satisfied independently:

(a)(i) At least 50 percent of all public entrances (excluding those in (b) below) shall comply with 4.14. At least one must be a ground floor entrance. Public entrances are any entrances that are not loading or service entrances.

(ii) Accessible public entrances must be provided in a number at least equivalent to the number of exits required by the applicable building or fire codes. (This paragraph does not require an increase in the total number of public entrances planned for a facility.)

(iii) An accessible public entrance must be provided to each tenancy in a facility (for example, individual stores in a strip shopping center).

(iv) In detention and correctional facilities subject to section 12, public entrances that are secured shall be accessible as required by 12.2.1.

One entrance may be considered as meeting more than one of the requirements in (a). Where feasible, accessible public entrances shall be the entrances used by the majority of people visiting or working in the building.

(b)(i) In addition, if direct access is provided for pedestrians from an enclosed parking garage to the building, at least one direct entrance from the garage to the building must be accessible.

(ii) If access is provided for pedestrians from a pedestrian tunnel or elevated walkway, one entrance to the building from each tunnel or walkway must be accessible.

(iii) In judicial, legislative, and regulatory facilities subject to section 11, restricted and secured entrances shall be accessible in the number required by 11.1.1.

One entrance may be considered as meeting more than one of the requirements in (b).

Because entrances also serve as emergency exits whose proximity to all parts of buildings and facilities is essential, it is preferable that all entrances be accessible.

(c) If the only entrance to a building, or tenancy in a facility, is a service entrance, that entrance shall be accessible.

(d) Entrances which are not accessible shall have directional signage complying with 4.30.1, 4.30.2, 4.30.3, and 4.30.5, which indicates the location of the nearest accessible entrance.

(9)* In buildings or facilities, or portions of buildings or facilities, required to be accessible, accessible means of egress shall be provided in the same number as required for exits by local building/life safety regulations. Where a required exit from an occupiable level above or below a level of accessible exit discharge is not accessible, an area of rescue assistance shall be provided on each such level (in a number equal to that of inaccessible required exits). Areas of rescue assistance shall comply with 4.3.11. A horizontal exit, meeting the requirements of local building/ life safety regulations, shall satisfy the requirement for an area of rescue assistance.

EXCEPTION: Areas of rescue assistance are not required in buildings or facilities having a supervised automatic sprinkler system.

(10)* Drinking Fountains:

(a) Where only one drinking fountain is provided on a floor there shall be a drinking fountain which is accessible to individuals who use wheelchairs in accordance with 4.15 and one accessible to those who have difficulty bending or stooping. (This can be accommodated by the use of a "hi-lo" fountain; by providing one fountain accessible to those who use wheelchairs and one fountain at a standard height convenient for those who have difficulty bending; by providing a fountain accessible under 4.15 and a water cooler; or by such other means as would achieve the required accessibility for each group on each floor.)

(b) Where more than one drinking fountain or water cooler is provided on a floor, 50% of those provided shall comply with 4.15 and shall be on an accessible route.

(11) Toilet Facilities: If toilet rooms are provided, then each public and common use toilet room shall comply with 4.22. Other toilet rooms provided for the use of occupants of specific spaces (i.e., a private toilet room for the occupant of a private office) shall be adaptable. If bathing rooms are provided, then each public and common use bathroom shall comply with 4.23. Accessible toilet rooms and bathing facilities shall be on an accessible route.

(12) Storage, Shelving and Display Units:

(a) If fixed or built-in storage facilities such as cabinets, shelves, closets, and drawers are provided in accessible spaces, at least one of each type provided shall contain storage space complying with 4.25. Additional storage may be provided outside of the dimensions required by 4.25.

(b) Shelves or display units allowing self-service by customers in mercantile occupancies shall be located on an accessible route complying with 4.3. Requirements for accessible reach range do not apply.

(c)* Where lockers are provided in accessible spaces, at least 5 percent, but not less than one, of each type of locker shall comply with 4.25.

(13) Controls and operating mechanisms in accessible spaces, along accessible routes, or as parts of accessible elements (for example, light switches and dispenser controls) shall comply with 4.27.

EXCEPTION: The requirements of 4.27 shall not apply to exercise machines.

(14) If emergency warning systems are provided, then they shall include both audible alarms and visual alarms complying with 4.28. Sleeping accommodations required to comply with 9.3 shall have an alarm system complying with 4.28. Emergency warning systems in medical care facilities may be modified to suit standard health care alarm design practice.

(15) Detectable warnings shall be provided at locations as specified in 4.29.

(16) Building Signage:

(a) Signs which designate permanent rooms and spaces shall comply with 4.30.1, 4.30.4, 4.30.5 and 4.30.6.

(b) Other signs which provide direction to or information about functional spaces of the building shall comply with 4.30.1, 4.30.2, 4.30.3, and 4.30.5.

EXCEPTION: Building directories, menus, and all other signs which are temporary are not required to comply.

(17) Public Telephones:

(a) If public pay telephones, public closed circuit telephones, or other public telephones are provided, then they shall comply with 4.31.2 through 4.31.8 to the extent required by the following table:

Number of each type of telephone provided on each floor	**Number of telephones required to comply with 4.31.2 through 4.31.8[1]**
1 or more single unit	1 per floor
1 bank[2]	1 per floor
2 or more banks[2]	1 per bank. Accessible unit may be installed as a single unit in proximity (either visible or with signage) to the bank. At least one public telephone per floor shall meet the requirements for a forward reach telephone[3]

[1] Additional public telephones may be installed at any height. Unless otherwise specified, accessible

telephones may be either forward or side reach telephones.

[2] A bank consists of two or more adjacent public telephones, often installed as a unit.

[3] EXCEPTION: For exterior installations only, if dial tone first service is available, then a side reach telephone may be installed instead of the required forward reach telephone.

(b)* All telephones required to be accessible and complying with 4.31.2 through 4.31.8 shall be equipped with a volume control. In addition, 25 percent, but never less than one, of all other public telephones provided shall be equipped with a volume control and shall be dispersed among all types of public telephones, including closed circuit telephones, throughout the building or facility. Signage complying with applicable provisions of 4.30.7 shall be provided.

(c) The following shall be provided in accordance with 4.31.9:

(i) If four or more public pay telephones (including both interior and exterior telephones) are provided at a site of a private facility, and at least one is in an interior location, then at least one interior public text telephone (TTY) shall be provided. If an interior public pay telephone is provided in a public use area in a building of a public facility, at least one interior public text telephone (TTY) shall be provided in the building in a public use area.

(ii) If an interior public pay telephone is provided in a private facility that is a stadium or arena, a convention center, a hotel with a convention center, or a covered mall, at least one interior public text telephone (TTY) shall be provided in the facility. In stadiums, arenas and convention centers which are public facilities, at least one public text telephone (TTY) shall be provided on each floor level having at least one interior public pay telephone.

(iii) If a public pay telephone is located in or adjacent to a hospital emergency room, hospital recovery room, or hospital waiting room, one public text telephone (TTY) shall be provided at each such location.

(iv) If an interior public pay telephone is provided in the secured area of a detention or correctional facility subject to section 12, then at least one public text telephone (TTY) shall also be provided in at least one secured area. Secured areas are those areas used only by detainees or inmates and security personnel.

(d) Where a bank of telephones in the interior of a building consists of three or more public pay telephones, at least one public pay telephone in each such bank shall be equipped with a shelf and outlet in compliance with 4.31.9(2).

EXCEPTION: This requirement does not apply to the secured areas of detention or correctional facilities where shelves and outlets are prohibited for purposes of security or safety.

(18) If fixed or built-in seating or tables (including, but not limited to, study carrels and student laboratory stations), are provided in accessible public or common use areas, at least five percent (5%), but not less than one, of the fixed or built-in seating areas or tables shall comply with 4.32. An accessible route shall lead to and through such fixed or built-in seating areas, or tables.

(19)* Assembly Areas:

(a) In places of assembly with fixed seating accessible wheelchair locations shall comply with 4.33.2, 4.33.3, and 4.33.4 and shall be provided consistent with the following table:

Capacity of Seating in Assembly Areas	Number of Required Wheelchair Locations
4 to 25	1
26 to 50	2
51 to 300	4
301 to 500	6
over 500	6 plus 1 additional space for each total seating capacity increase of 100

In addition, one percent, but not less than one, of all fixed seats shall be aisle seats with no armrests on the aisle side, or removable or folding armrests on the aisle side. Each such seat shall be identified by a sign or marker. Signage notifying patrons of the availability of such seats shall be posted at the ticket office. Aisle seats are not required to comply with 4.33.4.

(b) This paragraph applies to assembly areas where audible communications are integral to the use of the space (e.g., concert and lecture halls, playhouses and movie theaters, meeting rooms, etc.). Such assembly areas, if (1) they accommodate at least 50 persons, or if they have audio-amplification systems, and (2) they have fixed seating, shall have a permanently installed assistive listening system complying with 4.33. For other assembly areas, a permanently installed assistive listening system, or an adequate number of electrical outlets or other supplementary wiring necessary to support a portable assistive listening system shall be provided. The minimum number of receivers to be provided shall be equal to 4 percent of the total number of seats, but in no case less than two. Signage complying with applicable provisions of 4.30 shall be installed to notify patrons of the availability of a listening system.

(c) Where a team or player seating area contains fixed seats and serves an area of sport activity, the seating area shall contain the number of wheelchair spaces required by 4.1.3(19)(a), but not less than one wheelchair space. Wheelchair spaces shall comply with 4.33.2, 4.33.3, 4.33.4, and 4.33.5.

EXCEPTION 1: Wheelchair spaces in team or player seating areas shall not be required to provide a choice of admission price or lines of sight comparable to those for members of the general public.

EXCEPTION 2: This provision shall not apply to team or player seating areas serving bowling lanes not required to be accessible by 15.7.2.

(20) Where automated teller machines (ATMs) are provided, each ATM shall comply with the requirements of 4.34 except where two or more are provided at a location, then only one must comply.

EXCEPTION: Drive-up-only automated teller machines are not required to comply with 4.27.2, 4.27.3 and 4.34.3.

(21) Where dressing, fitting, or locker rooms are provided, the rooms shall comply with 4.35.

EXCEPTION: Where dressing, fitting, or locker rooms are provided in a cluster, at least 5 percent, but not less than one, of the rooms for each type of use in each cluster shall comply with 4.35.

(22) Where saunas or steam rooms are provided, the rooms shall comply with 4.36.

EXCEPTION: Where saunas or steam rooms are provided in a cluster, at least 5 percent, but not less than one, of the rooms for each type of use in each cluster shall comply with 4.36.

4.1.4 (Reserved)

4.1.5 Accessible Buildings: Additions. Each addition to an existing building or facility shall be regarded as an alteration. Each space or element added to the existing building or facility shall comply with the applicable provisions of 4.1.1 to 4.1.3, Minimum Requirements (for New Construction) and the applicable technical specifications of section 4 and the special application sections. Each addition that affects or could affect the usability of an area containing a primary function shall comply with 4.1.6(2).

4.34.5 Equipment for Persons with Vision Impairments. *Instructions and all information for use shall be made accessible to and independently usable by persons with vision impairments.*

4.35 Dressing, Fitting, and Locker Rooms.

4.35.1 General. *Dressing, fitting, and locker rooms required to be accessible by 4.1 shall comply with 4.35 and shall be on an accessible route.*

4.35.2 Clear Floor Space. *A clear floor space allowing a person using a wheelchair to make a 180-degree turn shall be provided in every accessible dressing room entered through a swinging or sliding door. No door shall swing into any part of the turning space. Turning space shall not be required in a private dressing room entered through a curtained opening at least 32 in (815 mm) wide if clear floor space complying with section 4.2 renders the dressing room usable by a person using a wheelchair.*

4.35.3 Doors. *All doors to accessible dressing rooms shall be in compliance with section 4.13.*

4.35.4 Bench. *A bench complying with 4.37 shall be provided within the room.*

4.35.5 Mirror. *Where mirrors are provided in dressing rooms of the same use, then in an accessible dressing room, a full-length mirror, measuring at least 18 in wide by 54 in high (460 mm by 1370 mm), shall be mounted in a position affording a view to a person on the bench as well as to a person in a standing position.*

4.36 Saunas and Steam Rooms.

4.36.1 General. *Saunas and steam rooms required to be accessible by 4.1 shall comply with 4.36.*

4.36.2* Wheelchair Turning Space. *A wheelchair turning space complying with 4.2.3 shall be provided within the room.*

EXCEPTION: Wheelchair turning space shall be permitted to be obstructed by readily removable seats.

4.36.3 Sauna and Steam Room Bench. *Where seating is provided, at least one bench shall be provided and shall comply with 4.37.*

4.36.4 Door Swing. *Doors shall not swing into any part of the clear floor or ground space required at a bench complying with 4.37.*

4.37 Benches.

4.37.1 General. *Benches required to be accessible by 4.1 shall comply with 4.37.*

4.37.2 Clear Floor or Ground Space. *Clear floor or ground space complying with 4.2.4 shall be provided and shall be positioned for parallel approach to a short end of a bench seat.*

EXCEPTION: Clear floor or ground space required by 4.37.2 shall be permitted to be obstructed by readily removable seats in saunas and steam rooms.

4.37.3* Size. *Benches shall be fixed and shall have seats that are 20 inches (510 mm) minimum to 24 inches (610 mm) maximum in depth and 42 inches (1065 mm) minimum in length (see Fig. 47).*

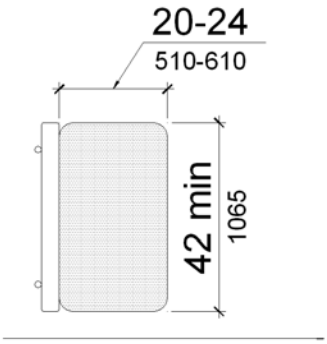


Fig. 47
Size of Bench

4.37 Benches

4.37.4 Back Support. *Benches shall have back support that is 42 inches (1065 mm) minimum in length and that extends from a point 2 inches (51 mm) maximum above the seat to a point 18 inches (455 mm) minimum above the seat (see Fig. 48).*

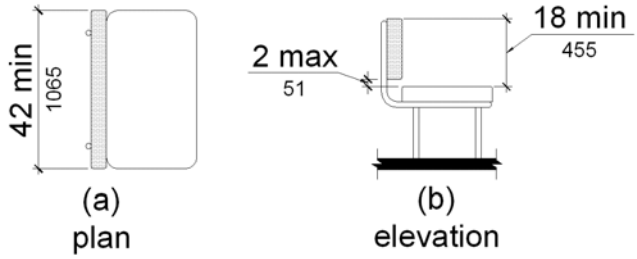


Fig. 48
Bench Back Support

4.37.5 Seat Height. *Bench seats shall be 17 inches (430 mm) minimum to 19 inches (485 mm) maximum above the floor or ground.*

4.37.6 Structural Strength. *Allowable stresses shall not be exceeded for materials used when a vertical or horizontal force of 250 lbs. (1112 N) is applied at any point on the seat, fastener, mounting device, or supporting structure.*

4.37.7 Wet Locations. *The surface of benches installed in wet locations shall be slip-resistant and shall not accumulate water.*

back support (e.g., attachment to wall). The structural strength of the bench attachments shall comply with 4.26.3.

(7) Storage. Fixed or built-in storage facilities, such as cabinets, shelves, closets, and drawers, shall contain storage space complying with 4.25.

(8) Controls. All controls intended for operation by inmates shall comply with 4.27.

(9) Accommodations for persons with hearing impairments required by 12.4.3 and complying with 12.6 shall be provided in accessible cells or rooms.

12.6 Visible Alarms and Telephones. Where audible emergency warning systems are provided to serve the occupants of holding or housing cells or rooms, visual alarms complying with 4.28.4 shall be provided. Where permanently installed telephones are provided within holding or housing cells or rooms, they shall have volume controls complying with 4.31.5.

EXCEPTION: Visual alarms are not required where inmates or detainees are not allowed independent means of egress.

13. RESIDENTIAL HOUSING. (Reserved).

14. PUBLIC RIGHTS-OF-WAY. (Reserved).

15. RECREATION FACILITIES.

Newly designed or newly constructed and altered recreation facilities shall comply with the applicable requirements of section 4 and the special application sections, except as modified or otherwise provided in this section.

15.1* Amusement Rides.

15.1.1 General. Newly designed or newly constructed and altered amusement rides shall comply with 15.1.

EXCEPTION 1*: Mobile or portable amusement rides shall not be required to comply with 15.1.

EXCEPTION 2*: Amusement rides which are controlled or operated by the rider shall be required to comply only with 15.1.4 and 15.1.5.

EXCEPTION 3*: Amusement rides designed primarily for children, where children are assisted on and off the ride by an adult, shall be required to comply only with 15.1.4 and 15.1.5.

EXCEPTION 4: Amusement rides without amusement ride seats shall be required to comply only with 15.1.4 and 15.1.5.

15.1.2* Alterations to Amusement Rides. A modification to an existing amusement ride is an alteration subject to 15.1 if one or more of the following conditions apply:

(1) The amusement ride's structural or operational characteristics are changed to the extent that the ride's performance differs from that specified by the manufacturer or the original design criteria; or

(2) The load and unload area of the amusement ride is newly designed and constructed.

15.1.3 Number Required. Each amusement ride shall provide at least one wheelchair space complying with 15.1.7, or at least one amusement ride seat designed for transfer complying with 15.1.8, or at least one transfer device complying with 15.1.9.

15.1.4* Accessible Route. When in the load and unload position, amusement rides required to comply with 15.1 shall be served by an accessible route complying with 4.3. Any part of an accessible route serving amusement rides with a slope greater than 1:20 shall be considered a ramp and shall comply with 4.8.

EXCEPTION 1: The maximum slope specified in 4.8.2 shall not apply in the load and unload areas or on the amusement ride where compliance is structurally or operationally infeasible, provided that the slope of the ramp shall not exceed 1:8.

EXCEPTION 2: Handrails shall not be required in the load and unload areas or on the amusement ride where compliance is structurally or operationally infeasible.

EXCEPTION 3: Limited-use/limited-application elevators and platform lifts complying with 4.11 shall be permitted to be part of an accessible route serving the load and unload area.

15.1.5 Load and Unload Areas. Load and unload areas serving amusement rides required to comply with 15.1 shall provide a maneuvering space complying with 4.2.3. The maneuvering space shall have a slope not steeper than 1:48.

15.1.6 Signage. Signage shall be provided at the entrance of the queue or waiting line for each amusement ride to identify the type of access provided. Where an accessible unload area also serves as the accessible load area, signage shall be provided at the entrance to the queue or waiting line indicating the location of the accessible load and unload area.

15.1.7 Amusement Rides with Wheelchair Spaces. Amusement rides with wheelchair spaces shall comply with 15.1.7.

15.1.7.1 Floor or Ground Surface. The floor or ground surface of wheelchair spaces shall comply with 15.1.7.1.

15.1.7.1.1 Slope. The floor or ground surface of wheelchair spaces shall have a slope not steeper than 1:48 when in the load and unload position and shall be stable and firm.

15.1.7.1.2* Gaps. Floors of amusement rides with wheelchair spaces and floors of load and unload areas shall be coordinated so that, when the amusement rides are at rest in the load and unload position, the vertical difference between the floors shall be within plus or minus 5/8 inches (16 mm) and the horizontal gap shall be no greater than 3 inches (75 mm) under normal passenger load conditions.

EXCEPTION: Where compliance is not operationally or structurally feasible, ramps, bridge plates, or similar devices complying with the applicable requirements of 36 CFR 1192.83(c) shall be provided.

15.1.7.2 Clearances. Clearances for wheelchair spaces shall comply with 15.1.7.2.

EXCEPTION 1: Where provided, securement devices shall be permitted to overlap required clearances.

EXCEPTION 2: Wheelchair spaces shall be permitted to be mechanically or manually repositioned.

EXCEPTION 3*: Wheelchair spaces shall not be required to comply with 4.4.2.

15.1.7.2.1 Width and Length. Wheelchair spaces shall provide a clear width of 30 inches (760 mm) minimum and a clear length of 48 inches (1220 mm) minimum measured to 9 inches (230 mm) minimum above the floor surface.

15.1.7.2.2* Wheelchair Spaces - Side Entry. Where the wheelchair space can be entered only from the side, the ride shall be designed to permit sufficient maneuvering space for individuals using a wheelchair or mobility device to enter and exit the ride.

15.1.7.2.3 Protrusions in Wheelchair Spaces. Objects are permitted to protrude a distance of 6 inches (150 mm) maximum along the front of the wheelchair space where located 9 inches (230 mm) minimum and 27 inches (685 mm) maximum above the floor or ground surface of the wheelchair space. Objects are permitted to protrude a distance of 25 inches (635 mm) maximum along the front of the wheelchair space, where located more than 27 inches (685 mm) above the floor or ground surface of the wheelchair space (see Fig. 58).

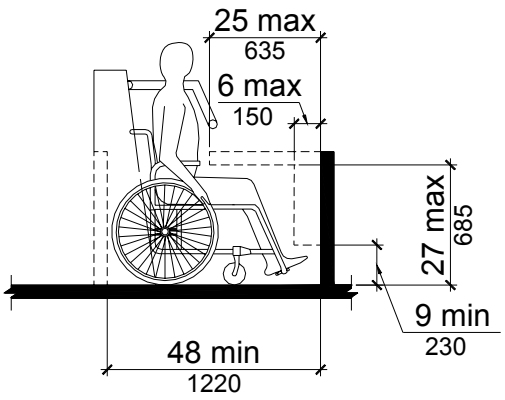


Fig. 58
Protrusions in Wheelchair Spaces

15.1.7.3 Openings. Where openings are provided to access wheelchair spaces on amusement rides, the entry shall provide a 32 inch (815 mm) minimum clear opening.

15.1.7.4 Approach. One side of the wheelchair space shall adjoin an accessible route.

15.1.7.5 Companion Seats. Where the interior width of the amusement ride is greater than 53 inches (1346 mm), seating is provided for more than one rider, and the wheelchair is not required to be centered within the amusement ride, a companion seat shall be provided for each wheelchair space.

15.1.7.5.1 Shoulder-to-Shoulder Seating. Where an amusement ride provides shoulder-to-shoulder seating, companion seats shall be shoulder-to-shoulder with the adjacent wheelchair space.

EXCEPTION: Where shoulder-to-shoulder companion seating is not operationally or structurally feasible, compliance with this provision shall be required to the maximum extent feasible.

15.1.8* Amusement Ride Seats Designed for Transfer. Amusement ride seats designed for transfer shall comply with 15.1.8 when positioned for loading and unloading.

15.1.8.1 Clear Floor or Ground Space. Clear floor or ground space complying with 4.2.4 shall be provided in the load and unload area adjacent to the amusement ride seats designed for transfer.

15.1.8.2 Transfer Height. The height of the amusement ride seats shall be 14 inches (355 mm) minimum to 24 inches (610mm) maximum measured above the load and unload surface.

15.1.8.3 Transfer Entry. Where openings are provided to transfer to amusement ride seats, the space shall be designed to provide clearance for transfer from a wheelchair or mobility device to the amusement ride seat.

15.1.8.4 Wheelchair Storage Space. Wheelchair storage spaces complying with 4.2.4 shall be provided in or adjacent to unload areas for each required amusement ride seat designed for transfer and shall not overlap any required means of egress or accessible route.

15.1.9* Transfer Devices for Use with Amusement Rides. Transfer devices for use with amusement rides shall comply with 15.1.9 when positioned for loading and unloading.

15.1.9.1 Clear Floor or Ground Space. Clear floor or ground space complying with 4.2.4 shall be provided in the load and unload area adjacent to the transfer devices.

15.1.9.2 Transfer Height. The height of the transfer device seats shall be 14 inches (355 mm) minimum to 24 inches (610 mm) maximum measured above the load and unload surface.

15.1.9.3 Wheelchair Storage Space. Wheelchair storage spaces complying with 4.2.4 shall be provided in or adjacent to unload areas for each required transfer device and shall not overlap any required means of egress or accessible route.

15.2 Boating Facilities.

15.2.1 General. Newly designed or newly constructed and altered boating facilities shall comply with 15.2.

15.2.2* Accessible Route. Accessible routes, including gangways that are part of accessible routes, shall comply with 4.3.

EXCEPTION 1: Where an existing gangway or series of gangways is replaced or altered, an increase in the length of the gangway is not required to comply with 15.2.2, unless required by 4.1.6(2).

EXCEPTION 2: The maximum rise specified in 4.8.2 shall not apply to gangways.

EXCEPTION 3: Where the total length of the gangway or series of gangways serving as part of a required accessible route is at least 80 feet (24 m), the maximum slope specified in 4.8.2 shall not apply to the gangways.

EXCEPTION 4: In facilities containing fewer than 25 boat slips and where the total length of the gangways or series of gangways serving as part of a required accessible route is at least 30 feet (9140 mm), the maximum slope specified in 4.8.2 shall not apply to the gangways.

EXCEPTION 5: Where gangways connect to transition plates, landings specified by 4.8.4 shall not be required.

EXCEPTION 6: Where gangways and transition plates connect and are required to have handrails, handrail extensions specified by 4.8.5 shall not be required. Where handrail extensions are provided on gangways or transition plates, such extensions are not required to be parallel with the ground or floor surface.

EXCEPTION 7: The cross slope of gangways, transition plates, and floating piers that are part of an accessible route shall be 1:50 maximum measured in the static position.

EXCEPTION 8: Limited-use/limited-application elevators or platform lifts complying with 4.11 shall be permitted in lieu of gangways complying with 4.3.

15.2.3* Boat Slips: Minimum Number. Where boat slips are provided, boat slips complying with 15.2.5 shall be provided in accordance with Table 15.2.3. Where the number of boat slips is not identified, each 40 feet (12 m) of boat slip edge provided along the perimeter of the pier shall be counted as one boat slip for the purpose of this section.

Table 15.2.3

Total Boat Slips in Facility	Minimum Number of Required Accessible Boat Slips
1 to 25	1
26 to 50	2
51 to 100	3
101 to 150	4
151 to 300	5
301 to 400	6
401 to 500	7
501 to 600	8
601 to 700	9
701 to 800	10
801 to 900	11
901 to 1000	12
1001 and over	12 plus 1 for each 100 or fraction thereof over 1000

15.2.3.1* Dispersion. Accessible boat slips shall be dispersed throughout the various types of slips provided. This provision does not require an increase in the minimum number of boat slips required to be accessible.

15.2.4* Boarding Piers at Boat Launch Ramps. Where boarding piers are provided at boat launch ramps, at least 5 percent, but not less than one of the boarding piers shall comply with 15.2.4 and shall be served by an accessible route complying with 4.3.

EXCEPTION 1: Accessible routes serving floating boarding piers shall be permitted to use exceptions 1, 2, 5, 6, 7, and 8 in 15.2.2.

EXCEPTION 2: Where the total length of the gangway or series of gangways serving as part of a required accessible route is at least 30 feet (9140 mm), the maximum slope specified by 4.8.2 shall not apply to the gangways.

EXCEPTION 3: Where the accessible route serving a floating boarding pier or skid pier is located within a boat launch ramp, the portion of the accessible route located within the boat launch ramp shall not be required to comply with 4.8.

15.2.4.1* Boarding Pier Clearances. The entire length of the piers shall comply with 15.2.5.

15.2.5* Accessible Boat Slips. Accessible boat slips shall comply with 15.2.5.

15.2.5.1 Clearances. Accessible boat slips shall be served by clear pier space 60 inches (1525 mm) wide minimum and at least as long as the accessible boat slips. Every 10 feet (3050 mm) maximum of linear pier edge serving the accessible boat slips shall contain at least one continuous clear opening 60 inches (1525 mm) minimum in width (see Fig. 59).

EXCEPTION 1: The width of the clear pier space shall be permitted to be 36 inches (915 mm) minimum for a length of 24 inches (610 mm) maximum, provided that multiple 36 inch (915 mm) wide segments are separated by segments that are 60 inches (1525 mm) minimum clear in width and 60 inches (1525 mm) minimum clear in length (see Fig. 60).

EXCEPTION 2: Edge protection 4 inches (100 mm) high maximum and 2 inches (51 mm) deep maximum shall be permitted at the continuous clear openings (see Fig. 61).

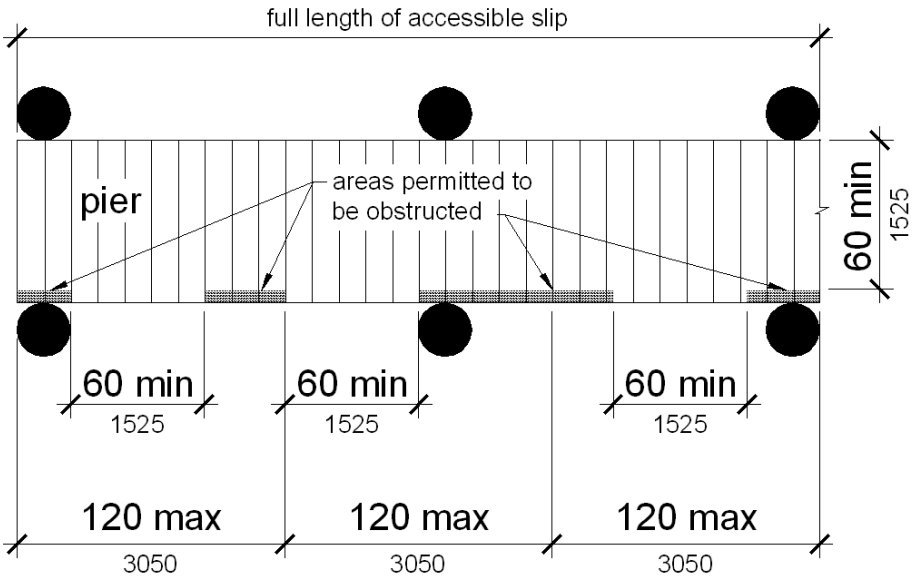


Fig. 59
Pier Clearances

EXCEPTION 3*: In alterations to existing facilities, clear pier space shall be permitted to be located perpendicular to the boat slip and shall extend the width of the boat slip, where the facility has at least one boat slip complying with 15.2.5, and further compliance with 15.2.5 would result in a reduction in the number of boat slips available or result in a reduction of the widths of existing slips.

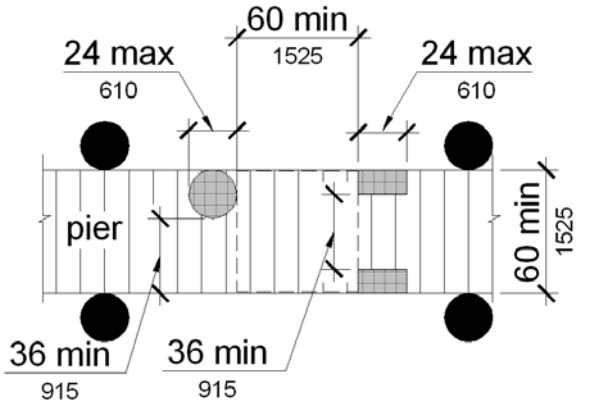


Fig. 60
Pier Clear Space Reduction

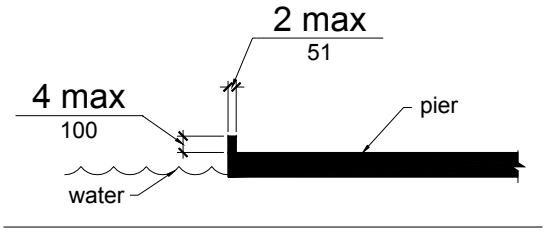


Fig. 61
Edge Protection at Pier

15.2.5.2 Cleats and Other Boat Securement Devices. Cleats and other boat securement devices shall not be required to comply with 4.27.3.

15.3 Fishing Piers and Platforms.

15.3.1 General. Newly designed or newly constructed and altered fishing piers and platforms shall comply with 15.3.

15.3.2 Accessible Route. Accessible routes, including gangways that are part of accessible routes, serving fishing piers and platforms shall comply with 4.3.

EXCEPTION 1: Accessible routes serving floating fishing piers and platforms shall be permitted to use exceptions 1, 2, 5, 6, 7,and 8 in 15.2.2.

EXCEPTION 2*: Where the total length of the gangway or series of gangways serving as part of a required accessible route is at least 30 feet (9140 mm), the maximum slope specified by 4.8.2 shall not apply to the gangways.

15.3.3 Railings. Where railings, guards, or handrails are provided, they shall comply with 15.3.3.

15.3.3.1* Edge Protection. Edge protection shall be provided and shall extend 2 inches (51 mm) minimum above the ground or deck surface.

EXCEPTION: Where the railing, guard, or handrail is 34 inches (865 mm) or less above the ground or deck surface, edge protection shall not be required if the deck surface extends 12 inches (305 mm) minimum beyond the inside face of the railing. Toe clearance shall be 9 inches (230 mm) minimum above the ground or deck surface beyond the railing. Toe clearance shall be 30 inches (760 mm) minimum wide (see Fig. 62).

15.3.3.2 Height. At least 25 percent of the railings, guards, or handrails shall be 34 inches (865 mm) maximum above the ground or deck surface.

EXCEPTION: This provision shall not apply to that portion of a fishing pier or platform where a guard which complies with sections 1003.2.12.1 (Height) and 1003.2.12.2 (Opening limitations) of the International Building Code (incorporated by reference, see 2.3.2) is provided.

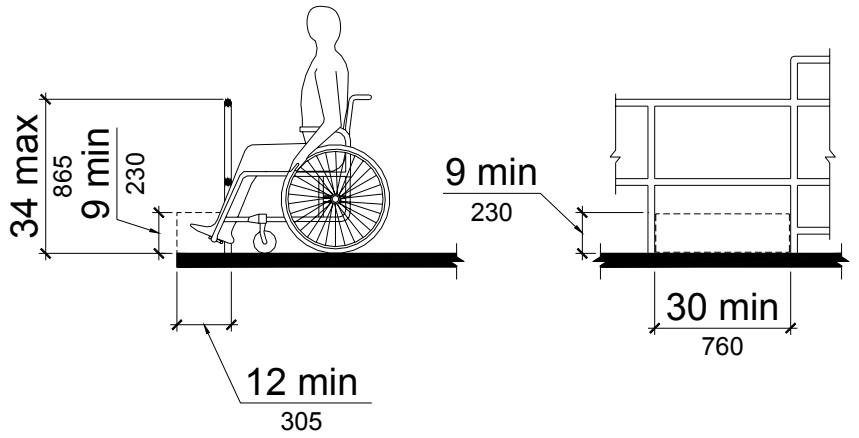


Fig. 62
Edge Protection at Fishing Piers

15.3.3.3* Dispersion. Railings required to comply with 15.3.3.2 shall be dispersed throughout a fishing pier or platform.

15.3.4 Clear Floor or Ground Space. At least one clear floor or ground space complying with 4.2.4 shall be provided where the railing height required by 15.3.3.2 is located. Where no railings are provided, at least one clear floor or ground space complying with 4.2.4 shall be provided.

15.3.5 Maneuvering Space. At least one maneuvering space complying with 4.2.3 shall be provided on the fishing pier or platform.

15.4 Golf.

15.4.1 General. Newly designed or newly constructed and altered golf courses, driving ranges, practice putting greens, and practice teeing grounds shall comply with 15.4.

15.4.2* Accessible Route - Golf Course. An accessible route shall connect accessible elements and spaces within the boundary of the golf course.

In addition, an accessible route shall connect the golf car rental area, bag drop areas, practice putting greens, accessible practice teeing grounds, course toilet rooms, and course weather shelters. The accessible route required by this section shall be 48 inches (1220 mm) minimum wide. Where handrails are provided, the accessible route shall be 60 inches (1525 mm) minimum wide.

EXCEPTION 1: A golf car passage complying with 15.4.7 shall be permitted in lieu of all or part of an accessible route required by 15.4.2.

EXCEPTION 2: The handrail requirements of 4.8.5 shall not apply to an accessible route located within the boundary of a golf course.

15.4.3* Accessible Route - Driving Ranges. An accessible route shall connect accessible teeing stations at driving ranges with accessible parking spaces and shall be 48 inches (1220 mm) wide minimum. Where handrails are provided, the accessible route shall be 60 inches (1525 mm) wide minimum.

EXCEPTION: A golf car passage complying with 15.4.7 shall be permitted in lieu of all or part of an accessible route required by 15.4.3.

15.4.4 Teeing Grounds. Teeing grounds shall comply with 15.4.4.

15.4.4.1 Number Required. Where one or two teeing grounds are provided for a hole, at least one teeing ground serving the hole shall comply with 15.4.4.3. Where three or more teeing grounds are provided for a hole, at least two teeing grounds shall comply with 15.4.4.3.

15.4.4.2 Forward Teeing Ground. The forward teeing ground shall be accessible.

EXCEPTION: In alterations, the forward teeing ground shall not be required to be accessible where compliance is not feasible due to terrain.

15.4.4.3 Teeing Grounds. Teeing grounds required by 15.4.4.1 and 15.4.4.2 shall be designed and constructed so that a golf car can enter and exit the teeing ground.

15.4.5 Teeing Stations at Driving Ranges and Practice Teeing Grounds. Where teeing stations or practice teeing grounds are provided, at least 5 percent of the practice teeing stations or practice teeing grounds, but not less than one, shall comply with 15.4.4.3.

15.4.6 Weather Shelters. Where weather shelters are provided on a golf course, each weather shelter shall have a clear floor or ground space 60 inches (1525 mm) minimum by 96 inches (2440 mm) minimum and shall be designed and constructed so that a golf car can enter and exit.

15.4.7 Golf Car Passage. Where curbs or other constructed barriers are provided along a golf car passage to prohibit golf cars from entering a fairway, openings at least 60 inches (1525 mm) wide shall be provided at intervals not to exceed 75 yds (69 m).

15.4.7.1 Width. The golf car passage shall be 48 inches (1220 mm) minimum wide.

15.4.8 Putting Greens. Each putting green shall be designed and constructed so that a golf car can enter and exit the putting green.

15.5* Miniature Golf.

15.5.1 General. Newly designed or newly constructed and altered miniature golf courses shall comply with 15.5.

15.5.2 Accessible Holes. At least fifty percent of holes on a miniature golf course shall comply with 15.5.3 through 15.5.5 and shall be consecutive.

EXCEPTION: One break in the sequence of consecutive accessible holes shall be permitted, provided that the last hole on a miniature golf course is the last hole in the sequence.

15.5.3* Accessible Route. An accessible route complying with 4.3 shall connect the course entrance with the first accessible hole and the start of play area on each accessible hole. The course shall be configured to allow exit from the last accessible hole to the course exit or entrance and shall not require travel back through other holes.

15.5.3.1 Accessible Route - Located On the Playing Surface. Where the accessible route is located on the playing surface of the accessible hole, exceptions 1-5 shall be permitted.

EXCEPTION 1: Where carpet is provided, the requirements of 4.5.3 shall not apply.

EXCEPTION 2: Where the accessible route intersects the playing surface of a hole, a 1 inch (26 mm) maximum curb shall be permitted for a width of 32 inches (815 mm) minimum.

EXCEPTION 3: A slope of 1:4 maximum for a 4 inch (100 mm) maximum rise shall be permitted.

EXCEPTION 4: Landings required by 4.8.4 shall be permitted to be 48 inches (1220 mm) in length minimum. Landing size required by 4.8.4(3) shall be permitted to be 48 inches (1220 mm) minimum by 60 inches (1525 mm) minimum.

Landing slopes shall be permitted to be 1:20 maximum.

EXCEPTION 5: Handrail requirements of 4.8.5 shall not apply.

15.5.3.2 Accessible Route - Adjacent to the Playing Surface. Where the accessible route is located adjacent to the playing surface, the requirements of 4.3 shall apply.

15.5.4 Start of Play Areas. Start of play areas at holes required to comply with 15.5.2 shall have a slope not steeper than 1:48 and shall be 48 inches (1220 mm) minimum by 60 inches (1525 mm) minimum.

15.5.5* Golf Club Reach Range. All areas within accessible holes where golf balls rest shall be within 36 inches (915 mm) maximum of an accessible route having a maximum slope of 1:20 for 48 inches (1220 mm) in length (see Fig. 63).

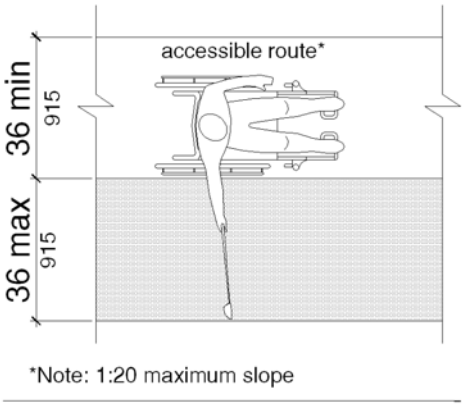


Fig. 63
Golf Club Reach Range

15.6 Play Areas.

15.6.1* General. Newly designed and newly constructed play areas for children ages 2 and over and altered portions of existing play areas shall comply with the applicable provisions of section 4, except as modified or otherwise provided by this section. Where separate play areas are provided within a site for specified age groups, each play area shall comply with this section. Where play areas are designed or constructed in phases, this section shall be applied so that when each successive addition is completed, the entire play area complies with all the applicable provisions of this section.

EXCEPTION 1: Play areas located in family child care facilities where the proprietor actually resides shall not be required to comply with 15.6.

EXCEPTION 2: Where play components are relocated in existing play areas for the purpose of creating safe use zones, 15.6 shall not apply, provided that the ground surface is not changed or extended for more than one use zone.

EXCEPTION 3: Where play components are altered and the ground surface is not altered, the ground surface shall not be required to comply with 15.6.7, unless required by 4.1.6(2).

EXCEPTION 4: The provisions of 15.6.1 through 15.6.7 shall not apply to amusement attractions.

EXCEPTION 5: Compliance with 4.4 shall not be required within the boundary of the play area.

EXCEPTION 6: Stairs shall not be required to comply with 4.9.

15.6.2* Ground Level Play Components. Ground level play components shall be provided in the number and types required by 15.6.2.1 and 15.6.2.2. Ground level play components that are provided to comply with 15.6.2.1 shall be permitted to satisfy the number required by 15.6.2.2, provided that the minimum required types of play components are provided. Where more than one ground level play component required by 15.6.2.1 and 15.6.2.2 is provided, the play components shall be integrated in the play area.

15.6.2.1 General. Where ground level play components are provided, at least one of each type provided shall be located on an accessible route complying with 15.6.4 and shall comply with 15.6.6.

15.6.2.2 Additional Number and Types. Where elevated play components are provided, ground level play components shall be provided in accordance with Table 15.6.2.2. Ground level play components required by 15.6.2.2 shall be located on an accessible route complying with 15.6.4 and shall comply with 15.6.6.

EXCEPTION: If at least 50 percent of the elevated play components are connected by a ramp, and if at least 3 of the elevated play components connected by the ramp are different types of play components, 15.6.2.2 shall not apply.

15.6.3* Elevated Play Components. Where elevated play components are provided, at least 50 percent shall be located on an accessible route complying with 15.6.4. Elevated play components connected by a ramp shall comply with 15.6.6.

15.6.4* Accessible Routes. At least one accessible route complying with 4.3, as modified by 15.6.4, shall be provided.

EXCEPTION 1: Transfer systems complying with 15.6.5 shall be permitted to connect elevated play components, except where 20 or more elevated play components are provided, no more than 25 percent of the elevated play components shall be permitted to be connected by transfer systems.

EXCEPTION 2: Where transfer systems are provided, an elevated play component shall be permitted to connect to another elevated play component in lieu of an accessible route.

EXCEPTION 3: Platform lifts (wheelchair lifts) complying with 4.11 and applicable State or local codes shall be permitted to be used as part of an accessible route.

Table 15.6.2.2 Number and Types of Ground Level Play Components Required to be on Accessible Route

Number of Elevated Play Components Provided	Minimum Number of Ground Level Play Components Required to be on Accessible Route	Minimum Number of Different Types of Ground Level Play Components Required to be on Accessible Route
1	Not applicable	Not applicable
2 to 4	1	1
5 to 7	2	2
8 to 10	3	3
11 to 13	4	3
14 to 16	5	3
17 to 19	6	3
20 to 22	7	4
23 to 25	8	4
More than 25	8 plus 1 for each additional 3 over 25, or fraction thereof	5

15.6.4.1 Location. Accessible routes shall be located within the boundary of the play area and shall connect ground level play components as required by 15.6.2.1 and 15.6.2.2 and elevated play components as required by 15.6.3, including entry and exit points of the play components.

15.6.4.2 Protrusions. Objects shall not protrude into ground level accessible routes at or below 80 in (2030 mm) above the ground or floor surface.

15.6.4.3 Clear Width. The clear width of accessible routes within play areas shall comply with 15.6.4.3.

15.6.4.3.1 Ground Level. The clear width of accessible routes at ground level shall be 60 in (1525 mm) minimum.

EXCEPTION 1: In play areas less than 1,000 square feet, the clear width of accessible routes shall be permitted to be 44 in (1120 mm) minimum, provided that at least one turning space complying with 4.2.3 is provided where the restricted accessible route exceeds 30 feet (9.14 m) in length.

EXCEPTION 2: The clear width of accessible routes shall be permitted to be 36 in (915 mm) minimum for a distance of 60 in (1525 mm) maximum, provided that multiple reduced width segments are separated by segments that are 60 in (1525 mm) minimum in width and 60 in (1525 mm) minimum in length.

15.6.4.3.2 Elevated. The clear width of accessible routes connecting elevated play components shall be 36 in (915 mm).

EXCEPTION 1: The clear width of accessible routes connecting elevated play components shall be permitted to be reduced to 32 in (815 mm) minimum for a distance of 24 in (610 mm) maximum provided that reduced width segments are separated by segments that are 48 in (1220 mm) minimum in length and 36 in (915 mm) minimum in width.

EXCEPTION 2: The clear width of transfer systems connecting elevated play components shall be permitted to be 24 in (610 mm) minimum.

15.6.4.4 Ramp Slope and Rise. Any part of an accessible route with a slope greater than 1:20 shall be considered a ramp and shall comply with 4.8, as modified by 15.6.4.4.

15.6.4.4.1 Ground Level. The maximum slope for ramps connecting ground level play components within the boundary of a play area shall be 1:16.

15.6.4.4.2 Elevated. Where a ramp connects elevated play components, the maximum rise of any ramp run shall be 12 in (305 mm).

15.6.4.5 Handrails. Where required on ramps, handrails shall comply with 4.8.5, as modified by 15.6.4.5.

EXCEPTION 1: Handrails shall not be required at ramps located within ground level use zones.

EXCEPTION 2: Handrail extensions shall not be required.

15.6.4.5.1 Handrail Gripping Surface. Handrails shall have a diameter or width of 0.95 in (24.1 mm) minimum to 1.55 in (39.4 mm) maximum, or the shape shall provide an equivalent gripping surface.

15.6.4.5.2 Handrail Height. The top of handrail gripping surfaces shall be 20 in (510 mm) minimum to 28 in (710 mm) maximum above the ramp surface.

15.6.5* Transfer Systems. Where transfer systems are provided to connect elevated play components, the transfer systems shall comply with 15.6.5.

15.6.5.1 Transfer Platforms. Transfer platforms complying with 15.6.5.1 shall be provided where transfer is intended to be from a wheelchair or other mobility device (see Fig. 64).

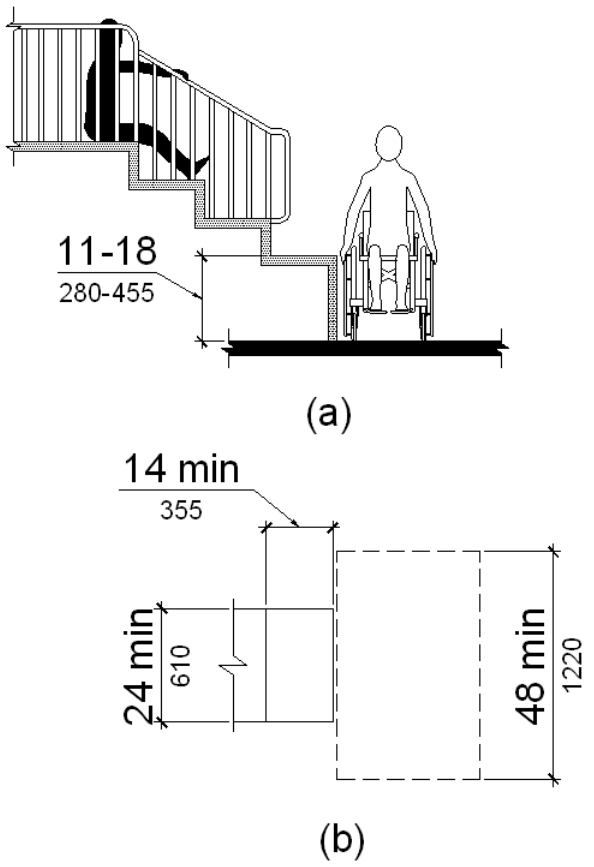


Fig. 64

15.6.5.1.1 Size. Platforms shall have a level surface 14 in (355 mm) minimum in depth and 24 in (610 mm) minimum in width.

15.6.5.1.2 Height. Platform surfaces shall be 11 in (280 mm) minimum to 18 in (455 mm) maximum above the ground or floor surface.

15.6.5.1.3 Transfer Space. A level space complying with 4.2.4 shall be centered on the 48 in (1220 mm) long dimension parallel to the 24 in (610 mm) minimum long unobstructed side of the transfer platform.

15.6.5.1.4 Transfer Supports. A means of support for transferring shall be provided.

15.6.5.2 Transfer Steps. Transfer steps complying with 15.6.5.2 shall be provided where movement is intended from a transfer platform to a level with elevated play components required to be located on an accessible route (see Fig. 65).

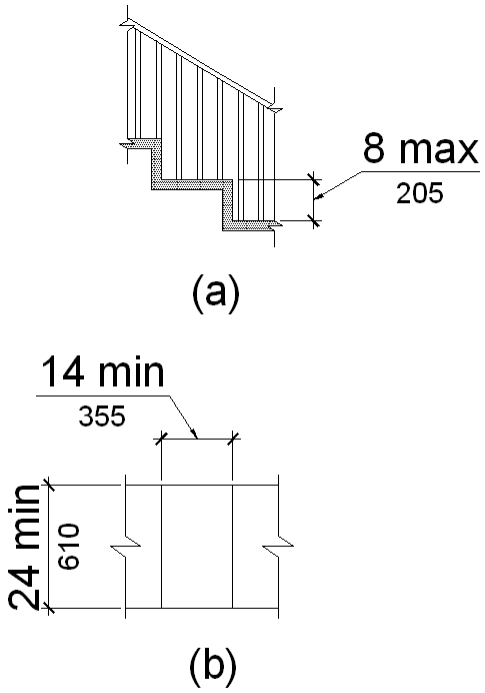


Fig. 65

15.6.5.2.1 Size. Transfer steps shall have a level surface 14 in (355 mm) minimum in depth and 24 in (610 mm) minimum in width.

15.6.5.2.2 Height. Each transfer step shall be 8 in (205 mm) maximum high.

15.6.5.2.3 Transfer Supports. A means of support for transferring shall be provided.

15.6.6* Play Components. Ground level play components located on accessible routes and

elevated play components connected by ramps shall comply with 15.6.6.

15.6.6.1 Maneuvering Space. Maneuvering space complying with 4.2.3 shall be provided on the same level as the play components. Maneuvering space shall have a slope not steeper than 1:48 in all directions. The maneuvering space required for a swing shall be located immediately adjacent to the swing.

15.6.6.2 Clear Floor or Ground Space. Clear floor or ground space shall be provided at the play components and shall be 30 in (760 mm) by 48 in (1220 mm) minimum. Clear floor or ground space shall have a slope not steeper than 1:48 in all directions.

15.6.6.3 Play Tables: Height and Clearances. Where play tables are provided, knee clearance 24 in (610 mm) high minimum, 17 in deep (430 mm) minimum, and 30 in (760 mm) wide minimum shall be provided. The tops of rims, curbs, or other obstructions shall be 31 in (785 mm) high maximum.

EXCEPTION: Play tables designed or constructed primarily for children ages 5 and under shall not be required to provide knee clearance if the clear floor or ground space required by 15.6.6.2 is arranged for a parallel approach and if the rim surface is 31 in (785 mm) high maximum.

15.6.6.4 Entry Points and Seats: Height. Where a play component requires transfer to the entry point or seat, the entry point or seat shall be 11 in (280 mm) minimum and 24 in (610 mm) maximum above the clear floor or ground space.

EXCEPTION: The entry point of a slide shall not be required to comply with 15.6.6.4.

15.6.6.5 Transfer Supports. Where a play component requires transfer to the entry point or seat, a means of support for transferring shall be provided.

15.6.7* Ground Surfaces. Ground surfaces along accessible routes, clear floor or ground spaces, and maneuvering spaces within play areas shall comply with 4.5.1 and 15.6.7.

15.6.7.1 Accessibility. Ground surfaces shall comply with ASTM F 1951 Standard Specification for Determination of Accessibility of Surface Systems Under and Around Playground Equipment (incorporated by reference, see 2.3.2). Ground surfaces shall be inspected and maintained regularly and frequently to ensure continued compliance with ASTM F 1951.

15.6.7.2 Use Zones. If located within use zones, ground surfaces shall comply with ASTM F 1292 Standard Specification for Impact Attenuation of Surface Systems Under and Around Playground Equipment (incorporated by reference, see 2.3.2).

15.6.8 Soft Contained Play Structures. Soft contained play structures shall comply with 15.6.8.

15.6.8.1 Accessible Routes to Entry Points. Where three or fewer entry points are provided, at least one entry point shall be located on an accessible route. Where four or more entry points are provided, at least two entry points shall be located on an accessible route. Accessible routes shall comply with 4.3.

EXCEPTION: Transfer systems complying with 15.6.5 or platform lifts (wheelchair lifts) complying with 4.11 and applicable State or local codes shall be permitted to be used as part of an accessible route.

15.7 Exercise Equipment and Machines, Bowling Lanes, and Shooting Facilities.

15.7.1 General. Newly designed or newly constructed and altered exercise equipment and machines, bowling lanes, and shooting facilities shall comply with 15.7.

15.7.2* Exercise Equipment and Machines. At least one of each type of exercise equipment and machines shall be provided with clear floor or ground space complying with 4.2.4 and shall be served by an accessible route. Clear floor or ground space shall be positioned for transfer or

for use by an individual seated in a wheelchair. Clear floor or ground spaces for more than one piece of equipment shall be permitted to overlap .

15.7.3 Bowling Lanes. Where bowling lanes are provided, at least 5 percent, but not less than one of each type of lane shall be served by an accessible route.

15.7.4* Shooting Facilities. Where fixed firing positions are provided at a site, at least 5 percent, but not less than one, of each type of firing position shall comply with 15.7.4.1.

15.7.4.1 Fixed Firing Position. Fixed firing positions shall contain a 60 inch (1525 mm) diameter space and shall have a slope not steeper than 1:48.

15.8 Swimming Pools, Wading Pools, and Spas.

15.8.1 General. Newly designed or newly constructed and altered swimming pools, wading pools, and spas shall comply with 15.8.

EXCEPTION: An accessible route shall not be required to serve raised diving boards or diving platforms.

15.8.2* Swimming Pools. At least two accessible means of entry shall be provided for each public use and common use swimming pool. The primary means of entry shall comply with 15.8.5 (Swimming Pool Lifts) or 15.8.6 (Sloped Entries). The secondary means of entry shall comply with one of the following: 15.8.5 (Swimming Pool Lifts), 15.8.6 (Sloped Entries), 15.8.7 (Transfer Walls), 15.8.8 (Transfer Systems), or 15.8.9 (Pool Stairs).

EXCEPTION 1*: Where a swimming pool has less than 300 linear feet (91 m) of swimming pool wall, at least one accessible means of entry shall be provided and shall comply with 15.8.5 (Swimming Pool Lifts) or 15.8.6 (Sloped Entries).

EXCEPTION 2: Wave action pools, leisure rivers, sand bottom pools, and other pools where user access is limited to one area, shall provide at least one accessible means of entry that complies with 15.8.5 (Swimming Pool Lifts), 15.8.6 (Sloped Entries), or 15.8.8 (Transfer Systems).

EXCEPTION 3: Catch pools shall be required only to be served by an accessible route that connects to the pool edge.

15.8.3 Wading Pools. At least one accessible means of entry complying with 15.8.6 (Sloped Entries) shall be provided for each wading pool.

15.8.4 Spas. At least one accessible means of entry complying with 15.8.5 (Swimming Pool Lifts), 15.8.7 (Transfer Walls), or 15.8.8 (Transfer Systems) shall be provided for each spa.

EXCEPTION: Where spas are provided in a cluster, 5 percent, but not less than one, in each cluster shall be accessible.

15.8.5* Pool Lifts. Pool lifts shall comply with 15.8.5.

15.8.5.1 Pool Lift Location. Pool lifts shall be located where the water level does not exceed 48 inches (1220 mm).

EXCEPTION 1: Where the entire pool depth is greater than 48 inches (1220 mm), 15.8.5.1 shall not apply.

EXCEPTION 2: Where multiple pool lift locations are provided, no more than one shall be required to be located in an area where the water level does not exceed 48 inches (1220 mm).

15.8.5.2 Seat Location. In the raised position, the centerline of the seat shall be located over the deck and 16 inches (405 mm) minimum from the edge of the pool. The deck surface between the centerline of the seat and the pool edge shall have a slope not greater than 1:48 (see Fig. 68).

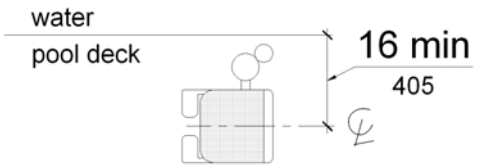


Fig. 68
Pool Lift Seat Location

15.8.5.3 Clear Deck Space. On the side of the seat opposite the water, a clear deck space shall be provided parallel with the seat. The space shall be 36 inches (915 mm) wide minimum and shall extend forward 48 inches (1220 mm) minimum from a line located 12 inches (305 mm) behind the rear edge of the seat. The clear deck space shall have a slope not greater than 1:48 (see Fig. 69).

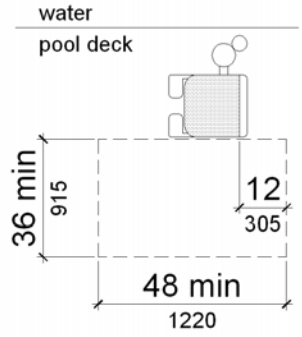


Fig. 69
Clear Deck Space at Pool Lifts

15.8.5.4 Seat Height. The height of the lift seat shall be designed to allow a stop at 16 inches (405 mm) minimum to 19 inches (485 mm) maximum measured from the deck to the top of the seat surface when in the raised (load) position (see Fig. 70).

15.8.5.5 Seat Width. The seat shall be 16 inches (405 mm) minimum wide.

15.8.5.6* Footrests and Armrests. Footrests shall be provided and shall move with the seat. If provided, armrests positioned opposite the water shall be removable or shall fold clear of the seat when the seat is in the raised (load) position.

EXCEPTION: Footrests shall not be required on pool lifts provided in spas.

15.8.5.7* Operation. The lift shall be capable of unassisted operation from both the deck and water levels. Controls and operating mechanisms shall be unobstructed when the lift is in use and shall comply with 4.27.4.

15.8.5.8 Submerged Depth. The lift shall be designed so that the seat will submerge to a water depth of 18 inches (455 mm) minimum below the stationary water level (see Fig. 71).

15.8.5.9* Lifting Capacity. Single person pool lifts shall have a minimum weight capacity of 300 lbs. (136 kg) and be capable of sustaining a static load of at least one and a half times the rated load.

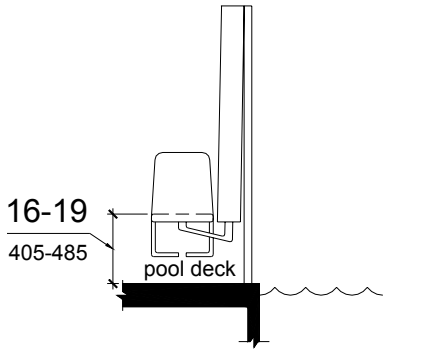


Fig. 70
Pool Lift Seat Height

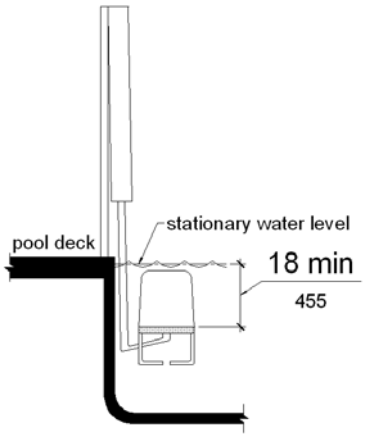


Fig 71
Pool Lift Submerged Depth

15.8.6 Sloped Entries. Sloped entries designed to provide access into the water shall comply with 15.8.6.

15.8.6.1* Sloped Entries. Sloped entries shall comply with 4.3, except as modified below.

EXCEPTION: Where sloped entries are provided, the surfaces shall not be required to be slip resistant.

15.8.6.2 Submerged Depth. Sloped entries shall extend to a depth of 24 inches (610 mm) minimum to 30 inches (760 mm) maximum below the stationary water level. Where landings are required by 4.8, at least one landing shall be located 24 inches (610 mm) minimum to 30 inches (760 mm) maximum below the stationary water level (see Fig. 72).

EXCEPTION: In wading pools, the sloped entry and landings, if provided, shall extend to the deepest part of the wading pool.

15.8.6.3* Handrails. Handrails shall be provided on both sides of the sloped entry and shall comply with 4.8.5. The clear width between handrails shall be 33 inches (840 mm) minimum and 38 inches (965 mm) maximum (see Fig. 73).

EXCEPTION 1: Handrail extensions specified by 4.8.5 shall not be required at the bottom landing serving a sloped entry.

EXCEPTION 2: Where a sloped entry is provided for wave action pools, leisure rivers, sand bottom pools, and other pools where user access is limited to one area, the required clear width between handrails shall not apply.

EXCEPTION 3: The handrail requirements of 4.8.5 and 15.8.6.3 shall not be required on sloped entries in wading pools.

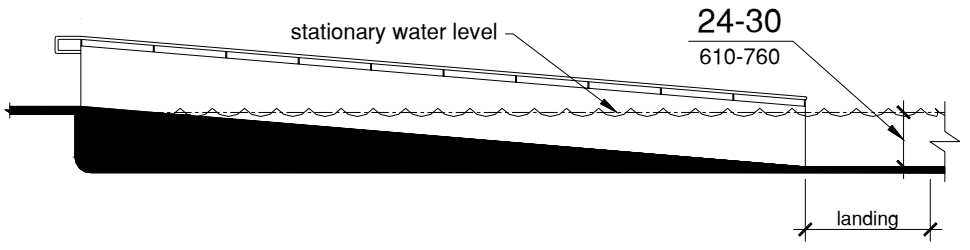


Fig. 72
Sloped Entry Submerged Depth

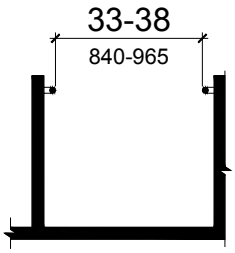


Fig. 73
Sloped Entry Handrails

15.8.7 Transfer Walls. Transfer walls shall comply with 15.8.7.

15.8.7.1 Clear Deck Space. A clear deck space of 60 inches (1525 mm) minimum by 60 inches (1525 mm) minimum with a slope not steeper than 1:48 shall be provided at the base of the transfer wall. Where one grab bar is provided, the clear deck space shall be centered on the grab bar. Where two grab bars are provided, the clear deck space shall be centered on the clearance between the grab bars (see Fig. 74).

15.8.7.2 Height. The height of the transfer wall shall be 16 inches (405 mm) minimum to 19 inches (485 mm) maximum measured from the deck (see Fig. 75).

15.8.7.3 Wall Depth and Length. The depth of the transfer wall shall be 12 inches (305 mm) minimum to 16 inches (405 mm) maximum. The length of the transfer wall shall be 60 inches (1525 mm) minimum and shall be centered on the clear deck space (see Fig. 76).

15.8.7.4 Surface. Surfaces of transfer walls shall not be sharp and shall have rounded edges.

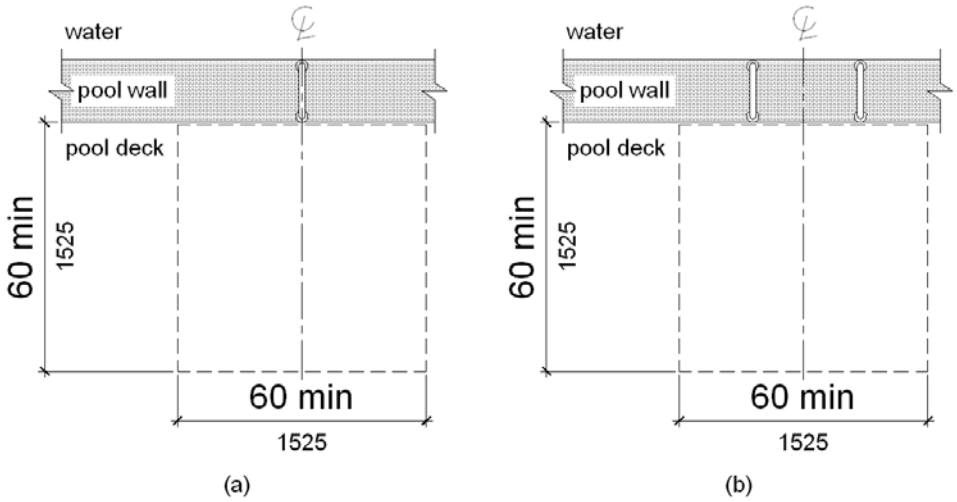


Fig. 74
Clear Deck Space at Transfer Walls

15.8.7.5 Grab Bars. At least one grab bar shall be provided on the transfer wall. Grab bars shall be perpendicular to the pool wall and shall extend the full depth of the transfer wall. The top of the gripping surface shall be 4 inches (100 mm) minimum and 6 inches (150 mm) maximum above walls. Where one grab bar is provided, clearance shall be 24 inches (610 mm) minimum on both sides of the grab bar. Where two grab bars are provided, clearance between grab bars shall be 24 inches (610 mm) minimum. Grab bars shall comply with 4.26 (see Fig. 77).

15.8.8 Transfer Systems. Transfer systems shall comply with 15.8.8.

15.8.8.1 Transfer Platform. A transfer platform 19 inches (485 mm) minimum clear depth by 24 inches (610 mm) minimum clear width shall be provided at the head of each transfer system (see Fig. 78).

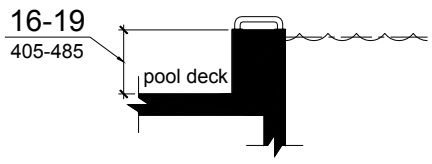


Fig. 75
Transfer Wall Height

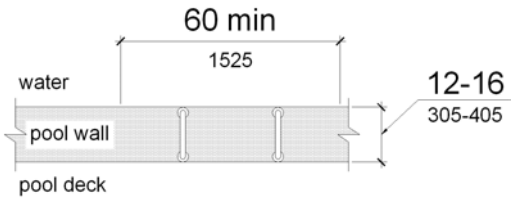


Fig. 76
Transfer Wall Depth and Length

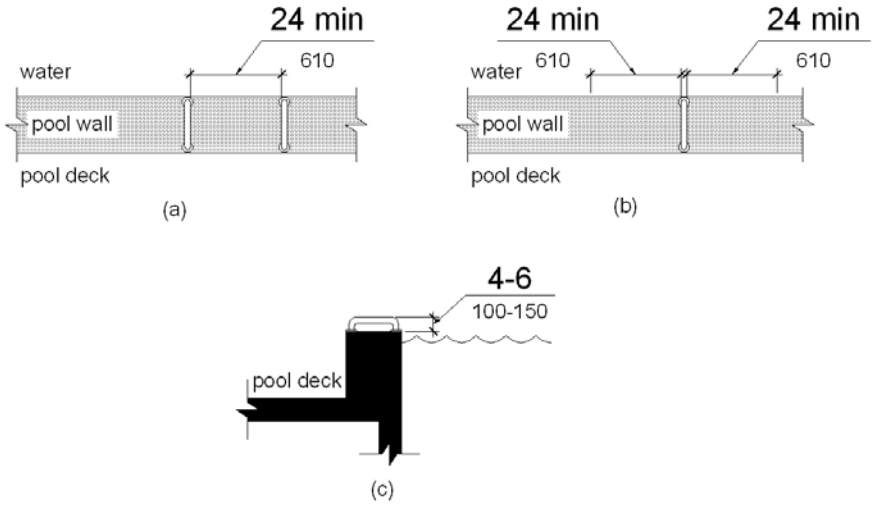


Fig. 77
Grab Bars at Transfer Walls

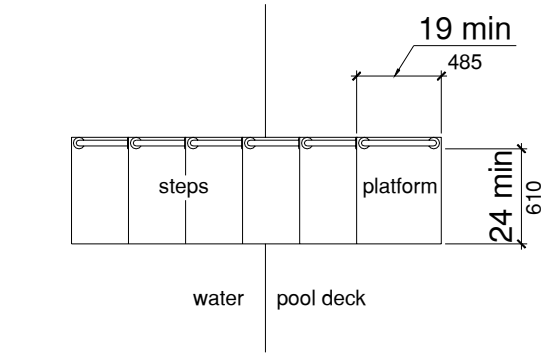


Fig. 78
Transfer System Platform

15.8.8.2 Clear Deck Space. A clear deck space of 60 inches (1525 mm) minimum by 60 inches (1525 mm) minimum with a slope not steeper than 1:48 shall be provided at the base of the transfer platform surface and shall be centered along a 24 inch (610 mm) minimum unobstructed side of the transfer platform (see Fig. 79).

15.8.8.3 Height. The height of the transfer platform shall comply with 15.8.7.2.

15.8.8.4* Transfer Steps. Transfer step height shall be 8 inches (205 mm) maximum. Transfer steps shall extend to a water depth of 18 inches (455 mm) minimum below the stationary water level (see Fig. 80).

15.8.8.5 Surface. The surface of the transfer system shall not be sharp and shall have rounded edges.

15.8.8.6 Size. Each transfer step shall have a tread clear depth of 14 inches (355 mm) minimum and 17 inches (430 mm) maximum and shall have a tread clear width of 24 inches (610 mm) minimum (see Fig. 81).

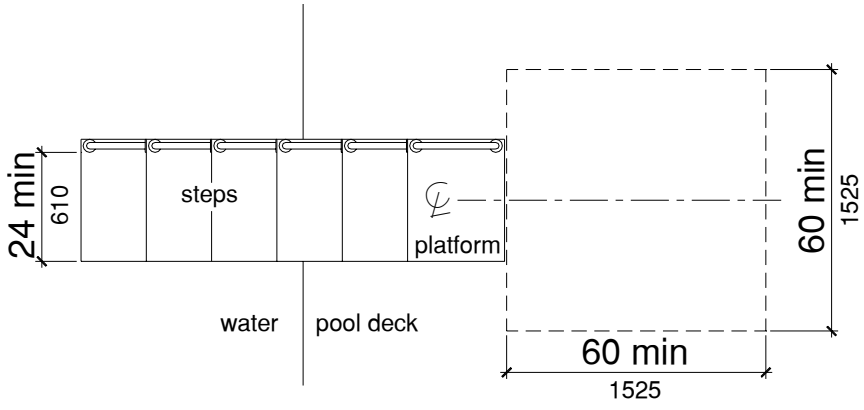


Fig. 79
Clear Deck Space at Transfer Systems

15.8.8.7* Grab Bars. At least one grab bar on each transfer step and the transfer platform, or a continuous grab bar serving each transfer step and the transfer platform, shall be provided. Where provided, the top of the gripping surface shall be 4 inches (100 mm) minimum and 6 inches (150 mm) maximum above each step and transfer platform. Where a continuous grab bar is provided, the top of the gripping surface shall be 4 inches (100 mm) minimum and 6 inches (150 mm) maximum above the step nosing and transfer platform. Grab bars shall comply with 4.26 and be located on at least one side of the transfer system. The grab bar located at the transfer platform shall not obstruct transfer (see Fig. 82).

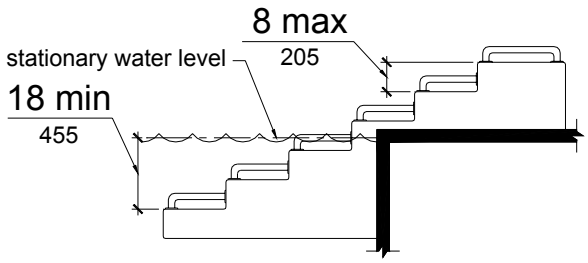


Fig. 80
Transfer System Steps

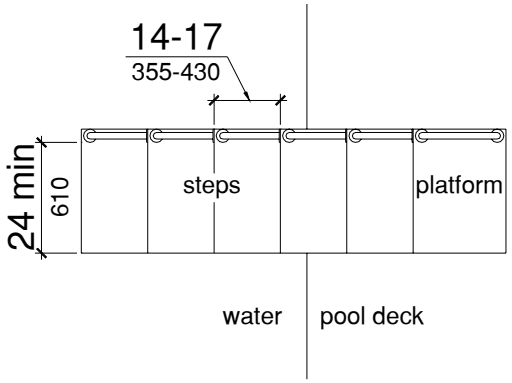


Fig. 81
Size of Transfer System Steps

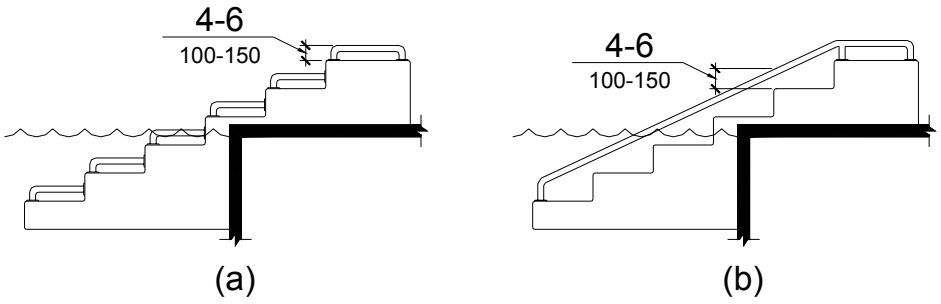


Fig. 82
Grab Bars at Transfer Systems

15.8.9 Pool Stairs. Pool stairs shall comply with 15.8.9. **15.8.9.1 Pool Stairs.** Pool stairs shall comply with 4.9, except as modified below. **15.8.9.2 Handrails.** The width between handrails shall be 20 inches (510 mm) minimum and 24 inches (610 mm) maximum. Handrail extensions required by 4.9.4 shall not be required at the bottom landing serving a pool stair. **15.8.10* Water Play Components.** Where water play components are provided, the provisions of 15.6 and 4.3 shall apply, except as modified or otherwise provided in this section. EXCEPTION 1: Where the surface of the accessible route, clear floor or ground spaces and maneuvering spaces connecting play components is submerged, the provisions of 15.6 and 4.3 for cross slope, running slope, and surface shall not apply. EXCEPTION 2: Transfer systems complying with 15.6.5 shall be permitted to be used in lieu of ramps to connect elevated play components.	

APPENDIX

This appendix contains materials of an advisory nature and provides additional information that should help the reader to understand the minimum requirements of the guidelines or to design buildings or facilities for greater accessibility. The paragraph numbers correspond to the sections or paragraphs of the guideline to which the material relates and are therefore not consecutive (for example, A4.2.1 contains additional information relevant to 4.2.1). Sections of the guidelines for which additional material appears in this appendix have been indicated by an asterisk. Nothing in this appendix shall in any way obviate any obligation to comply with the requirements of the guidelines itself.

A2.0 General.

A2.2 Equivalent Facilitation. Specific examples of equivalent facilitation are found in the following sections:

4.1.6(3)(c)	Elevators in Alterations
4.31.9	Text Telephones
7.2	Sales and Service Counters, Teller Windows, Information Counters
9.1.4	Classes of Sleeping Accommodations
9.2.2(6)(d)	Requirements for Accessible Units, Sleeping Rooms, and Suites

A3.0 Miscellaneous Instructions and Definitions.

A3.5 Definitions.

Transient Lodging. The Department of Justice's policy and rules further define what is covered as transient lodging.

A4.0 Accessible Elements and Spaces: Scope and Technical Requirements.

A4.1.1 Application.

A4.1.1(3) Areas Used Only by Employees as Work Areas. Where there are a series of individual work stations of the same type (e.g., laboratories, service counters, ticket booths), 5%, but not less than one, of each type of work station should be constructed so that an individual with disabilities can maneuver within the work stations. Rooms housing individual offices in a typical office building must meet the requirements of the guidelines concerning doors, accessible routes, etc. but do not need to allow for maneuvering space around individual desks. Modifications required to permit maneuvering within the work area may be accomplished as a reasonable accommodation to individual employees with disabilities under Title I of the ADA. Consideration should also be given to placing shelves in employee work areas at a convenient height for accessibility or installing commercially available shelving that is adjustable so that reasonable accommodations can be made in the future.

If work stations are made accessible they should comply with the applicable provisions of 4.2 through 4.35.

A4.1.2 Accessible Sites and Exterior Facilities: New Construction.

A4.1.2(2)(b) Court Sports: The accessible route must be direct and connect both sides of the court without requiring players on one side of the court to traverse through or around another court to get to the other side of the court.

A4.1.2(4) Exception 1. An accessible route is required to connect to the boundary of the area of sport activity. The term “area of sport activity” distinguishes that portion of a room or space where the play or practice of a sport occurs from adjacent areas. Examples of areas of sport activity include: basketball courts, baseball fields, running tracks, bowling lanes, skating rinks, and the area surrounding a piece of gymnastic equipment. While the size of an area of sport activity may vary from sport to sport, each includes only the space needed to play. The following example is provided for additional clarification.

Example. Boundary lines define the field where a football game is played. A safety border is also provided around the field. The game may

temporarily be played in the space between the boundary lines and the safety border when players are pushed out of bounds or momentum carries them forward while receiving a pass. In the game of football, the space between the boundary line and the safety border is used to play the game. This space and the football field are included in the area of sport activity.

A4.1.2(4) Exception 2. Public circulation routes where animals may also travel, such as in petting zoos and passageways alongside animal pens in State fairs, are not eligible for the exception.

A4.1.2(5)(e) Valet parking is not always usable by individuals with disabilities. For instance, an individual may use a type of vehicle controls that render the regular controls inoperable or the driver's seat in a van may be removed. In these situations, another person cannot park the vehicle. It is recommended that some self-parking spaces be provided at valet parking facilities for individuals whose vehicles cannot be parked by another person and that such spaces be located on an accessible route to the entrance of the facility.

A4.1.3 Accessible Buildings: New Construction.

4.1.3(1)(b) Court Sports: The accessible route must be direct and connect both sides of the court without requiring players on one side of the court to traverse through or around another court to get to the other side of the court.

4.1.3(3) Exception 1. An accessible route is required to connect to the boundary of the area of sport activity. The term “area of sport activity” distinguishes that portion of a room or space where the play or practice of a sport occurs from adjacent areas. Examples of areas of sport activity include: basketball courts, baseball fields, running tracks, bowling lanes, skating rinks, and the area surrounding a piece of fixed gymnastic equipment. While the size of an area of sport activity may vary from sport to sport, each includes only the space needed to play. The following example is provided for additional clarification.

Example. Boundary lines define the field where a football game is played. A safety border is also provided around the field. The game may temporarily be played in the space between the boundary lines and the safety border when players are pushed out of bounds or momentum carries them forward while receiving a pass. In the game of football, the space between the boundary line and the safety border is used to play the game. This space and the football field are included in the area of sport activity.

4.1.3(3) Exception 2. Public circulation routes where animals may also travel, such as in petting zoos and passageways alongside animal pens in State fairs, are not eligible for the exception.

A4.1.3(5) Only passenger elevators are covered by the accessibility provisions of 4.10. Materials and equipment hoists, freight elevators not intended for passenger use, dumbwaiters, and construction elevators are not covered by these guidelines. If a building is exempt from the elevator requirement, it is not necessary to provide a platform lift or other means of vertical access in lieu of an elevator.

Under Exception 4, platform lifts are allowed where existing conditions make it impractical to install a ramp or elevator. Such conditions generally occur where it is essential to provide access to small raised or lowered areas where space may not be available for a ramp. Examples include, but are not limited to, raised pharmacy platforms, commercial offices raised above a sales floor, or radio and news booths.

While the use of platform lifts is allowed, ramps are recommended to provide access to player seating areas serving an area of sport activity.

A4.1.3(9) Supervised automatic sprinkler systems have built in signals for monitoring features of the system such as the opening and closing of water control valves, the power supplies for needed pumps, water tank levels, and for indicating conditions that will impair the satisfactory operation of the sprinkler system. Because of these monitoring features, supervised automatic sprinkler systems have a high level of

satisfactory performance and response to fire conditions.

A4.1.3(10) If an odd number of drinking fountains is provided on a floor, the requirement in 4.1.3(10)(b) may be met by rounding down the odd number to an even number and calculating 50% of the even number. When more than one drinking fountain on a floor is required to comply with 4.15, those fountains should be dispersed to allow wheelchair users convenient access. For example, in a large facility such as a convention center that has water fountains at several locations on a floor, the accessible water fountains should be located so that wheelchair users do not have to travel a greater distance than other people to use a drinking fountain.

A4.1.3(12)(c) Different types of lockers may include full-size and half-size lockers, as well as those specifically designed for storage of various sports equipment.

within the seating area are provided. This will allow choice in viewing and price categories.

Building and life safety codes set minimum distances between rows of fixed seats with consideration of the number of seats in a row, the exit aisle width and arrangement, and the location of exit doors. "Continental" seating, with a greater number of seats per row and a commensurate increase in row spacing and exit doors, facilitates emergency egress for all people and increases ease of access to mid-row seats especially for people who walk with difficulty. Consideration of this positive attribute of "continental" seating should be included along with all other factors in the design of fixed seating areas.

Removable armrests are recommended on fixed companion seats provided in assembly areas in amusement facilities. This provides the option for an individual using a wheelchair or other mobility device to transfer into a seat where motion and other effects may be provided as part of the amusement experience.

A4.33.6 Placement of Listening Systems. A distance of 50 ft (15 m) allows a person to distinguish performers' facial expressions.

A4.33.7 Types of Listening Systems. An assistive listening system appropriate for an assembly area for a group of persons or where the specific individuals are not known in advance, such as a playhouse, lecture hall or movie theater, may be different from the system appropriate for a particular individual provided as an auxiliary aid or as part of a reasonable accommodation. The appropriate device for an individual is the type that individual can use, whereas the appropriate system for an assembly area will necessarily be geared toward the "average" or aggregate needs of various individuals. A listening system that can be used from any seat in a seating area is the most flexible way to meet this specification. Earphone jacks with variable volume controls can benefit only people who have slight hearing loss and do not help people who use hearing aids. At the present time, magnetic induction loops are the most feasible type of listening system for people who use hearing aids equipped with "T- coils," but people without hearing aids or those with hearing aids not equipped with inductive pick-ups cannot use them without special receivers. Radio frequency systems can be extremely effective and inexpensive. People without hearing aids can use them, but people with hearing aids need a special receiver to use them as they are presently designed. If hearing aids had a jack to allow a by-pass of microphones, then radio frequency systems would be suitable for people with and without hearing aids. The Department of Justice's regulations implementing titles II and III of the ADA require public entities and public accommodations to provide appropriate auxiliary aids and services to ensure effective communication. See 28 CFR 35.160, 28CFR 35.164, and 28 CFR 36.303. Where assistive listening systems are used to provide effective communication, the Department of Justice considers it essential that a portion of receivers be compatible with hearing aids.

Some listening systems may be subject to interference from other equipment and feedback from hearing aids of people who are using the systems. Such interference can be controlled by careful engineering design that anticipates feedback sources in the surrounding area.

Table A2, shows some of the advantages and disadvantages of different types of assistive listening systems. In addition, the Access Board has published a pamphlet on Assistive Listening Systems which lists demonstration centers across the country where technical assistance can be obtained in selecting and installing appropriate systems. The state of New York has also adopted a detailed technical specification which may be useful.

A4.36.2 Saunas and Steam Rooms. A 60-inch turning diameter space or a T-shaped space is required within the sauna or steam room. Removable benches or seats are permitted to obstruct the 60-inch or T-shaped space.

A4.37.3 Benches. Back support may be achieved through locating benches adjacent to walls or by other designs that will meet the minimum dimensions specified.

A5.0 Restaurants and Cafeterias.

A5.1 General. Dining counters (where there is no service) are typically found in small carry-out restaurants, bakeries, or coffee shops and may only be a narrow eating surface attached to a wall. This section requires that where such a dining counter is provided, a portion of the counter shall be at the required accessible height.

A7.0 Business, Mercantile and Civic.

A7.2(3)(iii) Counter or Teller Windows with Partitions. Methods of facilitating voice communication may include grilles, slats, talk-through baffles, and other devices mounted directly into the partition which users can speak directly into for effective communication. These methods are required to be designed or placed so that they are accessible to a person who is standing or seated. However, if the counter is only used by persons in a seated position, then a method of facilitating communication which is accessible to standing persons would not be necessary.

A15.0 Recreation Facilities.

Unless otherwise modified in Section 4 or specifically addressed in section 15, all other ADAAG provisions apply for the design and construction of recreation facilities and elements. The provisions in this section apply wherever these elements are provided. For example, office buildings may contain a room with exercise equipment and these sections therefore apply.

A15.1 Amusement Rides.

These guidelines apply to newly designed or newly constructed amusement rides. A custom designed and constructed ride is new upon its "first use," which is the first time amusement park patrons take the ride. With respect to amusement rides purchased from other entities, "new" refers to the first permanent installation of the ride, whether it is used "off the shelf" or it is modified before it is installed. Where amusement rides are moved after several seasons to another area of the park or to another park, the ride would not be considered newly designed or newly constructed.

Amusement rides designed primarily for children, amusement rides that are controlled or operated by the rider, and amusement rides without seats, are not required to provide wheelchair spaces, transfer seats, or transfer systems, and need not meet the signage requirements in 15.1.6. The load and unload areas of these rides must, however, be on an accessible route and must provide maneuvering space under 15.1.4 and 15.1.5.

The scoping and technical provisions of the guidelines were developed to address common amusement rides. There will be other amusement attractions that have unique designs and features which are not adequately addressed by the guidelines. In those situations, the guidelines are to be applied to the extent possible.

An accessible route must be provided to these areas. Where an attraction or ride has unique features for which there are no applicable scoping provisions, then a reasonable number, but at least one, of the features must be located on an accessible route. Where there are appropriate technical provisions, they must be applied to the elements that are covered by the scoping provisions. Where an attraction has unique designs for which the technical provisions are not appropriate, the operators of those attractions are still subject to all the other requirements of the ADA, including program accessibility, barrier removal and the general obligation to provide individuals with disabilities an equal opportunity to enjoy the goods and services provided by their facilities. An example of an amusement ride not specifically addressed by the guidelines includes "virtual reality" rides where the device does not move through a fixed course within a defined area.

A15.1 Exception 1. Mobile or temporary rides are those set up for short periods of time such as traveling carnivals, State and county fairs, and festivals. The amusement rides that are covered by section 15.1 are ones that are not regularly assembled and disassembled.

A15.1 Exception 2. The exception does not apply to those rides where patrons may cause the ride to make incidental movements, but where the patron otherwise has no control over the ride.

A15.1 Exception 3. The exception is limited to those rides designed "primarily" for children, where children are assisted on and off the ride by an adult. This exception is limited to those rides designed for children and not for the occasional adult user. An accessible route to and maneuvering space in the load and unload area will provide access for adults and family members assisting children on and off these rides.

A15.1.2 Alterations to Amusement Rides. Routine maintenance, painting, and changing of theme boards are examples of activities that do not constitute an alteration subject to section 15.1.2. Where existing amusement rides are moved and not altered, section 15.1 does not apply unless the load and unload area of the amusement ride is newly designed and constructed. If a load or unload area is altered, the alteration provisions of ADAAG 4.1.6 must be applied to the altered area.

A15.1.4 Accessible Route. Steeper slopes are permitted (not to exceed 1:8) where the accessible route connects to the amusement ride in the load and unload position. This is permitted only where compliance with 4.8.2 (maximum slope 1:12) is "structurally or operationally infeasible". In most cases, this will be limited to areas where the accessible route leads directly to the amusement ride and where there are space limitations on the ride, not the queue line. Where possible, the least possible slope should be used on the accessible route that serves the amusement ride.

A15.1.7.1.2 Amusement Rides with Wheelchair Spaces. 36 CFR 1192.83(c) ADA Accessibility Guidelines for Transportation Vehicles - Light Rail Vehicles and Systems - Mobility Aid Accessibility is available at www.access-board.gov/transit/html/vguide.htm#LRVM. It references provisions for bridge plates and ramps used for gaps between wheelchair spaces and floors of load and unload areas.

A15.1.7.2 Exception 3. This exception for protruding objects applies to the ride devices, not to circulation areas or accessible routes in the queue lines or the load and unload areas.

A15.1.7.2.2 Wheelchair Spaces - Side Entry. Under certain circumstances, a 32-inch clear opening will not provide sufficient width to accommodate a turn into an amusement ride. The amount of clear space needed within the ride, and the size and position of the opening are interrelated. Additional space for maneuvering and a wider door will be needed where a side opening is centered on the ride. For example, where a 42-inch opening is provided, a minimum clear space of 60 inches in length and 36 inches in depth is needed (see Fig. A9). This is necessary to ensure adequate space for maneuvering. For additional guidance refer to Figure 3 (Wheelchair Turning Space) and Figure 4 (Minimum Clear Floor Space for Wheelchairs) on minimum space requirements.

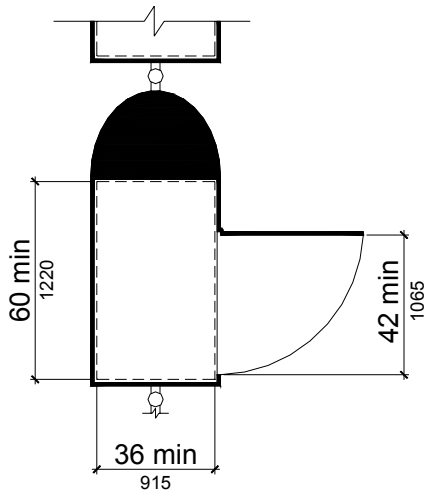


Fig. A9
Wheelchair Spaces - Side Entry

A15.1.8 Amusement Ride Seats Designed for Transfer. There are many different ways that individuals transfer to and from their wheelchairs or mobility devices. The proximity of the clear floor or ground space next to an element and the height of the element one is transferring to are both critical for a safe and independent transfer. Providing additional clear floor or ground space both in front of and diagonally to the element will provide flexibility and increased usability for a more diverse population of individuals with disabilities. Ride seats designed for transfer should involve only one transfer. Where possible, designers are encouraged to locate the ride seat no higher than 17 to 19 inches above the load and unload surface. Where greater distances are required for transfers, consideration should be given to providing gripping surfaces, seat padding, and avoiding sharp or protruding objects in the path of transfer to better facilitate the transfer process.

A15.1.9 Transfer Devices for Use with Amusement Rides. Transfer devices for use with

amusement rides should permit individuals to make independent transfers to and from their wheelchairs or mobility devices. There are a variety of transfer devices available that could be adapted to provide access onto an amusement ride. Examples of devices that may provide for transfers include, but are not limited to, transfer systems (see 15.8.8), lifts, mechanized seats, and other custom designed systems. Operators and designers have flexibility in developing designs that will facilitate individuals to transfer onto amusement rides. These systems or devices should be designed to be reliable and sturdy. A transfer board, for example, would not be sufficient because it will not provide enough support or stability and may cause injury.

Designs which limit the number of transfers required from one's wheelchair or mobility device to the ride seat are encouraged. When using a transfer device to access an amusement ride, the least amount of transfers for the least amount of distance is desired. Where possible, designers are encouraged to locate the transfer device seat no higher than 17 to 19 inches above the load and unload surface. Where greater distances are required for transfers, consideration should be given to providing gripping surfaces, seat padding, and avoiding sharp or protruding objects in the path of transfer to better facilitate the transfer process. Where a series of transfers are required to reach the amusement ride seat, each vertical transfer should not exceed 8 inches.

As discussed with amusement rides seats designed for transfer, there are many different ways that individuals transfer to and from their wheelchairs or mobility devices. The proximity of the clear floor or ground space next to an element and the height of the element one is transferring to are both critical for a safe and independent transfer. Providing additional clear floor or ground space both in front of and diagonally to the element will provide flexibility and increased usability for a more diverse population of individuals with disabilities.

A15.2 Boating Facilities.

A15.2.2 Accessible Route. The following two examples apply exceptions two and three.

Example 1. Boat slips which are required to be accessible are provided at a floating pier. The vertical distance an accessible route must travel to the pier when the water is at its lowest level is six feet, although the water level only fluctuates three feet. To comply with exceptions 2 and 3, at least one design solution would provide a gangway at least 72.25 feet long which ensures the slope does not exceed 1:12.

Example 2. A gangway is provided to a floating pier which is required to be on an accessible route. The vertical distance is 10 feet between the elevation where the gangway departs the landside connection and the elevation of the pier surface at the lowest water level. Exceptions 2 and 3, which modify 4.8.2, permit the gangway to be at least 80 feet long. Another design solution would be to have two 40-foot continuous gangways joined together at a float, where the float (as the water level falls) will stop dropping at an elevation five feet below the landside connection.

A15.2.3 Boat Slips: Minimum Number. Accessible boat slips are not "reserved" for persons with disabilities in the same manner as accessible vehicle parking spaces. Rather, accessible boat slip use is comparable to accessible hotel rooms. The Department of Justice is responsible for addressing operational issues relating to the use of accessible facilities and elements. The Department of Justice currently advises that hotels should hold accessible rooms for persons with disabilities until all other rooms are filled. At that point, accessible rooms can be open for general use on a first come, first serve basis.

The following two examples apply to a boating facility with a single non-demarcated pier.

Example 1. A site contains a new boating facility which consists of a single 60-foot pier. Boats are only moored parallel with the pier on both sides to allow occupants to embark or disembark.

Since the number of slips cannot be identified, section 15.2.3 requires each 40 feet of boat slip edge to be counted as one slip for purposes of determining the number of slips available and determines the number required to be accessible. The 120 feet of boat slip edge at the pier would equate with 3 boat slips. Table 15.2.3 would require 1 slip to be accessible and comply with 15.2.5. Section 15.2.5 (excluding the exceptions within the section) requires a clear pier space 60 inches wide minimum extending the length of the slip. In this example, because the pier is at least 40 feet long, the accessible slip must contain a clear pier space at least 40 feet long which has a minimum width of 60 inches.

Example 2. A new boating facility consisting of a single pier 25 feet long and 3 feet wide is being planned for a site. The design intends to allow boats to moor and occupants to embark and disembark on both sides, and at one end. As the number of boat slips cannot be identified, applying section 15.2.3 would translate to 53 feet of boat slip edge at the pier. This equates with two slips. Table 15.2.5 would require 1 slip to be accessible. To comply with 15.2.5 (excluding the exceptions within the section), the width of the pier must be increased to 60 inches. Neither 15.2.3 or 15.2.5 requires the pier length to be increased to 40 feet.

A15.2.3.1 Dispersion. Types of boat slips are based on the size of the boat slips; whether single berths or double berths, shallow water or deep water, transient or longer-term lease, covered or uncovered; and whether slips are equipped with features such as telephone, water, electricity and cable connections. The term “boat slip” is intended to cover any pier area where recreational boats embark or disembark, unless classified as a launch ramp boarding pier. For example, a fuel pier may contain boat slips, and this type of short term slip would be included in determining compliance with 15.2.3.1.

A15.2.4 Boarding Piers at Boat Launch Ramps. The following two examples apply to a boat launch ramp boarding pier.

Example 1. A chain of floats is provided on a launch ramp to be used as a boarding pier which is required to be accessible by 15.2.4. At high water, the entire chain is floating and a transition plate connects the first float to the surface of the launch ramp. As the water level decreases, segments of the chain end up resting on the launch ramp surface, matching the slope of the launch ramp. As water levels drop, segments function also as gangways because one end of a segment is resting on the launch ramp surface and the other end is connecting to another floating segment in the chain.

Under ADAAG 4.1.2(2), an accessible route must serve the last float because it would function as the boarding pier at the lowest water level. Under exception 3 in 15.2.4, each float is not required to comply with ADAAG 4.8, but must meet all other requirements in ADAAG 4.3, unless exempted by exception 1 in 15.2.4. In this example, because the entire chain also functions as a boarding pier, the entire chain must comply with the requirements of 15.2.5, including the 60-inch minimum clear pier width provision.

Example 2. A non-floating boarding pier supported by piles divides a launching area into two launch ramps and is required to be accessible. Under ADAAG 4.1.2(2), an accessible route must connect the boarding pier with other accessible buildings, facilities, elements, and spaces on the site. Although the boarding pier is located within a launch ramp, because the pier is not a floating pier or a skid pier, none of the exceptions in 15.2.4 apply. To comply with ADAAG 4.3, either the accessible route must run down the launch ramp or the fixed boarding pier could be relocated to the side of the two launch ramps. The second option leaves the slope of the launch ramps unchanged, because the accessible route runs outside the launch ramps.

A15.2.4.1 Boarding Pier Clearances. The guidelines do not establish a minimum length for accessible boarding piers at boat launch ramps. The accessible boarding pier would have a length which is at least equal to other boarding piers provided at the facility. If no other boarding pier

is provided, the pier would have a length equal to what would have been provided if no access requirements applied. The entire length of accessible boarding piers would be required to comply with the same technical provisions that apply to accessible boat slips. For example, at a launch ramp, if a 20-foot long accessible boarding pier is provided, the entire 20 feet must comply with the pier clearance requirements in 15.2.5. Likewise, if a 60-foot long accessible boarding pier is provided, the pier clearance requirements in 15.2.5 would apply to the entire 60 feet.

A15.2.5 Accessible Boat Slips. Although the minimum width of the clear pier space is 60 inches, it is recommended that piers be wider than 60 inches to improve the safety for persons with disabilities, particularly on floating piers.

A15.2.5.1 Clearances, Exception 3. Where the conditions in exception 3 are satisfied, existing facilities are only required to have one accessible boat slip with a pier clearance which runs the length of the slip. All other accessible slips are allowed to have the required pier clearance at the head of the slip. Under this exception, at piers with perpendicular boat slips, the width of most "finger piers" will remain unchanged. However, where mooring systems for floating piers are replaced as part of pier alteration projects, an opportunity may exist for increasing accessibility. Piers may be reconfigured to allow an increase in the number of wider finger piers, and serve as accessible boat slips.

A15.3 Fishing Piers and Platforms.

A15.3.3.1 Edge Protection. Edge protection is required only where railings, guards, or handrails are provided on a fishing pier or platform. Edge protection will prevent wheelchairs or other mobility devices from slipping off the fishing pier or platform. Extending the deck of the fishing pier or platform 12 inches where the 34-inch high railing is provided is an alternative design, permitting individuals using a wheelchair or other mobility device to pull into a clear space and move beyond the face of the railing. In such a design, edge protection is not required.

A15.3.2 Accessible Route, Exception 2. For example, to provide access to an accessible floating fishing pier, a gangway is used. The vertical distance is 60 inches between the elevation that the gangway departs the landside connection and the elevation of the pier surface at the lowest water level. Exception 2 permits the use of a gangway at least 30 feet long, or a series of connecting gangways with a total length of at least 30 feet. The length of transition plates would not be included in determining if the gangway(s) meet the requirements of the exception.

A15.3.3.3 Dispersion. Portions of the railings that are lowered to provide fishing opportunities for persons with disabilities must be located in a variety of locations on the fishing pier or platform to give people a variety of locations to fish. Different fishing locations may provide varying water depths, shade (at certain times of the day), vegetation, and proximity to the shoreline or bank.

A15.4 Golf.

A15.4.2 Accessible Routes. The accessible route or golf car passage must serve accessible elements and spaces located within the boundary of a golf course. The 48-inch minimum width for the accessible route is necessary to ensure passage of a golf car on either the accessible route or the golf car passage. This is important where the accessible route is used to connect the golf car rental area, bag drop areas, practice putting greens, accessible practice teeing grounds, course toilet rooms, and course weather shelters. These are areas outside the boundary of the golf course, but are areas where an individual using an adapted golf car may travel. A golf car passage may not be substituted for other accessible routes, required by ADAAG 4.1.2, located outside the boundary of the course. For example, an accessible route connecting an accessible parking space to the entrance of a golf course clubhouse is not covered by this provision.

A15.4.3 Accessible Route - Driving Ranges. Both a stand alone driving range or a driving range next to a golf course must provide an

accessible route or golf car passage that connects accessible teeing stations with accessible parking spaces. The accessible route must be a minimum width of 48 inches; 60 inches if handrails are provided. The additional width permits the use of a golf car on the accessible route. Providing a golf car passage will permit a person that uses a golf car to practice driving a golf ball from the same position and stance used when playing the game. Additionally, the space required for a person using a golf car to enter and exit the teeing stations required to be accessible should be considered.

A15.5 Miniature Golf.

Where possible, providing access to all holes on a miniature golf course is recommended. If a course is designed with the minimum 50 percent accessible holes, designers or operators are encouraged to select holes which provide for an equivalent experience to the maximum extent possible. Accessible holes are required to be consecutive with one break permitted, if the last hole on the course is in the sequence.

A15.5.3 Accessible Route. Where only the minimum 50 percent of the holes are accessible, an accessible route from the last accessible hole to the course exit or entrance must not require travel back through other holes. In some cases, this may require an additional route. Other options include increasing the number of accessible holes in a way that limits the distance needed to connect the last accessible hole with the course exit or entrance. In any case, careful consideration to the layout of the course will be important to minimize space impacts.

The 1-inch curb for a 32-inch minimum opening can be located in an area where the ball is less likely to ricochet. Where the accessible route on the hole is provided, steeper slopes are permitted for a limited distance. A landing or level area must separate each of these steeper sloping segments. This will provide a resting area between the steeper segments.

A15.5.5 Golf Club Reach Range. Accessible holes on a miniature golf course may be provided with an accessible route leading through the hole or with the accessible route next to the hole. Where the accessible route is provided adjacent to the hole, the route must be located within the golf club reach range. This allows individuals sufficient space and reach to play the game outside of the hole. Where possible, the distance between the level areas and the accessible route should be as close as possible, affording more opportunities for play.

A15.6 Play Areas.

A15.6.1 General. This section is to be applied during the design, construction, and alteration of play areas for children ages 2 and over. Play areas are the portion of a site where play components are provided. This section does not apply to other portions of a site where elements such as sports fields, picnic areas, or other gathering areas are provided. Those areas are addressed by other sections of ADAAG. Play areas may be located on exterior sites or within a building. Where separate play areas are provided within a site for children in specified age groups (e.g., preschool (ages 2 to 5) and school age (ages 5 to 12)), each play area must comply with this section. Where play areas are provided for the same age group on a site but are geographically separated (e.g., one is located next to a picnic area and another is located next to a softball field), they are considered separate play areas and each play area must comply with this section.

A15.6.2 Ground Level Play Components. A ground level play component is a play component approached and exited at the ground level. Examples of ground level play components include spring rockers, swings, diggers, and stand alone slides. When distinguishing between the different types of ground level play components, consider the general experience provided by the play component. Examples of different types of experiences include, but are not limited to, rocking, swinging, climbing, spinning, and sliding. A spiral slide may provide a slightly different experience from a straight slide, but sliding is the general experience and therefore a spiral slide is not considered a different type of play component than a straight slide.

The number of ground level play components is not dependent on the number of children who can play on the play component. A large seesaw designed to accommodate ten children at once is considered one ground level play component.

Where a large play area includes two or more composite play structures designed for the same age group, the total number of elevated play components on all the composite play structures must be added to determine the additional number and types of ground level play components that must be provided on an accessible route, and the type of accessible route (e.g., ramps or transfer systems) that must be provided to the elevated play components.

Ground level play components accessed by children with disabilities must be integrated in the play area. Designers should consider the optimal layout of ground level play components accessed by children with disabilities to foster interaction and socialization among all children. Grouping all ground level play components accessed by children with disabilities in one location is not considered integrated.

A15.6.3 Elevated Play Components. Elevated play components are approached above or below grade and are part of a composite play structure. A double or triple slide that is part of a composite play structure is one elevated play component. For purposes of this section, ramps, transfer systems, steps, decks, and roofs are not considered elevated play components. These elements are generally used to link other elements on a composite play structure. Although socialization and pretend play can occur on these elements, they are not primarily intended for play. Some play components that are attached to a composite play structure can be approached or exited at the ground level or above grade from a platform or deck. For example, a climber attached to a composite play structure can be approached or exited at the ground level or above grade from a platform or deck on a composite play structure. Play components that are attached to a composite play structure and can be approached from a platform or deck (e.g., climbers and overhead play components), are considered elevated play components. These play components are not considered ground level play components also, and do not count toward the requirements in 15.6.2 regarding the number of ground level play components that must be located on an accessible route.

A15.6.4 Accessible Routes. Accessible routes within the boundary of the play area must comply with 15.6.4. Accessible routes connecting the play area to parking, drinking fountains, and other elements on a site must comply with 4.3. Accessible routes provide children who use wheelchairs or other mobility devices the opportunity to access play components. Accessible routes should coincide with the general circulation path used within the play area. Careful placement and consideration of the layout of accessible routes will enhance the ability of children with disabilities to socialize and interact with other children.

Where possible, designers and operators are encouraged to provide wider ground level accessible routes within the play area or consider designing the entire ground surface to be accessible. Providing more accessible spaces will enhance the integration of all children within the play area and provide access to more play components. A maximum slope of 1:16 is required for ground level ramps; however, a lesser slope will enhance access for those children who have difficulty negotiating the 1:16 maximum slope. Handrails are not required on ramps located within ground level use zones.

Where a stand alone slide is provided, an accessible route must connect the base of the stairs at the entry point, and the exit point of the slide. A ramp or transfer system to the top of the slide is not required. Where a sand box is provided, an accessible route must connect to the border of the sand box. Accessibility to the sand box would be enhanced by providing a transfer system into the sand or by providing a raised sand table with knee clearance complying with 15.6.6.3.

Elevated accessible routes must connect the entry and exit points of at least 50 percent of elevated play components. Ramps are preferred over transfer systems since not all children who use wheelchairs or other mobility devices may be able to use or may choose not to use transfer systems. Where ramps connect elevated play components, the maximum rise of any ramp run is limited to12 inches. Where possible, designers and operators are encouraged to provide ramps with a lesser slope than the 1:12 maximum. Berms or sculpted dirt may be used to provide elevation and may be part of an accessible route to composite play structures.

Platform lifts complying with 4.11 and applicable State and local codes are permitted as a part of an accessible route. Because lifts must be independently operable, operators should carefully consider the appropriateness of their use in unsupervised settings.

A15.6.5 Transfer Systems. Transfer systems are a means of accessing composite play structures. Transfer systems generally include a transfer platform and a series of transfer steps. Children who use wheelchairs or other mobility devices transfer from their wheelchair or mobility devices onto the transfer platform and lift themselves up or down the transfer steps and scoot along the decks or platforms to access elevated play components. Some children may be unable or may choose not to use transfer systems. Where transfer systems are provided, consideration should be given to the distance between the transfer system and the elevated play components. Moving between a transfer platform and a series of transfer steps requires extensive exertion for some children. Designers should minimize the distance between the points where a child transfers from a wheelchair or mobility device and where the elevated play components are located. Where elevated play components are used to connect to another elevated play component in lieu of an accessible route, careful consideration should be used in the selection of the play components used for this purpose. Transfer supports are required on transfer platforms and transfer steps to assist children when transferring. Some examples of supports include a rope loop, a loop type handle, a slot in the edge of a flat horizontal or vertical member, poles or bars, or D rings on the corner posts.

A15.6.6 Play Components. Clear floor or ground spaces, maneuvering spaces, and accessible routes may overlap within play areas. A specific location has not been designated for the clear floor or ground spaces or maneuvering spaces, except swings, because each play component may require that the spaces be placed in a unique location. Where play components include a seat or entry point, designs that provide for an unobstructed transfer from a wheelchair or other mobility device are recommended. This will enhance the ability of children with disabilities to independently use the play component.

When designing play components with manipulative or interactive features, consider appropriate reach ranges for children seated in wheelchairs. The following table provides guidance on reach ranges for children seated in wheelchairs. These dimensions apply to either forward or side reaches. The reach ranges are appropriate for use with those play components that children seated in wheelchairs may access and reach. Where transfer systems provide access to elevated play components, the reach ranges are not appropriate.

Children's Reach Ranges

Forward or Side Reach	Ages 3 and 4	Ages 5 through 8	Ages 9 through 12
High (maximum)	36 in (915 mm)	40 in (1015 mm)	44 in (1120 mm)
Low (minimum)	20 in (510 mm)	18 in (455 mm)	16 in (405 mm)

Where a climber is located on a ground level accessible route, some of the climbing rings should be within the reach ranges. A careful balance of providing access to play components but not eliminating the challenge and nature of the activity is encouraged.

A15.6.7 Ground Surfaces. Ground surfaces along clear floor or ground spaces, maneuvering spaces, and accessible routes must comply with the ASTM F 1951 Standard Specification for Determination of Accessibility to Surface Systems Under and Around Playground Equipment. The ASTM F 1951 standard is available from the American Society for Testing and Materials (ASTM), 100 Barr Harbor Drive, West Conshohocken, PA 19428-2959, telephone (610) 832-9585. The ASTM F 1951 standard may be ordered online from ASTM (http://www.astm.org). The ASTM F 1951 standard determines the accessibility of a surface by measuring the work required to propel a wheelchair across the surface. The standard includes tests of effort for both straight ahead and turning movement, using a force wheel on a rehabilitation wheelchair as the measuring device. To meet the standard, the force required must be less than that required to propel the wheelchair up a ramp with a 1:14 slope. When evaluating ground surfaces, operators should request information about compliance with the ASTM F 1951 standard.

Ground surfaces must be inspected and maintained regularly and frequently to ensure continued compliance with the ASTM F 1951 standard. The type of surface material selected and play area use levels will determine the frequency of inspection and maintenance activities.

When using a combination of surface materials, careful design is necessary to provide appropriate transitions between the surfaces. Where a rubber surface is installed on top of asphalt to provide impact attenuation, the edges of the rubber surface may create a change in level between the adjoining ground surfaces. Where the change in level is greater than ½ inch, a sloped surface with a maximum slope of 1:12 must be provided. Products are commercially available that provide a 1:12 slope at transitions. Transitions are also necessary where the combination of surface materials include loose fill products. Where edging is used to prevent the loose surface from moving onto the firmer surface, the edging may create a tripping hazard. Where possible, the transition should be designed to allow for a smooth and gradual transition between the two surfaces.

A15.7 Exercise Equipment and Machines, Bowling Lanes, and Shooting Facilities.

A15.7.2 Exercise Equipment and Machines. Fitness facilities often provide a range of choices of exercise equipment. At least one of each type of exercise equipment and machine must be served by an accessible route. Most strength training equipment and machines are considered different types. For example, a bench press machine is considered a different type than a biceps curl machine. The requirement for providing access to each type is intended to cover the variety of strength training machines. Where operators provide a biceps curl machine and free weights, both are required to meet the provisions in this section, even though an individual may be able to work on their biceps through both types of equipment. Where the exercise equipment and machines provided are only different in that different manufacturers provide them, only one of each type of machine is required to meet these guidelines. For example, where two bench press machines are provided and each is manufactured by a different company, only one is required to comply.

Similarly, there are many types of cardiovascular exercise machines, such as stationary bicycles, rowing machines, stair climbers, and treadmills. Each machine provides a cardiovascular exercise and is considered a different type for purposes of these guidelines.

One clear floor or ground space is permitted to be shared between two pieces of exercise equipment. Designers should carefully consider layout

options to maximize space such as connecting ends of the row and center aisle spaces.

The position of the clear floor space may vary greatly depending on the use of the equipment or machine. For example, to make a shoulder press accessible, clear floor space next to the seat would be appropriate to allow for transfer. Clear floor space for a bench press machine designed for use by an individual seated in a wheelchair, however, will most likely be centered on the operating mechanisms.

Designers and operators are encouraged to select exercise equipment and machines that provide fitness opportunities for persons with lower body extremity disabilities. Upper body exercise equipment and machines that offer either cardiovascular or strength training will enhance fitness opportunities for persons with disabilities from a wheelchair or mobility device. Examples include: equipment or machines that provide arm ergometry, free weights, and weighted pulley systems that are usable from a wheelchair or mobility device.

A15.7.4. Shooting Facilities. Examples of different types of firing positions include, but are not limited to: positions having different admission prices, positions with or without weather covering or lighting, and positions supporting different shooting events such as argon, muzzle loading rifle, small bore rifle, high power rifle, bull's eye pistol, action pistol, silhouette, trap, skeet, and archery (bow and crossbow).

A15.8 Swimming Pools, Wading Pools, and Spas.

A15.8.2 Swimming Pools. Where more than one means of access is provided into the water, it is recommended that the means be different. Providing different means of access will better serve the varying needs of people with disabilities in getting into and out of a swimming pool. It is also recommended that where two or more means of access are provided, they not be provided in the same location in the pool. Different locations will provide increased options for entry and exit, especially in larger pools.

A15.8.2 Swimming Pools, Exception 1. Pool walls at diving areas and areas along pool walls where there is no pool entry because of landscaping or adjacent structures should be counted when determining the number of accessible means of entry required.

A15.8.5 Pool Lifts. There are a variety of seats available on pool lifts ranging from sling seats to those that are preformed or molded. Pool lift seats with backs will enable a larger population of persons with disabilities to use the lift. Pool lift seats that consist of materials that resist corrosion and provide a firm base to transfer will be usable by a wider range of people with disabilities. Additional options such as armrests, head rests, seat belts, and leg support will enhance accessibility and better accommodate people with a wide range of disabilities.

A15.8.5.6 Footrests and Armrests. Footrests are encouraged on lifts used in larger spas, where the foot well water depth is 34 inches or greater. Providing footrests, especially ones that support the entire foot, will facilitate safe and independent transfers by a larger population of persons with disabilities.

A15.8.5.7 Operation. Pool lifts must be capable of unassisted operation from both the deck and water levels. This will permit a person to call the pool lift when the pool lift is in the opposite position. It is extremely important for a person who is swimming alone to be able to call the pool lift when it is in the up position so he or she will not be stranded in the water for extended periods of time awaiting assistance. The requirement for a pool lift to be independently operable does not preclude assistance from being provided.

A15.8.5.9 Lifting Capacity. Single person pool lifts must be capable of supporting a minimum weight of 300 pounds and sustaining a static load of at least one and a half times the rated load. Pool lifts should be provided that meet the needs of the population it is serving. Providing a pool lift

with a weight capacity greater than 300 pounds may be advisable.

A15.8.6.1 Sloped Entries. Personal wheelchairs and mobility devices may not be appropriate for submerging in water. Some may have batteries, motors, and electrical systems that when submerged in water may cause damage to the personal mobility device or wheelchair or may contaminate the pool water. Providing an aquatic wheelchair made of non-corrosive materials and designed for access into the water will protect the water from contamination and avoid damage to personal wheelchairs or other mobility aids.

A15.8.6.3 Handrails. Handrails on both sides of a sloped entry provides stability to both persons with mobility impairments and persons using wheelchairs. For safety reasons, a single handrail is permitted on sloped entries provided at wave action pools, leisure rivers, sand bottom pools, and other pools where user access is limited to one area.

A15.8.8.4 Transfer Steps. Where possible, the height of the transfer step should be as minimal as possible. This will decrease the distance an individual is required to lift up or move down to reach the next step to gain access.

A15.8.8.7 Grab Bars. Pool operators have the choice of providing a grab bar on one side of each step and transfer platform or a continuous grab bar on one side serving each transfer step and the transfer platform. If provided on each step, the top of the gripping surface must be 4 to 6 inches above each step. Where a continuous grab bar is provided, the top of the gripping surface must be 4 to 6 inches above the step nosing. Each type has its advantages. A continuous handrail allows the person that is transferring to maintain a constant grip on the handrail while moving up or down the transfer steps. Grab bars provided on each step provide the gripping surface parallel to each step rather than on a diagonal.

A15.8.10 Water Play Components. Personal wheelchairs and mobility devices may not be appropriate for submerging in water when accessing play components located in water. Some may have batteries, motors, and electrical systems that when submerged in water may cause damage to the personal mobility device or wheelchair or may contaminate the water. Providing an aquatic wheelchair made of non-corrosive materials and designed for access into the water will protect the water from contamination and avoid damage to personal wheelchairs.

US Agencies - Radiation Sickness; National Institute of Building Sciences (NIBS), IEQ Indoor Environmental Quality; Recommendations for Accommodation for Electromagnetic Sensitivity; 2005

IEQ Indoor Environmental Quality

A project of the National Institute of Building Sciences (NIBS) with funding support from The Architectural and Transportation Barriers Compliance Board (Access Board)

Table of Contents

Designated Cleaner Air Rooms

Introduction

The Architectural and Transportation Barriers Compliance Board (Access Board) is an independent federal agency devoted to accessibility for people with disabilities. The Access Board is responsible for developing and maintaining accessibility guidelines to ensure that newly constructed and altered buildings and facilities covered by the Americans with Disabilities Act and the Architectural Barriers Act are accessible to and usable by people with disabilities. In November 1999, the Access Board issued a proposed rule to revise and update its accessibility guidelines. During the public comment period on the proposed rule, the Access Board received approximately 600 comments from individuals with multiple chemical sensitivities (MCS) and electromagnetic sensitivities (EMS). They reported that chemicals released from products and materials used in construction, renovation, and maintenance of buildings, electromagnetic fields, and inadequate ventilation are barriers that deny them access to most buildings.

Americans spend about 90 percent of their time indoors, where concentrations of air pollutants are often much higher than those outside. According to the U.S. EPA Healthy Buildings, Healthy People: A Vision for the 21st Century, www.epa.gov/iaq/hbhp/hbhptoc.html "Known health effects of indoor pollutants include asthma; cancer; developmental defects and delays, including effects on vision, hearing, growth, intelligence, and learning; and effects on the cardiovascular system (heart and lungs). Pollutants found in the indoor environment may also contribute to other health effects, including those of the reproductive and immune systems." (p. 4). The report further notes that "Most chemicals in commercial use have not been tested for possible health effects. (p. 8).

There are a significant number of people who are sensitive to chemicals and electromagnetic fields. Surveys conducted by the California and New Mexico Departments of Health and by medical researchers in North Carolina found 16 to 33 percent of the people interviewed reported that they are unusually sensitive to chemicals, and in the California and New Mexico health departments' surveys 2 percent to 6 percent reported that they have been diagnosed as having multiple chemical sensitivities. C. Miller and N. Ashford, "Multiple Chemical Intolerance and Indoor Air Quality," in *Indoor Air Quality Handbook* Chapter 27.8 (McGraw-Hill 2001). Another California Department of Health Services survey has found that 3 percent of the people interviewed reported that they are unusually sensitive to electric appliances or power lines. P. LeVallois, et al., "Prevalence and Risk Factors of Self-Reported Hypersensitivity to Electromagnetic Fields in California," in California EMF Program, "An Evaluation of the Possible Risks From Electric and Magnetic Fields (EMFs From Power Lines, Internal Wiring, Electrical Occupations and Appliances, Draft 3 for Public Comment, April 2001" Appendix 3 (http://www.dhs.ca.gov/ehib/emf/RiskEvaluation/riskeval.html).

Individuals with multiple chemical sensitivities and electromagnetic sensitivities, who submitted written comments and/or attended the public information meetings on the draft final rule, requested that the Access Board include provisions in the final rule to make buildings and facilities accessible for them.

The Board has not included such provisions in their rules, but they have taken the commentary very seriously and acted upon it. As stated in the Background for its Final Rule **Americans with Disabilities Act (ADA) Accessibility Guidelines for Buildings and Facilities; Recreation Facilities**: http://www.access-board.gov/recreation/final.htm

> "The Board recognizes that multiple chemical sensitivities and electromagnetic sensitivities may be considered disabilities under the ADA if they so severely impair the neurological, respiratory or other functions of an individual that it substantially limits one or more of the

> individual's major life activities. The Board plans to closely examine the needs of this population, and undertake activities that address accessibility issues for these individuals.
>
> The Board plans to develop technical assistance materials on best practices for accommodating individuals with multiple chemical sensitivities and electromagnetic sensitivities. The Board also plans to sponsor a project on indoor environmental quality. In this project, the Board will bring together building owners, architects, building product manufacturers, model code and standard-setting organizations, individuals with multiple chemical sensitivities and electromagnetic sensitivities, and other individuals. This group will examine building design and construction issues that affect the indoor environment, and develop an action plan that can be used to reduce the level of chemicals and electromagnetic fields in the built environment."

This report and the recommendations included within are a direct outgrowth from that public comment process. The Access Board contracted with the National Institute of Building Sciences (NIBS) to establish this Indoor Environmental Quality Project as a first step in implementing that action plan.

A broad and distinguished Steering Committee was established and met in January 2004 in Bethesda, Maryland, to review the project objectives. Subsequently four task teams (committees) were established to address specific issues in buildings related to Operations & Maintenance, Cleaner Air Rooms, Design and Construction, and Products and Materials. The following reports from these four committees offer recommendations for improving IEQ in buildings. They also list valuable resources and references to allow readers to investigate the pertinent issues in greater depth. The focus of the project was on commercial and public buildings, but many of the issues addressed and recommendations offered are applicable in residential settings.

Many volunteers worked diligently to create the recommendations in this report. These individuals are listed in the separate committee sections of the report, but special thanks go to the committee chairs: respectively Hal Levin, Building Ecology Research Group; Michael Mankin, California Division of the State Architect; Roger Morse, Morse-Zentner Associates; and Brent Kynoch, Kynoch Environmental Management, Inc. Lastly, an enormous debt of gratitude is owed to four amazing individuals who made significant contributions to the work of all four committees: Mary Lamielle, National Center for Environmental Health Strategies; Ann McCampbell, MD, Multiple Chemical Sensitivities Task Force of New Mexico; Susan Molloy, National Coalition for the Chemically Injured; and Toni Temple, Ohio Network for the Chemically Injured.

The overall objectives of this project were to establish a collaborative process among a range of stakeholders to recommend practical, implementable actions to both improve access to buildings for people with MCS and EMS while at the same time raising the bar and improving indoor environmental quality to create healthier buildings for the entire population.

This IEQ project supports and helps achieve the goals of the Healthy Buildings, Healthy People project, which acknowledges that "We will create indoor environments that are healthier for everyone by making indoor environments safer for the most vulnerable among us, especially children." (p.17)

Summary Recommendations

The recommendations in this report are only a first step toward the action plan envisioned by the Access Board.

The NIBS IEQ committee offers several recommendations for further action. It is recommended that a follow-on project organize and convene one, or more, workshops to deliberate the issues and recommendations in this report. It is also recommended that a project be organized to develop a single guidelines document. Such guidelines would be built on refinement and coordination of the recommendations of the Design & Construction and Products & Materials committees in this report. This same, or a separate project, should develop new building code provisions to accelerate the implementation of improved IEQ. Lastly, it is recommended that a project be organized to develop guidelines for the design of an "ideal space" for people with MCS and EMS. The recommended follow-up projects should involve collaborative effort and funding from a range of organizations across the building community; e.g., American Institute of Architects (AIA), Associated General Contractors of America (AGC), Building Owners & Managers Association International (BOMA), American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE), Environmental Protection Agency (EPA), and, of course, the Access Board.

Steering Committee

Nicolas Ashford, Massachusetts Institute of Technology
Kathy Barcus, Clarke Construction Company, Inc.
Marilyn Golden, Disability Rights Education and Defense Fund (DREDF)
Harry Gordon, Burt Hill Kosar and Rittelmann Associates
Mark Jackson, Lennox Industries, Inc.
Brent Kynoch, Kynoch Environmental Management, Inc.
Mary Lamielle, National Center for Environmental Health Strategies
Ann McCampbell, Multiple Chemical Sensitivities Task Force of New Mexico
Claudia Miller, University of Texas Health Sciences Center - San Antonio
Susan Molloy, National Coalition for the Chemically Injured
Roger Morse, Morse Zentner Associates
Larry Perry, Building Owners and Managers Association
Bruce Small, Building Inspections
Toni Temple, Ohio Network for the Chemically Injured
James Wasley, University of Wisconsin-Milwaukee

James Raggio, Access Board
Alexander Shaw, National Institute of Building Sciences

National Institute of Building Sciences (NIBS)
Indoor Environmental Quality (IEQ) Project
Operations & Maintenance Committee

May 26, 2005

Table of Contents

INTRODUCTION AND OVERVIEW

Problem Summary

The operation and maintenance of commercial and public buildings can affect their accessibility for people with asthma and multiple chemical and/or electromagnetic sensitivities. The presence of many products or conditions involved in cleaning, maintaining, using, and operating buildings often contributes to poor indoor environmental quality and are access barriers for these individuals.

Problematic substances include, but are not limited to, pesticides, fragrances, disinfectants, many cleaners and new building materials and furnishings, and smoke and other engine exhaust. Inadequate ventilation of a building further contributes to poor indoor environmental quality.

The presence of electromagnetic fields from office equipment and other sources is a barrier for those with electromagnetic sensitivities. Noise and vibration can adversely affect some people with chemical and/or electromagnetic sensitivities and trigger seizures in susceptible individuals.

General Solutions

Measures taken to improve indoor environmental quality, such as reducing air pollutants, noise and electromagnetic fields in buildings, will increase their accessibility for people with asthma and chemical and/or electromagnetic sensitivities, as well as provide a more healthful environment for all building occupants.

While “green” and “environmentally-friendly” practices and products for construction and maintenance of buildings sometimes provide more healthful indoor environments and improves access for those with asthma and multiple chemical sensitivities, this is not always the case. The U.S. EPA notes that there is growing concern that standards being promoted by the green building movement, such as Green Seal and Green Guard standards, are not sufficiently protective of health (1).

For example, some measures recommended to promote energy and water conservation -- such as reducing outdoor air supplied and/or reducing time of HVAC usage, using motion sensors that can create electromagnetic fields, using waterless urinals that require continuous chemical treatments, recommending cold water for cleaning, and promoting the use of alcohol hand wipes instead of hand washing – can cause or lead to increased indoor pollution and less healthful and accessible environments.

In addition, “greener cleaners” often promote the use of citrus- and/or pine-based products, which can react with even low levels of oxidants, such as ozone, to produce hazardous byproducts, as well as make buildings inaccesible for many people with chemical sensitivities. The addition of either synthetic or natural fragrances to cleaning and other products is also problematic for chemically sensitive individuals.

Other common green building recommendations, such as building on brownfields, using tuck-under parking, and putting heliports or gardens on roofs can also lead to diminished indoor air quality and create barriers for people with chemical sensitivities.

Lastly, the green building community has yet to provide guidance on the issue of electromagnetic fields.

BARRIERS & ISSUES

Fragrances

The presence of perfume, cologne, scented cleaners and other scented products contributes to poor indoor air quality and is one of the major access barriers for people with asthma and multiple chemical sensitivities.

“Fragrances” are chemical compounds added to a product to give it a scent. There are approximately 3000 chemicals used in the manufacture of fragrances. Most of these chemicals are synthetic and derived from petroleum. Chemicals found in fragrance formulations include toluene, alcohols, formaldehyde, styrene, benzene, limonene, phthalates, and musk. An individual fragrance formula may contain over 100 chemicals, but their identity is protected as a trade secret. Fragrances do not have to be tested for safety before they are put on the market (2).

Exposure to fragrances can trigger asthma attacks and migraine headaches, and aggravate sinus conditions. In those who are chemically sensitive, fragrance exposures can also cause irregular heartbeat, memory loss, confusion, fatigue, and neurological, vascular, and other problems. In addition, some fragrance chemicals are implicated in causing cancer and/or damaging the liver, kidneys, and central nervous system. Fragrance chemicals can enter the body via inhalation, skin absorption, or nasal passageways.

According to a 1986 U.S. House of Representatives Report:

"*In 1986, the National Academy of Sciences targeted fragrances as one of the six categories of chemicals that should be given high priority for neurotoxicity testing. The other groups include insecticides, heavy metals, solvents, food additives and certain air pollutants. The report states that 95 percent of chemicals used in fragrances are synthetic compounds derived from petroleum. They include benzene derivatives, aldehydes, and many other known toxics and sensitizers, which are capable of causing cancer, birth defects, central nervous system disorders and allergic reactions* " (3)

If a product label lists “fragrance” as an ingredient on the back of the label, it contains added fragrance, even if the front label says the product is “unscented” or “fragrance-free”. If “fragrance” is not listed as an ingredient, it may still contain fragrance chemicals or contain natural fragrances.

The main sources of fragrances in buildings are from 1) fragrance-emitting devices (FEDS), sprays, and deodorizers, 2) other scented cleaning and maintenance products, 3) perfume; cologne; essential oils; and scented skin and hair products, cosmetics, and other personal care products, 4) clothing that has been laundered with scented detergents, fabric softeners, or dryer sheets, and 5) potpourri, incense and scented candles (even when incense or scented candles are not burning). Sometimes fragrance is added to and dispersed by a building’s ventilation system.

Pesticides

Pesticides are hazardous chemicals designed to kill or repel insects, plants, and other pests. The term pesticide applies to insecticides, herbicides (weed-killers), fungicides, rodenticides, disinfectants, and other substances used to control pests. Many pesticides contain volatile and/or semi-volatile chemicals that contribute to poor indoor air and environmental quality (IAQ/IEQ).

A pesticide product consists of the active ingredient(s) and "inert" ingredients. Active ingredients are the chemicals that kill or repel the pest. The rest of the product is composed of "inert" ingredients, which often comprise over 95% of the pesticide product. "Inert" ingredients are commonly solvents and may be as, or more, toxic than the active ingredient(s).

Individuals exposed to pesticides are at risk for both acute and chronic health effects (4, 5, 6, 7). Pesticide exposures can exacerbate asthma and cause nausea, headaches, rashes, dizziness, fatigue and memory loss. Many pesticides are also linked with causing cancer, birth defects, neurological and reproductive disorders, and the onset and exacerbation of chemical sensitivities. Pesticide exposure can occur long after its application because pesticide products are often designed to be persistent in the environment.

For people who are chemically sensitive, exposure to even minute amounts of pesticides from, for example, pesticide drift from neighborhood lawn treatments, driving on a road where herbicides have been sprayed weeks earlier, or being in a building that was treated with pesticides even several years earlier, can cause severe, sometimes, life-threatening and/or prolonged illness (8). Thus the presence of pesticides is one of the greatest access barriers for people with chemical sensitivities.

The use of pesticides can be eliminated or significantly reduced through implementation of Integrated Pest Management (IPM) programs. IPM is a program of prevention, monitoring, record-keeping, and control that eliminates or drastically reduces the use of pesticides. The focus of IPM is to prevent pest problems by reducing or eliminating sources of pest food, water, and shelter and by maintaining healthy lawns and landscapes. The first approach to controlling a pest outbreak is to improve sanitation, make structural repairs (such as fixing leaky pipes and caulking cracks), and using physical or mechanical controls such as screens, traps and mechanical weed cutters. A least hazardous chemical is used only when other strategies have failed.

IPM strategies are being increasingly implemented in schools, parks, government facilities, and hospitals nationwide. One needs to be aware, however, that the term IPM is sometimes inappropriately used for pest management programs that use or recommend the use of significant amounts of pesticides.

Cleaning Products & Disinfectants

Many toxic chemicals are found in janitorial cleaning supplies used in industrial and commercial facilities. They often emit volatile organic compounds (VOC's) (9), contribute to poor indoor air quality (IAQ), and create access barriers for people with asthma, allergies, and/or chemical sensitivities. Some of these chemicals are associated with human health effects, including cancer, damage to major organs, interference with normal reproduction and development, and even death. (10).

Even "greener cleaners" may contain volatile substances, like citrus or pine, that can cause adverse health effects in building occupants.

There is a wide range of cleaning and maintenance products that include, but are not limited to, air fresheners, deodorizers, bathroom and tile cleaners, dusting aids, engine and other degreasers, lubricants, fabric protectants, floor polishes and waxes, furniture polish, general purpose cleaners, glass cleaners, laundry products, oven cleaners, carpet and upholstery cleaners, graffiti remover, and floor strippers. One of the most hazardous cleaning operations for workers and building occupants is the stripping and refinishing of floors.

Some cleaning products also contain disinfectants. The U.S. EPA notes that one major concern from a health standpoint is the increased incorporation of antimicrobial agents and fragrances in cleaners and air fresheners marketed to reduce indoor air contamination (1).

Many commonly used disinfectant or sanitizer products contain chlorine, phenol, quaternary ammonium compounds, and isopropyl and other alcohols. These produce hazardous fumes and present access barriers for people with chemical sensitivities.

Electromagnetic Fields

For people who are electromagnetically sensitive, the presence of cell phones and towers, portable telephones, computers, fluorescent lighting, unshielded transformers and wiring, battery re-chargers, wireless devices, security and scanning equipment, microwave ovens, electric ranges and numerous other electrical appliances can make a building inaccessible.

The National Institute for Occupational Safety and Health (NIOSH) notes that scientific studies have raised questions about the possible health effects of EMF's. NIOSH recommends the following measures for those wanting to reduce EMF exposure – informing workers and employers about possible hazards of magnetic fields, increasing workers' distance from EMF sources, using low-EMF designs wherever possible (e.g., for layout of office power supplies), and reducing EMF exposure times (11).

Renovation/Remodeling/Furniture

Many new building materials, such as paints, adhesives, wallboard, carpet, and insulation, as well as upholstered furniture, particleboard cabinets, and other furnishings emit hazardous volatile organic compounds (VOC's), contribute to poor indoor air quality (IAQ) and create significant access barriers for people with asthma and/or chemical sensitivities. These materials often outgas and are problematic for prolonged periods of time.

Smoke & Combustion

Many people with asthma and most people with chemical sensitivities are made sick by exposure to: 1) smoke, such as that from tobacco, fireplaces, candles, incense, and barbeques, and other outdoor fires, 2) vehicle and other engine exhaust, especially exhaust from vehicles using diesel or oxygenated fuel, and 3) combustion appliances burning kerosene, propane, or natural gas (natural gas usually being better tolerated than kerosene or propane). If combustion appliances are used, they should be directly vented to the outdoors. Electrical appliances are preferred by people with chemical sensitivities.

Noise & Vibration

Noise and vibration from HVAC systems, vacuums, pumps, helicopters and other sources can trigger severe symptoms, including seizures, in susceptible individuals.

Synergistic Effects of Indoor Air Pollutants

Indoor air is a "chemical soup" made up of a variety of chemicals emitted by building materials, cleaning products, pesticides, personal care and consumer products, emissions from building equipment and activities, etc. While individual chemicals may be hazardous, combinations of chemicals can be even more hazardous through additive or synergistic effects. Synergistic effects

occur when the health impacts of a chemical combination is greater than the sum of the impacts of the individual chemicals.

Indoor Air Chemistry

In indoor air, chemicals can react with one another to form other compounds that are more hazardous than the original chemicals. Increasing evidence has shown that ozone and hydroxyl radicals formed by other oxidants can react with alkenes (such as limonene found in citrus and fragrance formulations, as well as terpenes emitted by many wood products) to generate secondary pollutants, including formaldehyde, as well as hydroxy radicals that can react with organics to form other potentially toxic air pollutants. The toxicity of many of these secondary pollutants is well-established while for others it has yet to be evaluated (12, 13, 14, 15, 16). These reactions can be limited by employing carbon-based filters in locations where outdoor ozone concentrations commonly approach or exceed the National Ambient Air Quality Standards (NAAQS) promulgated by the U.S. EPA.

Persistence of Indoor Air Pollutants

Many porous building materials and furnishings, such as carpeting, couches, drapes, and wallboard, absorb cleaning chemicals, fragrances, pesticides, and other air pollutants. Chemicals adsorb to virtually all indoor surfaces but more strongly to rough rather than smooth surfaces. These processes are known as the “sink effect”. These chemicals can be re-emitted into the air for long periods of time leading to prolonged air pollution. For example, it is not uncommon for a building to retain the odor of a fragrance-emitting device (FED) months after it has been removed. Similarly, residual tobacco smoke can still be detected in buildings long after a no-smoking policy is implemented. Air pollutants clear more readily from buildings that contain a higher percentage of hard impermeable surfaces.

RECOMMENDED ACTIONS FOR FACILITY MANAGERS AND OPERATIONS & MAINTENANCE STAFF

The O & M Committee identified ***pesticides*** (indoors & outdoors), ***fragrances*** (especially fragrance-emitting devices/FEDS, air fresheners, and deodorizers), and volatile ***cleaners*** (including citrus & pine) as the biggest access barriers for people with chemical sensitivities related to operations and maintenance of a building. Cell phone use was identified as a significant barrier for people with electromagnetic sensitivities.

The Committee developed recommendations for making buildings more accessible for people with chemical and/or electromagnetic sensitivities in the areas of pest control, cleaning & disinfecting, mechanical / HVAC, landscape maintenance, and enclosure maintenance. They are listed in bullet form in the Appendix and summarized in the body of the report below.

In addition, recommendations are given for renovation, remodeling, and furnishings and for adoption of polices on smoking, fragrances, cell phone use, notification of building activities, and vehicle idling.

The Committee recognizes that the list of recommendations is long and that few buildings will be able to implement all of them. The recommendations are the ideal goal towards which to strive. Any steps taken to reduce the levels of the problematic substances or conditions listed above will improve access for people with chemical and/or electromagnetic sensitivities and create a healthier building.

Some of the recommendations will not apply to certain types of buildings or geographic areas. The recommendations are given in sufficient detail to help those who need to address a specific issue. Resources from which to obtain more information or guidance are also provided in the Appendix and at the end of the document in Additional Resources.

Recommendations for Pest Control

Adopt an Integrated Pest Management (IPM) program for building interiors and grounds as described in "Healthy Hospitals, Controlling Pests Without Harmful Pesticides" (17). The Los Angeles Unified School District also has an exemplary plan for an IPM program (18).

IPM is a program of prevention, monitoring, record-keeping, and control that eliminates or drastically reduces the use of pesticides. The focus of IPM is to prevent pest problems by reducing or eliminating sources of pest food, water, and shelter and by maintaining healthy lawns (19) and landscapes.

The first approach in controlling a pest outbreak is to improve sanitation, make structural repairs (such as fixing leaky pipes and caulking cracks), and using physical or mechanical controls such as screens, traps, vacuums, and mechanical weed cutters. Increased sanitation measures include more frequent trash removal, restricting eating to designated areas, securing trash container lids, and steam cleaning trash containers. The IPM approach uses knowledge of a pest's biology, habitat, and needs to time specific interventions to prevent and control pests. A least hazardous chemical is used only when other strategies have failed.

Pesticide use is discouraged in a true IPM program. If pesticides are used indoors or outdoors, however, the following precautions should be taken -- notification of applications (even for "spot" or crack & crevice treatments) should be given through posting of signs (before, during, and after applications) and by other means to building occupants, especially those on a pesticide notification

registry (20), applications should only be made by a licensed applicator, applications should not be made inside buildings by spraying, fogging, bombing, or tenting, and applications should not be made in occupied areas or areas that may become occupied during the 24 hours (at a minimum) following an application. In buildings that are constantly occupied, pesticide applications should be made when they are least occupied. It is recommended that pesticides be applied when there is the longest time before the area will be re-occupied, such as at the beginning of a weekend or vacation period.

The Committee recommends that certain pesticides, such as organophosphates, carbamates, pyrethroids, and other neurotoxic insecticides; 2,4-D, other phenoxy herbicides, and glyphosate; and fungicides such as mancozeb, chlorothalonil, and maneb, never be used.

Recommendations for Cleaning & Disinfecting

Use fragrance-free, low-VOC cleaning products. Do not use fragrance-emitting devices (FEDS), plug-ins, or sprays; urinal or toilet blocks; or other deodorizer/re-odorizer products. Reduce odors by increasing cleaning and ventilation and/or using baking soda or zeolite to absorb odors. Do not use products containing paradichlorobenzene (21) or naphthalene, which are common ingredients in FEDS.

Do not use cleaner/disinfectant combination products. Avoid or limit the use of products containing chlorine, ammonia, quaternary ammonium, phenol, isopropyl and other alcohols, formaldehyde, and other petroleum distillates. Do not use citrus- or pine-based products. Hydrogen peroxide-based products are the preferred disinfectants, but still should be used with caution and care. Use hot water for cleaning to reduce the need for soaps, detergents, and disinfectants.

Use disinfectants only in areas and at strengths (i.e., levels of disinfection) required by law. Check with
local health department to obtain details of all legal requirements. Clean surfaces thoroughly before disinfecting. Leave disinfectants in place for the correct amount of time before wiping surfaces clean.

Audit cleaning chemicals currently in use and develop a plan to replace with safer alternatives.

Vacuum frequently and thoroughly using vacuums with HEPA filters and strong suction. If carpets must be cleaned, use steam or least toxic all-purpose cleaner or carpet cleaner that does not contain petroleum solvents. Spot clean whenever possible. Clean stains while they are fresh to avoid the need for aggressive cleaning later. Dust hard surfaces with a lint-free cloth, or with water only.

Spray cleaning products on to cloths rather than on to surfaces or into the air. Dry all washed surfaces with a dry cloth or mop to reduce chemical residue and chance of mold growth. Minimize the use of floor waxes and buffing.

Ventilate well when using cleaning products. Post signs during cleaning. Make cleaning schedule available to employees or others upon request.

Schedule heavy cleaning, repairs and maintenance during low or no-occupancy periods whenever possible.

Prohibit occupant usage of cleaning chemicals except as authorized. Establish a list of least toxic, low-VOC cleaning products (and/or provide them to employees) which they can use to clean computers, erase felt pen writing on white board, and perform other similar activities.

In decorative building fountains, use the minimum amount of chlorine necessary for disinfection, avoid the use of bromine, use closed ozone water treatment systems to the maximum extent possible, and make use of newer, less-toxic disinfecting technologies as they become available.

Avoid the use of wall-mounted devices, similar to fragrance-emitting devices (FEDS), that operate automatically or by pushing a button to dispense deodorizers, disinfectants, and pesticides.

Recommendations for Mechanical Equipment / HVAC

Adhere to a strict maintenance schedule for HVAC equipment and make sure it is working properly. Use the highest efficiency filters compatible with current HVAC system, and if necessary, consider retrofitting the system to increase filtration capabilities. Maintain relative humidity between 30% and 50%.

Use non-chemical methods to maintain HVAC ducts free of particulate matter, dust, and debris, such as physical removal or use of vacuums. Do not use the HVAC system to disperse fragrances or other materials.

Seal return air openings into HVAC system during remodeling and exhaust directly to the outdoors, by temporarily removing window glazing if necessary.

Use demand controlled ventilation (DCV) that provides liberal amounts of air flow and outdoor air ventilation. Before a building is re-occupied in the morning or after weekends, flush with at least three complete outdoor air exchanges.

Create door and window-opening protocol to maintain proper pressure relationships and air flow in the building. Educate and provide protocol to staff and other building occupants. Policy should include provision that allows chemically sensitive and other individuals to open windows on a temporary or regular basis, as needed because of a health condition. Windows should also be permitted to be opened by occupants when the HVAC system is not working or shut off, such as may occur during nights and weekends.

Make maximum use of economizer cycle. Avoid energy conservation practices that reduce intake of outside air below minimum requirements.

Avoid or minimize the use of humidifiers in the building's HVAC system. Prohibit the use of personal humidifiers except when an occupant has a medical need for one. Maintain the cleanliness of all humidifier equipment and use the minimum amount of water treatment chemicals necessary to control dissolved solids and pH and prevent antimicrobial contamination. Do not allow the use of portable air "cleaners" that emit ozone.

Repair plumbing with least toxic, low-VOC materials. Use snakes or other mechanical methods to clear clogged drains. Use bacterial enzymes to prevent drain clogs. Inspect floor and other drains, especially those that are infrequently used, to ensure there is water in the P-traps, thereby avoiding sewer gas backup. Treat grease traps daily with bacterial enzymes.

Recommendations for Landscape Maintenance

Maintain lawns and gardens organically. Use integrated pest management (IPM) to eliminate or minimize the use of herbicides, fungicides, insecticides, and other pesticides. Maintain soil health. Avoid the use of synthetic fertilizers.

Pull, mow, or use mechanical weed cutters to remove weeds. Vinegar can be used to kill weeds along fence lines and other hard to reach places.

Avoid dust-blowing equipment like leaf blowers. Sweeping, raking, and use of vacuums are the preferred methods for removing debris.

Avoid diesel-powered and 2-cycle engine equipment. Use electric lawn and landscape equipment whenever possible.

Use rock, gravel, flat stones, or pavers for mulch, and/or use typar landscape barrier to suppress weeds. Avoid organic mulches, like cocoa beans, peat moss, wood chips, and bark, especially near operable windows and doors of buildings. These mulches usually emit volatile fumes and may produce or harbor mold.

Avoid the use of CCA wood or wood chips because they contain arsenic and other toxic chemicals which can leach into the environment. Do not use railroad ties because they contain creosote.

Apply pesticide, fertilizers, and lime only when there is little or no wind and apply them in a manner that prevents drift. Post signs and provide advance notification to building occupants before starting these applications.

Use least toxic, low-VOC paints, stains, and finishes on outside equipment, like benches, poles, decks, and porches.

Recommendations for Enclosure Maintenance

It is important to properly maintain the building envelop in order to prevent mold problems and block pest entry.

Routinely inspect and clean roof and gutters to make sure they are draining properly. Promptly repair roof or plumbing leaks. Regularly inspect walls and foundations, especially all utility entrance seals (e.g., phone, water, electric, and cable) for cracks and repair promptly if found. Insulate cold pipes to prevent condensation.

Promptly remove wet ceiling tiles and wall panels.

Remove excess water from carpeting damaged by clean water and quickly dry it to avoid mold buildup. Do not use disinfectants or moldicides (other than hydrogen peroxide-based ones). Instead, utilize a steam extraction carpet cleaning system with a hydrogen peroxide-based cleaner/disinfectant. Inspect carpet after it is completely dried to ensure there is no mold or mildew. Those with asthma or chemical sensitivities should be removed from areas where there is wet carpeting. Remove carpeting if it has been wet longer than 24 hours.

Immediately remove and do not re-use any wet carpeting that has been contaminated with sewer water, heavy dirt and soils, or toxic chemicals.

Seal rusted surfaces with a least toxic low VOC sealant to minimize emissions of airborne particles.

Recommendations for Renovation/Remodeling/Furnishings

It is recommended that buildings and furnishings be well maintained to reduce the need for renovation and remodeling. Chemically sensitive individuals often tolerate older building materials and furnishings better than new ones because older materials have usually outgassed and emit lower levels of VOCs.

If renovation and remodeling is done, however, efforts should be made to limit activities to select areas, rather than being done on a wide scale. They should be performed when the areas are unoccupied (or the least occupied in buildings that are in constant use).

If new materials and finishes are applied (especially wet-applied products such as paints, sealants, caulks, and adhesives), maximum outdoor air ventilation with no recirculation should be employed during and for a reasonable period of time after the application.

When possible, new furnishings should be thoroughly aired out before being brought into the occupied space.

GENERAL RECOMMENDATIONS

Indoor Air & Environmental Quality Program

The O & M Committee recommends that facilities adopt an Indoor Air & Environmental Quality Program (IAQ/IEQ) to promote practices that prevent or reduce the contamination of indoor air, thereby contributing to a safe, healthy, productive and comfortable environment for building occupants. Benefits of good IAQ/IEQ may include improved health of occupants, decrease in the spread of infectious disease, protection of susceptible populations, increased productivity of occupants, improved relationships/fewer complaints, reduction in potential building closures (due to unhealthful conditions), less deterioration of buildings and equipment, reduced maintenance costs, and decreased liability and risk (22).

An IAQ/IEQ Program should include the maintenance of a log that records building problems and health complaints reported by building occupants.

Policies

The O & M committee recommends the following policies be adopted in commercial and public buildings:

No Smoking Policy

It is recommended that smoking be prohibited inside buildings. Smoking should be restricted to designated outdoor smoking areas that are 100 feet from paths of travel, entryways, operable windows, and air intakes.

Fragrance-Free Policy

It is recommended that a fragrance-free policy include prohibition of fragrance-emitting devices (FEDS) and sprays; use of fragrance-free maintenance, laundry, paper and other products; restrictions on perfume, cologne, and other scented personal care products used by employees, visitors, and other occupants; and prohibitions on use of potpourri and burning incense and scented candles.

An important first step is educating staff and others about the need for and benefits of reducing or eliminating the use of fragranced products.

Resources

No Scents Makes Sense brochure, Lung Association of New Brunswick: http://www.nb.lung.ca/pdf/NoScentsMakeSense.pdf

Guidelines on Wearing Scented Products and We Share the Air posters, University of Waterloo, Ontario, Canada, www.safetyoffice.uwaterloo.ca/hspm/hspmm_intro/safety_manual_index.htm, (under 12. Hygiene).

See "*Steps for Implementing a Scent-free Policy in the Workplace*" in Additional Resources.

Cell Phone Use Policy

It is recommended that cell phone use be prohibited in areas of a building when requested by an electromagnetically sensitive individual who needs to work or visit that area. Also, see information on use of a Cleaner Air Symbol in the Designated Cleaner Air Room report.

Notification Policy

It is recommended that facilities adopt a posting and notification policy to notify staff, visitors, and other building occupants of pesticide applications, cleaning and maintenance activities, renovation and construction, and other activities that may produce hazardous fumes or dust.

Vehicle Idling Policy

It is recommended that facilities limit or prohibit idling of vehicles, especially diesel vehicles, near entryways, loading docks, operable windows, and air intakes (23).

Recommendations for Future Actions

1. The O & M Committee recommends that the U.S. Access Board sponsor a meeting with stakeholders, including architects, building owners and managers, government officials, scientists, advocates, sensitive and vulnerable individuals, and others to evaluate the recommendations of this report (Operations & Maintenance). This meeting should provide a forum for increasing awareness of the report, facilitating dialogue among stakeholders, assessing the feasibility of the recommendations, and identifying ways to advance the recommendations.

2. The recommendations on cleaning products and practices in this report are based on information that is currently available. The O & M committee found that much more information and research is needed to better define cleaning products and practices that are effective and that will best protect occupant health. Some of the data gaps or problems the Committee identified are lack of information on labels and Material Safety Data Sheets, lack of information on fragrance ingredients combined with incomplete information on their health effects, and safety questions about citrus- and pine-based cleaning products because, among other things, they react with ozone to produce hazardous byproducts.

We, therefore, recommend that the U.S. Access Board and/or NIBS, in conjunction with U.S. EPA and other stakeholders, sponsor a workshop to examine existing information on cleaning products and practices, identify those products and practices that have the least adverse impact on indoor environmental quality and occupant health (including impacts on sensitive and vulnerable individuals), develop best practices, and determine research needs.

REFERENCES

1) Program Needs for Indoor Environments Research (PNIER), U.S. EPA, 402-B-05-001, March 2005, www.epa.gov/iaq/pubs/pnier.pdf

2) Bridges, B, Fragrance: emerging health and environmental concerns, Flavour and Fragrance Journal 2002; 17: 361-371, http://www3.interscience.wiley.com/cgi-bin/fulltext/93514043/PDFSTART

3) Neurotoxins: At Home and the Workplace, Report by the Committee on Science and Technology, U.S. House of Representatives, Sept. 16, 1986, Report 99-827.

4) National Strategies for Health Care Providers: Pesticide Initiative, The National Environmental Education & Training Foundation (NEETF), www.neetf.org/health/providers/index.shtm, and U.S. EPA, www.epa.gov/pesticides/safety/healthcare/healthcare.htm, Implementation Plan, 2002.

5) Recognition and Management of Pesticide Poisonings, Fifth Edition, EPA 735-R-98-003, http://www.epa.gov/pesticides/safety/healthcare/handbook/handbook.htm

6) (Contains information on acute health effects of pesticides, but does not cover the range of effects experienced by people with pesticide or chemical sensitivities).

7) Sanborn M, et. al, Pesticides Literature Review, The Ontario College of Family Physicians, April 23, 2004, http://www.ocfp.on.ca/local/files/Communications/Current%20Issues/Pesticides/Final%20Paper%2023APR2004.pdf

8) Solomon, G, Pesticides and Human Health, A Resource for Health Care Professionals, Physicians for Social Responsibility and Californians for Pesticide Reform, 2000, www.psrla.org/pesthealth.htm

9) McCampbell A, Pesticide Sensitivities, pp. 606-609, in *Encyclopedia of Pest Management*, Pimentel D, Ed., New York: Marcel Dekker, 2002.

10) Initial Statement of Reasons for Proposed Amendments to the California Aerosol Coating Products, Antiperspirants and Deodorants, and Consumer Products Regulation, Test Method 310, and Airborne Toxic Control Measure for Para-dichlorobenzene Solid Air Fresheners and Toilet/Urinal Care Products, Volume I: Executive Summary, Air Resources Board, State of California, www.arb.ca.gov/regact/conprod/execsum.pdf

11) Cleaning for Health: Products and Practices for a Safer Indoor Environment, INFORM, 2002, Chapters 1-5, http://www.informinc.org/cleanforhealth.php

12) EMFs in the Workplace, NIOSH Fact Sheet, DHHS (NIOSH) Publication No. 96-129, www.cdc.gov/niosh/emf2.html

13) Nazaroff WW, Weschler CJ, Cleaning products and air fresheners: exposure to primary and secondary air pollutants, *Atmospheric Environment* 38 (2004) 2841-2865.

14) Nojgaard JK, Christensen KB, Wolkoff P, The effect on human eye blink frequency of exposure to limonene oxidation products and methacrolein, *Toxicology Letters* 156 (2005) 241-251.

15) Weschler CJ, Reactions Among Indoor Pollutants: What's New, Paper #291, Proceedings of the Annual Meeting of the Air and Waste Management Association, Orlando, FL, June, 2001.

16) Weschler, CJ, Ozone in Indoor Environments: Concentration and Chemistry, *Indoor Air* 2000;10: 269-288.

17) Weschler, CJ, Chemical Transformations of Indoor Pollutants: Effects on Indoor Air Quality, In Proceedings of Indoor Climate of Buildings 2004, D. Petras, Ed., Slovak University of Technology, Bratislava, 2004, pp. 1-8.

18) Healthy Hospitals, Controlling Pests Without Harmful Pesticides, a report by Beyond Pesticides and Health Care Without Harm, 2003, http://www.noharm.org/ (http://www.noharm.org/details.cfm?ID=864&type=document) and http://www.beyondpesticides.org/ (http://www.beyondpesticides.org/hospitals/Healthy_Hospitals_Report.pdf)

19) Los Angeles Unified School District, Integrated Pest Management Policy, www.laschools.org/employee/mo/ipm/docs/ipmpolicyretype.pdf, and Integrated Pest Management Procedures Manual, written by Bill Currie of International Pest Management Institute, October, 2000, http://www.laschools.org/employee/mo/ipm/docs/ipm-procedures-manual.pdf

20) Healthy Lawn, Healthy Environment, Caring for Your Lawn in an Environmentally Friendly Way, U.S. EPA, 735-K-04-001, September 2004, http://www.epa.gov/oppfead1/Publications/lawncare.pdf

21) New Jersey Pesticide Control Regulations, New Jersey Administrative Code Title 7 Chapter 30, Subchapters 1-12, www.nj.gov/dep/enforcement/pcp/pcp-regs.htm and New Jersey School Integrated Pest Management (IPM) Program, Laws and Regulations Supplement, Pesticide Control Regulations, NJAC 7:30-13, Integrated Pest Management in Schools, www.nj.gov/dep/enforcement/pcp/ipm-laws2.htm

22) Health Risk and Needs Assessment for the Airborne Toxic Control Measure for Para-Dichlorobenzene Solid Air Fresheners and Toilet/Urinal Care Products, Air Resources Board, State of California, www.arb.ca.gov/regact/conprod/ch7.pdf

23) Texas Voluntary Indoor Air Quality Guidelines for Government Buildings, Texas Department of Health, January 2003, http://www.tdh.state.tx.us/beh/iaq/Gov_Bld_Gd.htm

24) New Jersey Requirements for Diesel-Powered Motor Vehicles, N.J.A.C. 7:27-14, http://www.state.nj.us/dep/aqm/sub14v2001-10-01.htm

APPENDIX - DETAILED RECOMMENDATIONS

Detailed Recommendations for Pest Control

Use Integrated Pest Management:

Use integrated pest management (IPM) – a program of pest prevention, monitoring, record-keeping, and control that eliminates or drastically reduces the use of pesticides.

Follow recommendations for integrated pest management (IPM) in "Healthy Hospitals, Controlling Pests Without Harmful Pesticides". The Los Angeles Unified School District also has an exemplary plan for an IPM Program.

Eliminate the use of chemical pesticides or minimize their use to the greatest possible extent.

Pest management program should be part of an overall Indoor Air & Environmental Quality (IAQ/IEQ) program.

Designate an IPM coordinator.

When contracting for IPM services, give clear instructions on the type of service requested, including which, if any, pesticides are acceptable for use under specific conditions.

Eliminate all scheduled or routine use of pesticides. Use chemical pesticides only as a last resort when non-chemical methods have failed to control a pest problem.

Use organic methods to maintain lawns and landscape vegetation.

Do not use fertilizers that contain herbicides (e.g., "weed and feed" products).

Do not use herbicides to kill grass, shrubs, or other unwanted vegetation prior to removal or replacement.

If control methods are needed, preference should be given to physical (e.g., barriers), mechanical (e.g., mouse traps, pulling weeds, vacuuming, fly swatters, hosing insects off plants), and cultural (e.g., improved soil health, proper watering and pruning) controls, using bio-controls (e.g., natural predator insects) if those methods fail, and only using chemical pesticides as a last resort.

Prevent Pests:

Emphasize pest prevention through non-chemical means.

To avoid creating conditions attractive to pests, clean thoroughly, promptly fix building cracks and plumbing leaks, restrict eating to designated areas, and promptly dispose of waste.

Adopt and adhere to strict maintenance schedules to determine and repair points of possible pest entry, such as torn screens, cracks and holes in walls, and damaged or improperly placed door seals and sweeps.

Initiate additional housekeeping routines to reduce the chances of pest infestation, including more frequent trash removal, securing trash container lids, and steam cleaning trash containers.

Locate trash cans and dumpsters, compactors, and recycling areas away from the building.

Maintain healthy lawns and landscape vegetation to increase resistance to pests.

To maximize health of lawns, develop healthy soils, mow often and with sharp blades, reduce thatch, and water deeply but not too often.

Maintain soil health. Avoid the use of synthetic fertilizers.

Prevent mosquitoes from breeding by draining stagnant water from bird baths, swimming pool covers, buckets, tires and other areas where water may be collecting. Drill holes in bottom of recycling bins that must be kept outside. Check rain gutters to ensure they are draining properly.

Discourage the introduction or presence of indoor plants because they attract pests, encourage pesticide use, and often promote mold growth.

If indoor plants are present, minimize mold growth by being careful not to over water, loosening the top layer of soil every week, and not keeping plants in wicker baskets. Do not use synthetic fertilizers or pesticides on indoor plants.

Change the water in flower vases frequently.

Pesticides:

USE PESTICIDES ONLY AS A LAST RESORT WHEN NON-CHEMICAL METHODS HAVE FAILED TO CONTROL A PEST PROBLEM

Use the least toxic pesticide in the least amount necessary to accomplish the job. Spot treatments are preferred.

Least hazardous pest management materials include:

Boric acid and disodium octoborate tetrahydrate;
Soybean oil and corn gluten meal;
Diatomaceous earth;
Nonvolatile insect and rodent baits in tamper-resistant containers or for use in crack and crevices;
Microbe-based insecticides (such as Bacillus thuringiensis, B.t.);
Botanical insecticides that do not contain synthetic pyrethroids or toxic synergists;
Biological control agents, such as parasites and predators; and
Soap-based products.

[Note that due to individual variations in sensitivities, some people with allergies, asthma, or chemical sensitivities may not tolerate one or more of the above least hazardous materials.]

Least hazardous physical pest management methods include the use of liquid nitrogen for cold treatment of termites.

Pesticide applications should only be made by a licensed pest control applicator.

The O & M Committee recommends that certain pesticides, such as organophosphates, carbamates, pyrethroids, and other neurotoxic insecticides; 2,4-D, other phenoxy herbicides, and glyphosate; and fungicides such as mancozeb, chlorothalonil, and maneb, never be used.

Do not apply pesticides to buildings by fogging, bombing, or tenting or by space, broadcast, or baseboard spraying.

Do not apply pesticides in occupied areas or areas that may become occupied during the 24 hours (at a minimum) following an application. In buildings that are constantly occupied, pesticide applications should be made when they are least occupied. It is recommended that pesticides be applied when there is the longest time before the area will be re-occupied, such as at the beginning of a weekend or vacation period.

Minimize contamination of the HVAC system by sealing all inlets and outlets to the area where pesticides are applied. When the seals are removed, ventilate the area with 100% outside air with no recirculation at least until the building is re-occupied.

No application of pesticides should be made along paths of travel or in the vicinity of entrances, windows, or outside air intakes.

Do not use pesticides that contain added fragrance.

Ensure proper training of all personnel working with pesticides.

Prohibit other staff and building occupants from using pesticide products.

In the event of a scheduled structural or lawn care pesticide application (including spot or crack & crevice treatments), provide pre-notification and post signage in appropriate disability formats before, during, and after the application.

Signage for pesticide applications should include the name of the pesticide product applied and EPA registration number, date and time of application, name of the applicator, and the name and number of contact person from whom to obtain more information. For examples of notification requirements, see Healthy Hospitals report (17) and New Jersey regulations (20) under References.

Require that pest control applicators provide the building manager or designated agent copies of Material Safety Data Sheet(s) and product label(s) for all pesticides used inside the building or on facility grounds. These documents should be provided to building occupants and the public upon request. Note, however, that neither the MSDS or product label provide complete information on product ingredients or their potential health effects.

Maintain a voluntary registry of persons at increased risk of injury or harm from pesticide exposures who wish to receive individual notification prior to pesticide applications (or notified after an emergency application).

Reasonable accommodation to programs, services, and employment needs to be readily available to people whose disabilities require that they avoid exposures to pesticides.

Maintain secured separate storage for pesticides and limit access to authorized personnel only.

Store any pesticide and disinfectant products away from food, laundry areas, paper product storage, areas occupied by children, and HVAC air intakes.

Maintain separate equipment, including mixing containers, for use with pesticides. Avoid cross contamination with equipment used for cleaning and other maintenance activities.

Establish a reporting procedure and encourage individuals who are experiencing adverse health effects from a pesticide exposure to report the incident to the building manager and the U. S. Environmental Protection Agency. See EPA Pesticide Health Incident Reporting, http://www.epa.gov/pesticides/health/reporting.htm

Resources

IPM for Schools: A How-to Manual, EPA 909-B-97-001, March 1997, http://www.epa.gov/pesticides/ipm/schoolipm/

Pest Prevention: Maintenance Practices and Facility Design by Sewell Simmons, California School IPM, California Department of Pesticide Regulation, http://www.cdpr.ca.gov/cfdocs/apps/schoolipm/managing_pests/71_pest_prevention.cfm?crumbs_list=1,34

School Integrated Pest Management Program, California Department of Pesticide Regulation, www.cdpr.ca.gov/cfdocs/apps/schoolipm/main.cfm

Responsible Pest Management: Best Practices and Alternatives, Canada http://www.pestinfo.ca/main/ns/22/doc/23/lang/EN

Second National Report on Human Exposure to Environmental Chemicals, Centers for Disease Control and Prevention, U.S. Department of Health and Human Services, 2003, www.cdc.gov/exposurereport/2nd

ExToxNet (Extension Toxicology Network) Pesticide Information Profiles, Cornell University, http://pmep.cce.cornell.edu/profiles/extoxnet/ (Does not include information on all health impacts experienced by people with pesticide/chemical sensitivities)

The Safety Source for Pest Management: A National Directory of Least-Toxic Service Providers, www.beyondpesticides.org/safetysource

Beyond Pesticides
701 E Street, SE, Suite 200, Washington DC 20003
202-543-5450
info@beyondpesticides.org
www.beyondpesticides.org

Bio-Integral Resource Center
P. O. Box 7414, Berkeley CA 94707
510-524-2567
birc@igc.org
www.birc.org

Californians for Pesticide Reform
49 Powell Street, #530, San Francisco, CA 94102
415-981-3939
pests@igc.org
www.pesticidereform.org

International Pest Management Institute
P. O. Box 474, Ash Fork AZ 86320
928-637-2378
Bill Currie, Director
bugebill@earthlink.net

IPM Institute of North America
1914 Rowley Avenue, Madison WI 53705
608-232-1528
ipmworks@ipminstitute.org
www.ipminstitute.org

National Center for Environmental Health Strategies
1100 Rural Avenue, Voorhees NJ 08043
856-429-5358
ncehs@ncehs.org
www.ncehs.org

Northwest Coalition for Alternatives to Pesticides
P.O. Box 1393, Eugene OR 97440-1393
541-344-5044
info@pesticide.org
www.pesticide.org

Pesticide Action Network North America
49 Powell Street, Suite 500, San Francisco CA 94102
415-981-1771
panna@panna.org
www.panna.org, www.pesticideinfo.org

U.S. Environmental Protection Agency
Office of Pesticide Programs
Ariel Rios Building
1200 Pennsylvania Ave., NW, Mail Code 3213A
Washington, DC 20460
202-260-2090
www.epa.gov/pesticides

National Pesticide Information Center
Cooperative effort between Oregon State University and U.S. EPA
333 Weniger, Corvallis OR 97331
800-858-7378
npic@ace.orst.edu
http://npic.orst.edu
(Good site for basic pesticide information, but does not include full range of possible health effects experienced by people with pesticide or chemical sensitivities)

Detailed Recommendations for Cleaning & Disinfecting

Do not used fragrance-emitting devices (FEDS), plug-ins, or sprays; urinal or toilet blocks; or other deodorizer/re-odorizer products.

To reduce odors, increase cleaning and ventilation and/or use baking soda or zeolite to absorb odors.

Do not use products containing paradichlorobenzene or naphthalene (commons ingredients in FEDS).

Avoid or limit the use of products containing chlorine, ammonia, quaternary ammonium, phenol, isopropyl and other alcohols, formaldehyde, and other petroleum distillates.

Discourage the use of alcohol-based hand washes.

Do not use products that contain or have a fragrance.

Do not use citrus- or pine-based products.

Use vegetable-based surfactants rather than petroleum-based ones. Do not use or citrus- or pine-based solvents.

Cleaning and disinfecting programs should be part of an overall Indoor Air & Environmental Quality (IAQ/IEQ) program.

Establish an audit of all cleaning chemicals currently in use. Develop a priority list and plan to establish alternatives for chemicals and cleaning methods.

Raise awareness among building maintenance staff and occupants that "green" and "environmentally friendly" products are not necessarily good for occupant health.

Minimize the number of cleaning and disinfecting products used.

Perform cleaning maintenance on an as needed basis – use spot or area cleaning rather than broad-based cleaning.

Clean stains while they are fresh to avoid need for aggressive cleaning later.

Choose cleaning products and disinfectants that emit the lowest levels of volatile fumes.

Dust with a dry lint-free cloth, or with water only. Avoid or minimize the use of polish dusting products.

Avoid perfumed and/or chemically-treated cleaning products and supplies, such as cleaning rags, vacuum bags, trash bags, tissue, toilet paper, and hand soaps.

Increase scrubbing and other mechanical methods of cleaning to reduce the need for chemicals.

Inspect areas to insure there has been proper cleaning using visual inspection, white cloth, or ultraviolet light.

Do not use cleaner/disinfectant combination products.

Hot water should be available for hand washing and cleaning.

Whenever possible, clean with hot water to reduce the amount of soap, detergent, and disinfectant that must be used.

Spray cleaning products on to cloths rather than on to surfaces or into the air.

If carpets must be cleaned, use steam or least-toxic all-purpose cleaner or carpet cleaner that does not contain petroleum solvents. Spot clean whenever possible.

Adopt fast-drying methods for carpet cleaning, 4 hours maximum. Steam cleaning + highest extraction + higher dry air flow = fast drying.

Dry all washed surfaces and floors with a dry cloth or mop to minimize chemical residues and reduce the chance of mold growth.

Use vacuums with HEPA (High Efficiency Particulate Attenuation) filters and strong suction. Vacuum frequently and thoroughly.

Minimize the use of floor waxes and buffing, and if done, notify employees and the public.

Order cleaning products for use with pumps rather than spray or aerosol dispensers to minimize chemical contamination of the air and HVAC system.

Take control of your own dispensing to ensure proper measurements. Establish minimal dosing for applications. When chemical has multiple uses, dispense separately for each use. A good dispensing program can save 25% to 40% in chemical consumption and costs.

Educate staff that mixing cleaning chemicals is dangerous because it can create new compounds that are more toxic than the original products.

Initiate protocol to authorize, supervise, and provide safe areas to mix authorized chemicals.

Store cleaning chemicals securely, separated from paper, cloth, or other absorbent materials.

Post signs during cleaning activities. Make cleaning schedule available to employees or others upon request.

Schedule heavy cleaning, repairs and maintenance during low or no-occupancy periods whenever possible.

Maintain strict protocol for training employees who use hazardous products or materials. Maintain an active list of those authorized to perform those duties.

Restrict cleaning to authorized personnel only.

Prohibit occupant usage of cleaning chemicals except as authorized. Establish a list of least toxic, low-VOC cleaning products (and/or provide them to employees) which they can use to clean computers, erase felt pen writing on white board, and perform other similar activities.

Use micro vacuums for cleaning electronic equipment. Do not use solvent cleaners.

Increase air intake to a building to dilute cleaning products present in indoor air, especially during major cleaning activities such as cleaning of carpet, walls, etc.

Provide a well-ventilated room with exhaust fans in which to service computers and other portable equipment whenever toxic chemicals are involved in the repair process.

Develop protocol to dispose of cleaning solutions safely.

Reduce tracked-in dirt by using mats and grills in entryways. Where appropriate, exhaust air between separated doorway entrances.

Replace wet entrance mats and dry wet floors and carpeting as soon as possible.

Utilize only those floor mats that do not emit odors/fumes or particles.

Reasonable accommodation to programs, services, and employment needs to be readily available to people whose disabilities require that they avoid exposures to cleaning, disinfecting, and maintenance chemicals.

Waterless urinals should be maintained using products containing bacterial enzymes that biodegrade urea.

Disinfectants

Eliminate combined cleaner/disinfectant products.

Use disinfectants only when and where necessary. This includes:

1) Knowing what organisms need to be reduced/disinfected. Disinfectants are formulated to target certain organisms or combination of organisms. It is important to use the right product in the right place.

2) Knowing what surfaces do (or do not) need to be disinfected, and how often.

3) Cleaning surfaces thoroughly before disinfecting. Disinfectants can only be effective through contact. A layer of surface grime is likely to prevent sufficient contact.

4) Using proper disinfectant mixing and cleaning procedures. This includes leaving disinfectants in place for the correct amount of time before wiping surfaces clean.

Limit or avoid the use of disinfectant or cleaning products containing chlorine, quaternary ammonium, phenol, and isopropyl and other alcohols.

Hydrogen peroxide-based disinfectants are preferred, but should be used judiciously with caution and care.

Use disinfectants only in areas and at strengths (i.e., levels of disinfection) required by law. Check with local health department to obtain details of all legal requirements.

Restrict or eliminate the use of alcohol-based hand washes.

Do not use hand soaps containing triclosan or other disinfectants.

Resources

See Addendum B for more information on Cleaning

Detailed Recommendations for Mechanical Equipment & HVAC Systems

If a building has poor indoor air quality, investigate the extent to which outdoor air contaminants are contributing to the problem.

In areas where poor outdoor air is a problem, use the highest efficiency filters compatible with current HVAC system, and if necessary, consider retrofitting system to increase filtration capabilities.

Use demand controlled ventilation (DCV) that utilize sensors in occupied spaces to determine when ventilation should be increased due to increased occupancy or other loads. Be wary of using motion sensors that can create significant electromagnetic fields.

Provide liberal amounts of ventilation. It is better to have more ventilation than necessary rather than too little.

Where there is an adjoining parking garage or busy roadway, or nearby heliport, anticipate the need to decrease air exchange and ventilation in buildings prior to and during “rush hours” or times of usage, respectively. During periods of decreased outdoor air ventilation, increase recirculation and filtration of recirculated air.

Adhere to a strict maintenance plan for all HVAC equipment to make sure it is working properly. This will reduce the chance of air contamination, maintain optimal efficiency, and minimize noise and vibration.

Create door and window-opening protocol to maintain proper pressure relationships and air flow in the building. Educate and provide protocol to staff and other building occupants. Policy should include provision that allows chemically sensitive and other individuals to open windows on a temporary or regular basis, as needed because of a health condition. Windows should also be permitted to be opened by occupants when the HVAC system is not working or shut off, such as may occur during nights and weekends. Policy should address emergency situations in which opening windows could exacerbate the crisis.

Maintain HVAC ducts free of particulate matter, dust, and debris. Use non-chemical methods, such as physical removal or use of vacuums.

Do not use HVAC system to disperse fragrances or other chemicals.

Before a building is re-occupied (e.g., in the mornings or after weekends), flush with at least three complete outdoor air exchanges.

Make maximum use of economizer cycle. Avoid energy conservation practices that reduce intake of outside air below minimum requirements.

Make sure the supply and return air diffusers, grills, and registers are working correctly.

Test for stagnant air areas where furniture, wall partitions, or equipment may be blocking air movement. Use ribbons or dry ice rather than smoke to study air flow patterns.

Maintain relative humidity between 30 and 50%.

Avoid or minimize the use of humidifiers in the buildings HVAC system. Maintain the cleanliness of all humidifier equipment and use the minimum amount of water treatment chemicals necessary to prevent antimicrobial contamination and to control dissolved solids and pH.

Prohibit the use of personal humidifiers except where there is a medical need.

Isolate and contain construction chemicals and particulate matter from HVAC system by covering registers and diffusers and using negative-pressure air systems.

Seal return air openings into HVAC system during remodeling and exhaust directly to the outdoors, by temporarily removing window glazing if necessary.

Quickly evacuate a building if the HVAC system becomes contaminated with a solvent, pesticide, toxic gas, or other harmful chemical at a level that can cause adverse health impacts in occupants, including sensitive and more vulnerable individuals.

Eliminate storage of toxic and/or volatile chemicals near HVAC intakes.

Do not allow the use of portable air “cleaners” that emit ozone.

Repair plumbing with least toxic, low-VOC materials.

To clear clogged drains, use mechanical methods such as snakes, or steam cleaning.

Utilize bacterial enzymes to prevent drain clogs, instead of using acids, solvents and alkalines which deteriorate pipes and necessitate repairs.

Inspect floor and other drains, especially those that are infrequently used, to ensure there is water in the P-traps, thereby avoiding sewer gas backup in the building.

Treat grease traps daily with preventive dose of bacterial enzymes, to avoid the need to use strong chemical cleaners if they become clogged.

In decorative fountains, use the minimum amount of chlorine necessary for disinfection, avoid the use of bromine, use closed ozone water treatment systems to the maximum extent possible, and make use of newer, less-toxic disinfecting technologies as they become available.

Resources

EPA, Indoor Air Quality Building Education and Assessment Guidance (I-BEAM) Software package, can be downloaded for free from EPA website at http://www.epa.gov/iaq/largebldgs/ibeam_page.htm, or can be obtained on CD from IAQ Clearinghouse at at 1-800-438-4318 or via e-mail at iaqinfo@aol.com (ask for EPA 402-C-01-001).

See references regarding HVAC in Building Design & Construction report

Detailed Recommendations for Landscape Maintenance

Use integrated pest management (IPM) to eliminate or minimize the use of herbicides, fungicides, insecticides, and other pesticides. (See recommendations for Pest Control).

Maintain lawn and gardens organically.

Maintain soil health.

Avoid the use of synthetic fertilizer.

Do not use fertilizer products that contain herbicides (e.g., “weed and feed” products).

Maintain healthy lawns and landscape vegetation to increase resistance to pests.

To maximize health of lawns, develop healthy soils, mow often and with sharp blades, reduce thatch, and water deeply but not too often.

Pull, mow, or use mechanical weed cutter to control weeds. Vinegar can be used to kill weeds along fence lines or other hard to reach areas.

Avoid dust-blowing equipment, such as leaf blowers. Sweeping, raking, and use of a vacuum are the preferred methods for removing debris.

If string or other mechanical weed cutter is used, attempt to minimize dispersal of dust, dirt, and debris.

Avoid diesel-powered or 2-cycle engine equipment, use electric lawn equipment instead.

Close windows during grass cutting, or prior to pesticide, fertilizer, or lime applications, or use of gas-powered equipment or vehicles on building grounds.

Use least toxic low-VOC paints, stains and finishes on outside equipment, including benches, poles, decks, and porches, as is recommended for interior and exterior of buildings (see recommendations in Building Products & Materials report).

Use rock, gravel, flat stones, or pavers for mulch and/or use typar landscape barrier to suppress weeds. Avoid organic mulches (e.g., cocoa beans, peat moss, wood chips, bark), especially near windows and doors of buildings. These mulches emit volatile fumes and may harbor mold.

Avoid the use of CCA wood or wood chips because they contain arsenic and other toxic chemicals which can leach into the environment.

Do not use railroad ties because they contain creosote.

Remove plants that are chronically ill and/or frequently attract insect pests.

When replacing plants or redesigning landscape, follow recommendations in Building Construction & Design report.

Apply pesticide, fertilizers, and lime only when there is little or no wind present and in a manner that prevents drift.

Provide prenotification by posting signs prior to pesticide, synthetic fertilizer, or lime applications.

Resources

Allergy-Free Gardening, Thomas Leo Ogren, www.allergyfree-gardening.com

Detailed Recommendations for Enclosure Maintenance

Routinely inspect and clean roof and gutters to make sure they are draining properly.

Promptly repair roof or plumbing leaks.

Regularly inspect walls and foundations, especially all utility entrance seals (e.g., phone, water, electric, cable) for cracks and repair promptly if found.

Insulate cold pipes to prevent condensation.

Promptly remove wet ceiling tiles and wall panels.

Seal rusted surfaces to minimize emissions of airborne particulates using least toxic low-VOC sealant.

Include proper seal of the building in commissioning and re-commissioning programs for the building.

Remove excess water from carpeting damaged by clean water and quickly dry it to avoid mold buildup. Do not use disinfectants or moldicides (other than hydrogen peroxide-based ones). Instead, utilize a steam extraction carpet cleaning system with a hydrogen peroxide-based cleaner/disinfectant. Inspect carpet after it is completely dried to ensure there is no mold or mildew. Those with asthma or chemical sensitivities should be removed from areas where there is wet carpeting. Remove carpeting if it has been wet longer than 24 hours.

Immediately remove and do not re-use any wet carpeting that has been contaminated with sewer water, heavy dirt and soils, or toxic chemicals.

Seal rusted surfaces with a least toxic low VOC sealant to minimize emissions of airborne particles.

Include proper seal of the building in commissioning and re-commissioning programs for the building.

Resources

Treschel, Hans, Ed. Moisture Control in Buildings. West Conshohocken, PA: American Society for Testing and Materials. 1992.

COMMITTEE

Active
Chair – Hal Levin, Building Ecology Research Group
Mary Lamielle, National Center for Environmental Health Strategies
Ann McCampbell, Multiple Chemical Sensitivities Task Force of New Mexico
Susan Molloy, National Coalition for the Chemically Injured
Charlie Reid, Hamilton County Board of Health, Ohio
Toni Temple, Ohio Network for the Chemically Injured

Contributing
Terry Brennan, Camroden Associates

Dave Rupp, Cabinet King, Inc.

ADDITIONAL RESOURCES

General Guidance for Building Cleaning Programs

By Charlie Reid, Member Hamilton County General Health District Board of Directors 1995-Present, Independent Consultant 1983 - Present.

Outdoor Air Intakes & Building Pressurization

The outside air intakes for positively pressurized buildings have a history of poor location. Many public buildings with utility or service entrances and loading docks have the outside air intake louvers near pollution sources that allow exhaust fumes from trucks to be drawn into the building. Some high-rise office buildings place air intakes in the path of drift from cooling towers on roofs, where contaminants such as bacteria that have caused Legionnaires' disease can enter the ventilation system. Air intakes of other rooftop installations have entrained roof sealants that are emitted into the air. Still others have entrained emissions from plumbing vent stacks resulting in sewer gas entrainment. Roosting birds can also be a source of contaminants that are entrained in outdoor air supply streams.

Outdoor air intakes are often poorly maintained and the areas are dirty. Getting good intake air - either by shielding or relocating intakes or by fine particle filtration eliminates the many contaminants from outside, as well as avoiding the added burden to cleaning inside. Mechanical rooms and nearby areas may also be the location for chemical storage and janitors' closets for many buildings. Mixing chemicals there sends vapors into the ventilation systems of the building. These are cleaning issues that affect indoor air quality.

Since most positively pressurized buildings do not provide for door or window ventilation, all cleaning activities create polluted air until gases and particles are diluted and removed by outside air supply and exhaust. Some older buildings, where the outdoor air supply rates are grandfathered into the energy saving criteria established in the era of President Carter and the 1970's oil embargo, have special problems with indoor air quality. They generally have lower levels of outside air ventilation and, thus, lower levels of dilution.

First Reduce Soil and Dirt:

Put emphasis on entryways. Reduce tracking in of outside soils and other particulate matter to make inside areas less difficult to clean. Mats, entryway grids, and special ventilation of vestibules reduces intake of soil and dust.

Evaluate high traffic patterns for use of removable matting that can be cleaned away from personnel in order to reduce the overall general cleaning required for carpet.

Limit eating to designated areas that can be cleaned by wiping and light mopping.

Quickly identify and clean spills and stains to eliminate the need for harsher treatments later.

Increase the light wipe and cleaning of hard floors to lessen the required stripping and finishing required. Much of this can be done with water or very light dilutions of an all-purpose cleaner.

Caution on use of the wrong mop is important because residual chemicals on an unrinsed mop can start stripping the finish from the floor, which then requires more frequent refinishing.

Employ better vacuums. Use HEPA (High Efficiency Particulate Attenuation) filtered vacuums with continuous suction. Higher suction not only reduces the amount of soil in buildings, it substantially reduces both hard floor and carpet cleaning. The removal rate makes the cost of high quality equipment worth the investment. The machines are larger, harder to manipulate, and because they have more suction, do not move as fast across the floor. Using a HEPA vacuum following a typical upright vacuum can make a visible difference in the brighter color of a carpet as the floor wand passes over a surface. Ground-in dirt is substantially reduced as is the need to clean the carpet.

Building occupants should be prohibited from having and using cleaning chemicals.

Selection of cleaning methods/general rules:
Chemicals are used to make water work better in cleaning. Chemicals add surface wetting agents, soil reduction and rinsing agents, evaporative qualities, and at times mild coating to prevent re-deposition of soils or the re-appearance of soils. The lower the soil level, the less water needs help to clean.

Higher temperature water dissolves better, cuts greasy soils, and requires less agitation. Increased agitation requires less chemical action to cut into soils.

Wiping and general rinsing after cleaning eliminate the need for many rinsing additives. Most all-purpose cleaners, window cleaners, and other hard surface cleaners have an alternative available in vegetable-based surfactant chemistry. Using many of the alternative products can eliminate alcohol, which lingers in the air long after use. Many of these products can be used in higher dilutions and thus less product is required.

Wiping needs to replace spraying. Many companies have gone to dispensing systems that fill spray bottles. Spraying not only diffuses a solution into the air as well as on the surface, it generally wastes product by over-wetting a surface - thus the need for adding evaporative alcohol to the product. By wetting a wipe lightly and applying to a surface, the excess from spraying does not require the additional labor to work off the hard surface, which saves labor.

Water can be used in general dusting of non-wood surfaces, as can lint-free wipes for most surfaces. Spray devices can be used to dispense into a wipe and this is the most efficient application method.

There is no cleaning need for fragrances and they all need to be eliminated.

There are products on the market which are advertised as deodorizers/re-odorizers that have four times the level of quaternary ammonia as a disinfectant. They are not listed as a disinfectant because they are purportedly for cleaning and reodorizing. This is not uncommon in the labeling of janitorial products.

Fragrances are leading culprits in accessibility problems related to indoor air quality.

Detergent with warm or hot water disinfects as well as disinfectant cleaners most of the time. For quality assurance, use of an ultraviolet light detects bacterial growth and areas which are evading cleaning. In problem areas that are frequently not reached – as behind toilets, around urinals, and beneath the nozzle of soap dispensers - personnel need to be trained and instructed to thoroughly clean the affected area.

Peroxides (as stabilized additives) are capable of disinfecting in more critical areas. Bathrooms, food service areas, and dining areas all follow this general guideline.

Dispensers are most often provided by the companies that sell chemicals. They install the dispensers and set the dilutions. Use of dispensers when building ownership or management is in control of the dispensers is appropriate. Supervisory control over dilutions is essential.

Carpet cleaning often results in off-gassing of toxic solvents for days and even weeks. Use of steam, non-petroleum based cleaners - even in some cases peroxides - and fast drying has proven essential to reducing the impact of cleaning.

Carpets are typically treated with numerous products, including insecticides, sealants, and optical brighteners. No matter what method is used to clean it, e.g., washing, dry-cleaning, or steam cleaning, all cause the release of the built-in chemistry of the carpet.

While it is a general rule to dry carpet in less than 24 hours to reduce the chance for mold growth, optimal drying time is less than 4 hours. This may require selecting less humid days to do the work. It may require increased airflow in the building. It may require blowers and heating to the affected area. It may require higher, more efficient extraction after chemical application. Faster drying shortens the time for the air to recover from the cleaning.

Hard floor finishing is often a process that results in off-gassing for weeks. It is recommended that the work be completed during unoccupied or low occupancy times for the building, using higher air flows for drying, and maintaining maximum dilution with outside air until off-gassing is complete.

Frequent inspections of floors and refinishing only the areas necessary reduces chemical usage and impact. Scheduled finishing may not be the best practice. Using an “inspect and finish as necessary” program allows for limited work to preserve the floors while reducing labor requirements and chemical usage.

Some gel strippers may have lower off-gassing levels and should be evaluated for potential usage. Experiment with strippers to find the lowest effective concentration to achieve the work. Refinishing material as well as strippers should be managed carefully by dispensing in proper amounts to ensure proper usage and to avoid over-usage.

Carpet de-spotting can be accomplished by using mild detergent and baking soda. This old remedy can remove many stains, particularly when fresh. Using the mixture in hot water (120 degrees) and rubbing inward from the outside of the stain can remove many without the use of strong chemicals.

Bathroom fixtures, urinal, and toilets are subject to staining. Where possible, peroxide-based cleaners are preferable. Baking soda provides a mild cleaner-abrasive capability. Use of acids in

difficult circumstances may be necessary. When this is done, the bathroom should be completely ventilated before reopening it for use.

A continuous audit of building practices, education of building personnel, and control of chemical usages by occupants will go a long way in reducing the adverse chemical impacts associated with cleaning. Safer alternative products exist for almost all cleaning needs. Cleaning protocols do not need to change much and can be phased into a building's existing program. While one may look for one practice to save the day, there is no magic bullet. Only one change in cleaning will leave others to create problems. A comprehensive approach is necessary and can be implemented step by step.

Checklist Guidance

Building managers can use the following list of questions as a guide to assess their office building cleaning efforts and to determine where to start transitioning cleaning activities. The checklist does not actually tell a building manager how to set up a cleaning program, but it serves as a starting point for educating everyone involved in a safer air cleaning program—managers, occupants, and janitors—about what they need to do to make it a successful program.

Building Considerations

- How are various areas within the building used? Determine which require the most cleaning, and why (e.g., public restrooms, kitchen areas). What are the hours of use and are there preferred times to clean when personnel are not present?
- Where do people eat (e.g., individual offices throughout the building, designated areas)?
- Are there any special considerations related to the building itself (e.g., is it an historical building that has special preservation requirements or security issues)?
- Do any office furnishings have special cleaning requirements (e.g., thick carpets, antique furniture)?
- Are there any known at-risk populations who may be more adversely affected by the use of some chemicals (e.g., children, people with asthma, allergies or chemical sensitivities, and pregnant women)?
- Does the building have an adequate ventilation system to circulate air throughout the building?
- Does the building have any plumbing or moisture problems?
- Is there a method in place to keep dirt from entering the building (e.g., mats at the front door, double-door entryways)?

Cleaning Checklist

PROCEDURE	FREQUENCY	PRODUCT BRAND (indicate whether it is purchased in concentrate or ready-to-use form)	MONTHLY PRODUCT USEAGE	CLEANING PROCEDURE
Clean furniture				
Clean walls				
Clean bathrooms				
Disinfection – Bathroom				
Disinfection – General				
Clean washroom fixtures				
Carpet spot removal				
Carpet cleaning				
Gum removal				
Concrete cleaning				
Graffiti removal				
Glass cleaning				
Metal cleaning				
Hard floor – routine cleaning				
Floor stripping				
Floor refinishing				
Other all purpose cleaning				

Adequacy of Current Cleaning Program

- What are issues of concern to management, cleaning personnel, and building occupants? Conduct interviews with all stakeholders rather than on a representative basis.
- Review the log of tenant complaints over the last year. What are the items that come up consistently?
- How is the quality of cleaning currently being evaluated/measured? How often are inspections performed? Are there trends in the problems that are identified?

Cleaning Materials Usage

- List the janitorial products that are currently in use for each of the following categories and identify how often the cleaning task is performed and how much of the product is used per month.
- Are there any reasons to change the procedure or frequency for these cleaning applications? In what manner can chemicals be eliminated or reduced? Seek methods to eliminate usage, reduce usage, and change products to those better for air quality.

Selecting Chemicals

In selecting chemicals for cleaning, there can be considerable confusion. "Green," "environmentally safe" and various other claims as to the safety of cleaning products do not provide adequate guidance for determining which products do not adversely affect air quality. Below is a list of some terms with which a buyer of chemical products needs to become familiar. The list also includes comments and discussion of alternatives to potentially hazardous chemicals.

Bio-Degradable: The product will break down in the environment over time into supposedly harmless materials. This does not mean the product is safe for the environment, including soil, water, or air.

Chlorine-free: Contains no chlorine, a toxic chemical responsible for substantial problems in air quality as well as more poisonings each year than any other chemical. Oxygen bleaches, the chlorine-free alternatives for bleaching action, are less stable than chlorine bleaches, but much has been done to stabilize oxygen bleaches in the past few years. Do not use concentrated hydrogen peroxide in pure form for disinfection because its application to a flammable surface can cause it to ignite. For scouring, use of baking soda, borax and scrub pads provides additional cleaning capacity. Using a compound containing stabilized peroxide is useful for bleaching.

Natural: Implies the product does not contain synthetic ingredients. Since the use of this term is unregulated and the claim can only be verified by checking with the manufacturer, do not rely upon it for any selection criteria. And since naturally-occurring substances can also be harmful, this term does not have meaning with respect to air quality.

Neutral pH: The product is neither alkaline, nor acidic. These are most useful for products that require handling or mixing or are intended for application to bare skin. Even if a product has a neutral pH, it may have been refined from petroleum and other hydrocarbons and emit volatile fumes. For better air quality, it is often preferable to use a non-petroleum *alkaline* product rather than a solvent or petroleum-based *neutral* product. Very acidic or alkaline products that become airborne can cause irritation and even severe damage to skin, eyes, and lungs.

Non-Toxic: Supposedly only a very large amount will cause damage. Since this term is unregulated in its use, is has little meaning. Fewer than 5% of all cleaning compounds have been tested for safety. A few manufacturers test for skin irritation or ingestion effects. Since a product

can impact air quality and affect people with a large range of sensitivities, a product claiming to be non-toxic may still cause adverse health effects.

Oxygenated: Helps whiten and brighten by releasing oxygen which breaks up stains, and eliminates mildew and mold. See Chlorine above. Oxygenated products, such as those containing hydrogen peroxide, can be as effective as chlorine when used in proper doses and according to safety instructions.

Phosphate-free: Generally meaningless term. Phosphates are allowed by law only in certain automatic dish detergents. Not a criterion for most purchases.

Surfactant: This is the active ingredient in most detergent cleaners, such as all- purpose cleaners, floor cleaners, dish detergents, fabric softeners, and hard surface cleaners. Most often they are created from petroleum and are neutral in pH. Surfactants are used to alter the surface properties of the surface being cleaned. This can make the surface more penetrable, easier to rinse, and less able to be adhered to and more repellant of dirt. Numerous surfactants have been used as reducing agents to dissolve heavy greases and soils. Surfactants are now available in non-petroleum-based (vegetable) forms and the newer surfactants offer interesting new chemistry for air quality. In general they have higher flash points. The vegetable-based surfactants rarely have alcohol or other solvents. They can easily be wiped on and off and do not require evaporative assistance, such as adding alcohol and ether to most window cleaners.

Deodorizer/Re-odorizer: This group of products may contain higher concentrations of quaternary ammonia than disinfectants. They also frequently contain strong fragrances and/or masking agents that diminish the sense of smell. Paradichlorobenzene and naphthalene are common ingredients in fragrance-emitting devices. Deodorizer products are often used in public bathrooms found in restaurants, motels, theaters, subways, trains, airports, airplanes, and other public facilities. The use of deodorizer/re-odorizer products can be avoided by increasing ventilation/air flow and thoroughly cleaning with mildly alkaline non-surfactant detergents followed by the use of disinfectants, preferably peroxide-based ones. Inspection by ultraviolet light is recommended after all intensive cleaning to verify that surfaces have been adequately cleaned

Fragrance: This is an air pollutant that is intended to give the false impression that air is clean. Truly clean air has no smell. Fragrance formulas can contain benzene, toluene, styrene, and formaldehyde, along with other ingredients. Fragrance chemicals can enter the body through the lungs, skin, and nasal passageways. They can affect the brain and nervous system in a matter of seconds, either by their presence in the brain or via stimulation of olfactory nerves. Avoid all products that list fragrance as an ingredient or have a fragrant odor. Be aware that even if "fragrance" is not listed as an ingredient, fragrance chemicals may have been added to a product for another purpose, or claimed to be added for another purpose - such as an anti-microbial stabilizer, blending agent, or enhancer.

Solvent: Water is a solvent. Using alcohol, petroleum, and coal tar-based solvents for floor refinishing, metal cleaning, stain removal, and graffiti control is commonplace. To preserve air quality, use water as a solvent whenever possible. Use petroleum-based solvents only as a last resort. Non-water-based solvents should be used in controlled programs, with substantial increased ventilation, pre-notification of building occupants, use during low building occupancy, and retesting of air to make sure it is clear before a space is re-occupied. The use of many solvent products, such as spot stain-removers, can be eliminated by promptly cleaning stains, using mild

detergent and baking soda with a gentle rubbing action and working in from the outside perimeter of the stain.

Vinegar: An acidic fluid usable for basic surface cleaning, window cleaning, and bathroom fixture wiping. The mild acidic properties provide the ability to remove hard water spots and cut soap films. Note that while vinegar is considered a less-toxic cleaner, some chemically sensitive individuals may react adversely to it.

Getting Started

Eliminating fragranced products is perhaps the quickest and easiest step to improving air quality.

Eliminate air fresheners and fragrance-emitting devices. Do not use urinal or toilet deodorizer blocks which contain paradichlorobenzene, naphthalene, solvents or fragrances. Substitute vegetable-based surfactants combined with microbe-based urea reducing properties. Choose non-fragranced cleaners, hand soaps, and lotions. Choose basic paper items that do not contain fragrances. Do not use cleaner/disinfectant combination products. Disinfectants should be used after a surface is clean for optimal deep cleaning, which should be done on an as needed basis. Inspect cleaned areas using ultraviolet light to verify that the surface has been adequately cleaned. Concentrate heaviest cleaning on essential areas. This will control odor.

Find and remove room deodorizers and dispensing devices. Establish a policy restricting occupant usage of fragrance-emitting plug-ins.

Inventory all current products. Discontinue any product that has fragrance as an ingredient or has a strong odor – such as cleaners containing pine, tea tree oil, orange, lemon, or citrus.

Using Above Chart on Cleaning Materials Usage

Select products used most frequently. This is most often an all-purpose cleaner, a window cleaner, and disinfectant cleaner or straight disinfectant.

Most of these products are overused. In addition, suitable substitutes can almost always be found that have less impact on air quality.

Experiment with dosages to find the minimum amount of cleaning product that will accomplish the job. This is best done after selecting a new vegetable surfactant-based all-purpose cleaner, window cleaner, or oxygen-based disinfectant for bathrooms. Control dispensers to make sure that the minimum dosages necessary are dispensed.

Make increased use of mechanical/physical methods of cleaning to reduce chemical usage.

Vacuuming: Vacuuming extracts soil at a rate of barely 60% when done with typical upright vacuum systems found today. Carpets tend to absorb particles from the air as well as tracked-in grease and other contaminants. Using a stronger vacuum system with continuous suction (non-pumping action) combined with a slower motion increases the extraction rate to above 85%. Keeping vacuumed dirt and fumes from escaping from the vacuum and re-contaminating a room requires strong filtration. HEPA systems work well to remove particulate matter, but care needs to be taken to insure there are no air leaks around the filter. An activated charcoal impregnated membrane will absorb and trap gasses.

A strong vacuuming program that includes daily and thorough vacuuming is the first guard against the need for frequent carpet cleaning. Secondly, evaluate traffic patterns and use throw rugs and entry mats to protect carpeting in heavily trafficked areas that quickly become dirty. Only clean spots or small areas of carpet that require cleaning. Clean carpet on an "as-needed" basis rather than on a regular schedule.

For widespread carpet cleaning, employ extraction methods using steam; mild cleaners that do not contain fragrances or solvents; or peroxide-based cleaners and fast four hour drying to reduce impacts on air quality and chances of mold growth.

Dusting: Wipe surfaces for dusting with lint-free cloths or damp clean rags. This is usually as effective as using chemical dusting products.

Mopping & Buffing: Damp mop hard floors using soft water in high traffic areas. Wipe with a dry mop on return pattern. Frequent mopping protects the floors and reduces the need for buffing and refinishing. Buff floors during off hours using the minimum amount of product necessary to refinish the floor.

Floor Refinishing: Refinish floors based on need rather than a fixed schedule. Keep service records that include the date and area where floor was refinished and the products used. Mandate that only the minimum amount of product necessary to accomplish the job will be used. Provide personnel with information on tracking and the goal of chemical reduction. All stripping and refinishing needs to be done during non-occupancy periods with substantial increases in outside air flow.

Keep Track

Using a computer, create an ongoing tracking system on reductions in the amount and number of chemicals used, changes in chemicals used, and eliminations of chemicals. This overall program needs to be continuously evaluated and communicated to building owners, managers, and occupants.

Steps for Implementing a Scent-Free Policy in the Workplace

(Adapted from the Canadian Centre for Occupational Health and Safety)

What steps should I take when implementing a scent-free policy in the workplace?

The situation may arise and create the need for a scent-free policy. As with most workplace policies, be sure to consider the following:

- Conduct an assessment or survey of the employees to determine the extent of the problem. Collect opinions and suggestions at the same time to help you develop a policy appropriate to your workplace.
- Designate one key person to oversee the project and its development. If you work at a large company, it may better to create a committee with members representing all groups (employees, unions, management).
- Involve the health and safety committee, and get management commitment from the beginning.
- Set and stick to deadlines for creating a draft policy, a review of the policy, and for implementation.
- Be sure that all employees have been fully informed of the policy and that they know what they have to do before the policy becomes effective.
- Educate the employees. You may choose to include brochures or flyers in payroll envelopes, publish articles in company newsletter, or give presentations. In any case, the goal is to inform all employees of the health concerns related to scents and why the policy is needed.
- Address any concerns the employees raise openly and honestly. Reinforce the idea that this policy is being implemented as a result of medical concerns - not merely because of a dislike for a certain smell.
- Make it clear that the policy applies to everyone (including visitors, patients, etc).
- Search local legislation for any supporting documentation.
- Do not limit the scent free policy to perfumes and colognes. Many cleaning and personal care products also have scents.
- Post a list of "approved" unscented products and where they are available locally.
- Review all MSDSs for the products currently used and for those you are considering using. Make sure that the ingredients are acceptable. Remember that some products which claim to be scent-free may be using additional chemicals to mask smells instead of truly being "unscented".
- Conduct trials in limited areas before purchasing large quantities of a product.
- Post notices that waxing, shampooing, painting, or spraying (etc.) will be conducted one week beforehand so that affected personnel can make arrangements or have their duties modified during that time.
- Put the policy statement notice on all appointment cards, stationery, room booking notices, employment postings, etc.
- Decide on wording for 'Scent Free' signs and where the signs will be posted.
- Let everyone know that the policy will be reviewed and can be changed because of experience or new knowledge.

What is an example of a policy?

Policies should be based on the health concerns of employees - especially those who have sought medical help. Keep the policy short, but specific. The policy must also apply uniformly throughout the company.

Sample: Scent-Free Policy
Policy: Due to the health concerns arising from exposure to scented products, ABC Company Inc. has instituted this policy to provide a scent-free environment for all employees and visitors.
Definitions: The use of scented products will not be allowed within the building at any time. In addition, all materials used for cleaning will be scent-free (where ever possible). A list of locally available scent-free products is available from the health and safety office.
Procedure: Employees will be informed of this policy through signs posted in buildings, the policy manual, promotional materials and will receive orientation and training. Visitors will be informed of this policy through signs and it will be explained to them by their host. Any violations of this policy will be handled through standard disciplinary procedures. This policy is effective on 01/01/01.

What should the 'posted notice' say?

Signs should be posted near the entrances to company building(s). In addition, statements on business cards, letter head or promotional materials may be helpful if you receive a lot of visitors.

Examples include:

Some people who work at ABC Company report sensitivities to various chemical-based or scented products. We ask for everyone's cooperation in our efforts to accommodate their health concerns.

In response to health concerns, ABC Company has developed a Scent-Free Policy. Scented products such as hair spray, perfume, and deodorant can trigger reactions such as respiratory distress and headaches. Staff and visitors are asked to not use these products when reporting to this office.

ABC Company is a Scent-free environment. Please do not use scented products while at work.

National Institute of Building Sciences (NIBS)
Indoor Environmental Quality (IEQ) Project
Designated Cleaner Air Rooms Committee

Table of Contents

INTRODUCTION AND OVERVIEW

Individuals with multiple chemical and/or electromagnetic sensitivities have identified the availability of designated cleaner air rooms and paths of travel in public and commercial buildings as highly important for improving access. The Designated Cleaner Air Rooms Committee examined the rationale for having Designated Cleaner Air Rooms, the types of

buildings or occupancies that may be appropriate for having such rooms, the minimum criteria for such a designation, and who would benefit from having these rooms.

Promising Practices
In November 2001 the State of California adopted a Cleaner Air Symbol and Conditions of Use in its building code to identify areas in publicly funded or leased facilities owned by the State of California that are accessible to and useable by people who are adversely impacted by airborne chemicals or particulate(s) and/or the use of certain electrical fixtures or devices.(1) The symbol can be used when minimum conditions established in the code are met. Use of the designation is voluntary.

A fact sheet on the California Cleaner Air Symbol and Criteria can be found at:
http://www.documents.dgs.ca.gov/dsa/pubs/cleanerair_factsheet.pdf

See ***1117B.5.11 Cleaner air symbol*** (page 109) of the California Code of Regulations for the code language: (see Appendix A)
www.documents.dgs.ca.gov/dsa/pubs/regulations_02-16-05.pdf

Recommended Actions
The Committee was charged with

1) reviewing the California symbol and criteria and investigating where it has been implemented, how it has worked, and what modifications and improvements, if any, are necessary to recommend broader usage;

2) developing and promoting a national Cleaner Air Symbol and Conditions of Use as appropriate; and

3) defining the scope of guidelines for creating an ideal zone (room and path of travel) hereafter referred to as a Clean Air Room in buildings for people with chemical and/or electromagnetic sensitivities.

During the project, the scope of work was expanded to include a brief discussion of accommodations for people with multiple chemical and/or electromagnetic sensitivities to address the needs of those individuals for whom a Cleaner Air Room would not provide adequate access or for those situations when such a designation would not be possible or feasible. Resources that address access and accommodations for people with multiple chemical and/or electromagnetic sensitivities at work, at school, at public meetings, and in hospitals are included at the end of this report.

Committee Recommendations

- The Committee highly recommends that the Access Board and/or the National Institute of Building Sciences (NIBS) fund or seek funding for FY2006 to develop specifications for designing and constructing a Clean Air Room and Path of Travel, the ideal or model room. This project is a natural outgrowth of the work of the other three committees.

- The Committee proposes a Pilot Project for FY2006 to implement a national Cleaner Air Symbol, as promulgated by the State of California, and Conditions of Use, as modified in the National Cleaner Air Signage, Conditions of Use section below, in

select public and commercial buildings such as independent living centers, disability organizations, schools and other educational institutions, public meeting places, or other business or government entities. The Committee recommends that one or more committee members in conjunction with the Access Board and/or the National Institute of Building Sciences assist in its implementation, track its use, analyze how well it has worked, and determine whether modifications or improvements are necessary prior to recommending promotion nationally. This same group would also examine implementation of the California Signage which is expected to take place during the same time frame.

- The Committee recommends that the Access Board, or a committee created by the Board, identify, review, summarize, and publish best practices for accommodations for people with multiple chemical and/or electromagnetic sensitivities on the website. Such a project was previously proposed by Access Board officials and discussed with members of this Committee but was not part of the charge of the current project.

NATIONAL CLEANER AIR SIGNAGE

Background:
In November 2001 the State of California adopted the California Cleaner Air Symbol, California Building Code, Title 24, Parts 2 and 12, 1117B.5.11ff., which established a symbol and criteria for conditions of use to identify a room, facility, and paths of travel that are accessible to and useable by people who are adversely impacted by airborne chemicals or particulate(s) and/or the use of electrical fixtures and/or devices. Installation and use of the Cleaner Air Symbol is on a voluntary basis in state buildings. The Committee learned that the Cleaner Air Symbol has yet to be implemented in California although members of our group are aware of individuals in California and in other states who are using the symbol as a means of advocating for or obtaining individual access needs.

The California Cleaner Air Symbol and Conditions of Use were also proposed for adoption at the meeting of the Accredited Standards Committee A117 on Architectural Features and Site Design of Public Buildings and Residential Structures for Persons with Disabilities in December 2001.(2) The Cleaner Air Symbol received a favorable vote. It was later dropped prior to the issuance of the final standard in 2003: International Code Council, American National Standard-Accessible and Useable Buildings and Facilities, ICC/ANSI A117.1-2003. The Cleaner Air Symbol is expected to be reintroduced for consideration during a new standard cycle that will begin shortly. The Standard must be adopted by a state or locality to be enforceable.

The Committee also discussed the identification of state buildings in California that might qualify for the Cleaner Air Symbol either due to a building's unique ability to meet the implementation criteria, or the need to make public meeting rooms accessible for those with chemical and/or electromagnetic sensitivities. Committee members are also aware of the need to encourage residents of California who may need to access state buildings to seek to implement the Cleaner Air Symbol.

Purpose:
To provide voluntary guidelines for a Cleaner Air Symbol that can be used nationally or adapted for state and local use.

Proposed Language:

National Cleaner Air Symbol: The national symbol shall be the standard used to identify a room, facility, and paths of travel that are more accessible to and useable by people who are adversely impacted by airborne pollutants, such as those with chemical sensitivities, asthma, and other respiratory conditions, and/or people who are adversely impacted by electromagnetic fields from electrical fixtures and equipment such as those with electromagnetic sensitivities.

The Symbol will comply with the specifications as described in the California code.
When the Cleaner Air designation symbol is used, the following requirements must be met:

- The symbol and text, "Cleaner Air" is displayed within a minimum 6-inch square;
- The "Cleaner Air" text is located under the symbol, as shown
- The Cleaner Air Symbol is shown as either a negative or positive image.
- The symbol and text are posted in either black and white, or in Federal Blue and white. When blue is used, Federal Blue Color No. 15090, Federal Standard 595B, is used.
- There is at least a 70% color contrast between the backgrounds of the sign and the surface that it is mounted on.

Conditions of Use
The Cleaner Air Symbol may be posted to identify the room and path of travel if there is verification that the room, facility, and path of travel to the room meet all of the Cleaner Air Requirements as indicated below:

- No Smoking
- Fragrance-Free
- Pesticide-Free (Indoors and Outdoors)
- Least Toxic/Risk Cleaning Products
- No Recent Construction or Remodeling Including Carpet Installation
- Cell phones turned off
- Ability to turn off or unplug computers and other electrical equipment by occupant or staff
- Ability to turn off fluorescent lighting by occupant or staff
- Ability to adjust temperature and air flow by occupant or staff, or the availability of operable window(s)

Paths of Travel

Every effort should be made to make the Paths of Travel as accessible as possible for those with multiple chemical and/or electromagnetic sensitivities even though the paths of travel might not meet all of the criteria of the Cleaner Air Room. It is important that the Path of Travel from the building entrance to the Cleaner Air Room be as short as possible. The building entrance should also be fully accessible to those with mobility and other impairments.

Restrooms

If possible, restrooms that are already fully accessible to those with mobility and other impairments should be designated for use by those individuals using the Cleaner Air Room. These restrooms should be located along the path of travel or as close as possible to the Cleaner Air Room. The restrooms should meet as many of the criteria as possible. The restrooms should prohibit smoking and be free of perfumes, fragranced products, air fresheners, deodorizers, and pesticides. Cleaning should be done with the same least toxic products used in the Cleaner Air Room. Cell phones should be turned off along the path of travel and in the restrooms.

Contact Information for the building/facilities manager or the designated agent responsible for maintaining and/or recording activity in the Cleaner Air Room should be posted at the Cleaner Air Room and at the accessible entrance, if possible, and be readily available to anyone seeking additional information by telephone, fax, e-mail, or mail.

Maintaining a Cleaner Air Record Log

A log shall be maintained on site, accessible to the public either in person or by telephone, fax, e-mail, mail or other accessible means as requested. One or more individuals shall be designated to maintain the log. The log shall record any product or practice used in the designated Cleaner Air Room, the path of travel, and accessible restrooms, as well as scheduled activities that may impact the Cleaner Air designation. The log shall also include the product label and Material Safety Data Sheet(s), as available, for any products used. Note, however, that neither the MSDS nor the product label provides complete information on product ingredients or their potential health effects.

Removal of The Symbol

If the path of travel, room and/or facility restrooms identified by the Cleaner Air Symbol should temporarily or permanently cease to meet the minimum conditions as set forth above, the Cleaner Air symbol shall be removed and shall not be replaced until the minimum conditions are again met.

Temporary Use of Cleaner Air Symbol

The Cleaner Air Symbol may be used to identify a room, path of travel, and restrooms that meet the conditions of use on a temporary basis.

Further Explanation of the Criteria for Conditions of Use:

No Smoking: Smoking is prohibited in the path of travel, Cleaner Air Room, and restrooms serving the room. To qualify as a Cleaner Air Room, the room, path of travel, restrooms and surrounding area must be free of tobacco residue. Those who smoke, or who have tobacco residue on their person, would be prohibited from using the room. Smoking should be restricted to outdoor, designated smoking areas that are at a minimum of 100 feet from paths of travel, entryways, operable windows, and air intakes. (See No Smoking Policy, Operations and Maintenance Report)

Fragrance-Free: Prohibit fragrance-emitting devices (FEDS), air fresheners, deodorizers, and similar products. Recommend that no fragranced, citrus-and/or pine-based products be used in cleaning or maintaining the room, path of travel, and restrooms. Any persons with perfume, cologne, aftershave, as well as fragranced personal care and laundry products, would be prohibited from using the room. (See Fragrance-Free Policy, Operations and Maintenance Report)

Pesticide-Free Indoors and Outdoors:

Practice Integrated Pest Management. Use least hazardous pest management materials such as non-volatile baits, sticky traps, and boric acid with knowledge and input from those using the path of travel and Cleaner Air Room. The sign should be removed in the event of a least hazardous pesticide application for 24-48 hours because it is likely that the certified pest control applicator is in regular contact with chemical pesticides and could leave residue from clothing or equipment. In addition, some chemically sensitive individuals may be made sick by exposure to even least hazardous pesticides especially when they are first applied.

In the event of a chemical pesticide application made to the building or grounds, other than a least hazardous pesticide such as those listed above, remove the sign and consult with those who use the space and others regarding the length of time that the room would need to be closed to protect affected populations based on the product(s) used. (See Operations and Maintenance for least hazardous pest management materials and cautions in the event that a chemical pesticide application is considered for use in the Cleaner Air Room, Path of Travel, Restrooms, or the building or grounds.)

Least Toxic/Risk Cleaning Products:
Avoid or limit the use of products containing chlorine, ammonia, quaternary ammonium, phenol, isopropyl and other alcohols, formaldehyde, and other petroleum distillates. Do not use fragranced, citrus-and/or pine-based cleaning products as mentioned above. Consult those who plan to use the Cleaner Air Room and Path of Travel for cleaning product recommendations. Follow the recommendations of Operations and Maintenance Report for best practices.

No Recent Construction or Remodeling Including Carpet Installation:
Every effort should be made to avoid remodeling activities in the Cleaner Air Room, path of travel, and restrooms. Any remodeling activity would require removal of the signage. The length of time for removal should be determined by the type of activity, extent of the remodeling, and the products and materials selected for use. It is important to choose the least toxic, least problematic products and practices. Except for minimal touch up painting, for example, it would not be unusual to have the signage removal in effect for a period of 3- 6 months to a year or more depending on the nature and extent of the remodeling activity. Be sure to consult building occupants with existing health problems and those who are using the Cleaner Air Room for their input and to help determine when the Cleaner Air Room may again be safe for use. (See Products and Materials Report and Design and Construction Report for more information)

Cell Phones Turned Off:
Protect those with electromagnetic sensitivities and others who may be adversely affected by electrical equipment.

Ability to turn off or unplug computers and other electrical equipment by occupant or staff:
Protect those with electromagnetic sensitivities and others who may be adversely affected by computers and electrical equipment.

Ability to turn off fluorescent lighting by occupant or staff:
LEED (Leadership in Energy and Environmental Design) recommendations for new construction call for individual control of lighting.(3) Newer fluorescents that contain electronic rather than magnetic ballasts may be less problematic for some people with electromagnetic sensitivities because they do not produce a visible flicker or audible hum. They are also less prone to trigger seizures.

Ability to adjust temperature and air flow by occupant or staff, or the availability of operable window(s):
LEED recommendations for new construction include individual control of temperature and ventilation.(3) Opening an operable window may improve the air quality or air flow in a Cleaner Air Room and compensate for situations when individual control of temperature and air flow is not possible.
The text below is duplicated on the website

*****

RECOMMENDATIONS FOR ACCOMMODATIONS

People with chemical and/or electromagnetic sensitivities can experience debilitating reactions from exposure to extremely low levels of common chemicals such as pesticides, cleaning products, fragrances, and remodeling activities, and from electromagnetic fields emitted by computers, cell phones, and other electrical equipment.

The severity of sensitivities varies among people with chemical and/or electromagnetic sensitivities. Some people can enter certain buildings with minor accommodations while others may be so severely impacted that they are unable to enter these same spaces without debilitating reactions. Furthermore tolerances to specific exposures can vary greatly from one individual to the next. Meanwhile some exposures, such as the application of certain pesticides or extensive remodeling, for example, may be devastating to all chemically sensitive people and make a building or facility inaccessible for a substantial period of time.

According to the Americans with Disabilities Act (ADA) and other disability laws, public and commercial buildings are required to provide reasonable accommodations for those disabled by chemical and/or electromagnetic sensitivities. These accommodations are best achieved on a case-by-case basis.

Reasonable accommodations for a chemically sensitive and/or electromagnetically sensitive individual can include providing a space or meeting area that addresses one or more of the Cleaner Air criteria, upon request, such as

- Remove fragrance-emitting devices (FEDS)
- Delay or postpone indoor or outdoor pesticide applications, carpet cleaning, or other cleaning or remodeling until after the meeting
- Provide room or meeting area near exterior door or with window(s) that can be opened
- Require cell phones and computers be turned off
- Provide incandescent lighting in lieu of fluorescent lighting
- Provide at least one nonsmoking, fragrance-free person per shift to provide services (e.g. nurse, police officer, security guard, clerk)

For individuals who are unable to use or meet in a building or facility, or who are too severely impacted by chemical and/or electromagnetic exposures to use a designated Cleaner Air Room, accommodations may include:

- Meet an individual at the door or outside to conduct business
- Allow a person to wait outside or in car until appointment
- Provide a means, such as a phone, intercom, bell, or buzzer to summon staff to an outside door for assistance
- Permit business to be conducted by phone, fax, mail, or e-mail rather than in person
- Allow participation in a meeting by speakerphone

End duplicated text

SPECIAL ACKNOWLEDGEMENT: The Committee extends a generous thank you to Sharon Toji, Access Communications, for designing the Cleaner Air Symbol and making it available for public use.

REFERENCES

1) California Access Compliance Reference Manual, Division of the State Architecture, Chapter 11B Part 2 Title 24, California Code of Regulations 110 November 1, 2002.

2) American National Standards Institute (ANSI) Accredited Standards Committee A117, Committee on Architectural Features and Site Design of Public Buildings and Residential Structures for Persons with Disabilities, www.iccsafe.org/cs/standards/a117/index.html

3) LEED Green Building Rating System for New Construction & Major Renovation, (LEED-NC), Version 2.1, US Green Building Council, pages 68 and 69. www.usgbc.org
LEED Controllability of Systems:
6.1 Provide at least an average of one operable window and one lighting control zone per 200 SF for all regularly occupied areas within 15 feet of the perimeter wall.
6.2 Provide controls for each individual for airflow, temperature and lighting for at least 50% of the non-perimeter, regularly occupied areas.

RESOURCES FOR ACCESS AND ACCOMMODATIONS

Lamielle, M., Creating an Accessible Indoor Environment, Fact Sheet, National Center for Environmental Health Strategies, 2004.

Lamielle, M., Multiple Chemical Sensitivity and the Workplace, National Center for Environmental Health Strategies, 2004.

Temple, T., Healthier Hospitals, Ohio Network for the Chemically Injured, 1996.

Miller, CS, Ashford, NA, Multiple Chemical Intolerance and Indoor Air Quality. In Indoor Air Quality Handbook, Spengler, J, Samet J and McCarthy J, Eds., New York, McGraw-Hill, Inc., 2000.

Job Accommodations Network, a free service of the Office of Disability Employment Policy, U.S. Department of Labor, www.jan.wvu.edu

University of Minnesota, Disability Services, Internal Guidelines Regarding Multiple Chemical Sensitivity/Environmental Illness (MCS/EI),
http://ds.umn.edu/disabilities/MCSEIPolicy.html

The Evergreen State College, policy on air quality,
www.evergreen.edu/policies/g-air.htm

COMMITTEE

Active
Chair – Michael Mankin, Division of the California State Architect
Libby Kelly, Council on Wireless Technology Impacts
Mary Lamielle, National Center for Environmental Health Strategies
Ann McCampbell, Multiple Chemical Sensitivities Task Force of New Mexico
Susan Molloy, National Coalition for the Chemically Injured
Toni Temple, Ohio Network for the Chemically Injured

Contributing
Mark Jackson, Lennox Industries, Inc.
R. Bruce McCreary, Snowflake, AZ

Commenting
Dora McGregor, Salt Lake City, UT

APPENDICES

Appendix A - *1117B.5.11 Cleaner air symbol* (page 109) of the California Code of Regulations

1117B.5.11 Cleaner air symbol. "*STRICTLY FOR PUBLICLY FUNDED FACILITIES OR ANY FACILITIES LEASED OR RENTED BY STATE OF CALIFORNIA. NOT CONCESSIONAIRES". This symbol shall be the standard used to identify a room, facility and paths of travel that are accessible to and usable by people who are adversely impacted by airborne chemicals or particulate(s) and/or the use of electrical fixtures and/or devices. When used, the symbol shall comply with Figure 11B-40.*

1117B.5.11.1 Color and size of symbol. *The symbol shall be used when the following minimum conditions are met. The symbol, which shall include the text "Cleaner Air" as shown, shall be displayed either as a negative or positive image within a square that is a minimum of 6 inches on each side. The symbol may be shown in black and white or in color. When color is used, it shall be Federal Blue (Color No. 15090 Federal Standard 595B) on white, or white on Federal Blue. There shall be at least a 70% color contrast between the background of the sign from the surface that it is mounted on.*

Strictly for publicly funded public facilities or any facilities leased or rented by State of California. Not concessionaires.
* In 1117B.5.8.1 (Symbols of Accessibility) the title of this section is incorrectly worded, which is causing misunderstanding regarding proper standard reference. Change title to read 'International Symbol of Accessibility.' This will be submitted for correction in Rulemaking.
CALIFORNIA ACCESS COMPLIANCE REFERENCE MANUAL . DIVISION OF THE STATE ARCHITECT

1117B.5.11.2 Conditions of use. *Use of the cleaner air symbol is voluntary. The cleaner air symbol shall be permitted for use to identify a path of travel, and a room or a facility when the following is met.*

1. *Floor or wall coverings, floor or wall covering adhesives, carpets, formaldehyde-emitting particleboard cabinetry, cupboards or doors have not been installed or replaced in the previous 12 months.*

2. *Incandescent lighting provided in lieu of fluorescent or halogen lighting, and electrical systems and equipment shall be operable by or on behalf of the occupant or user of the room, facility or path of travel.*

3. *Heating, ventilation, air conditioning and their controls shall be operable by or on behalf of the occupant or user.*

4. *To maintain "cleaner-air" designation only nonirritating, nontoxic products will be used in cleaning, maintenance, disinfection, pest management or for any minimal touch-ups that are essential for occupancy of the area. Deodorizers or Fragrance Emission Devices and Systems (FEDS) shall not be used in the designated area. Pest control practices for cleaner-air areas shall include the use of bait stations using boric acid, sticky traps and silicon caulk for sealing cracks and crevices. Areas shall be routinely monitored for pest problems. Additional nontoxic treatment methods, such as temperature extremes for termites, may be employed in the event of more urgent problems. These pest control practices shall not be used 48 hours prior to placement of the sign, and the facility shall be ventilated with outside air for a minimum of 24 hours following use or application.*

5. *Signage shall be posted requesting occupants or users not to smoke or wear perfumes, colognes or scented personal care products. Fragranced products shall not be used in the designated cleaner-air room, facility or path of travel.*

6. *A log shall be maintained on site, accessible to the public either in person or by telephone, e-mail, fax or other accessible means as requested. One or more individuals shall be designated to maintain the log. The log shall record any product or practice used in the cleaner-air designated room, facility or path of travel, as well as scheduled activities, that may impact the Cleaner-Air designation. The log shall also include the product label as well as the* *******Material Safety Data Sheets (MSDS).*

1117B.5.11.3 Removal of symbol. *If the path of travel, room and/or facility identified by the cleaner air symbol should temporarily or permanently cease to meet the minimum conditions as set forth above, the cleaner air symbol shall be removed and shall not be replaced until the minimum conditions are again met.*

Appendix B – SOUTHWEST COMMUNITY HEALTH SYSTEM POLICY GUIDELINE
Southwest General Health Center (SWGHC)
Middleburg Heights, OH

EFFECTIVE DATE: July, 2002	**POLICY 742**
Revision Dates:	**Page 1 of 7**

POLICY NAME: MULTIPLE CHEMICAL SENSITIVITY SYNDROME (MCS)

POLICY:

Southwest General Health Center will provide guidelines to ensure optimal care of the patient experiencing Multiple Chemical Sensitivity (MCS) which is mutually established with the patient, family/significant other and health care team.

I. INTERPRETATION:

Multiple Chemical Sensitivity (MCS), also referred to as environmental illness or chemical injury is a medical condition in which individuals develop symptoms from exposure to very low level of chemicals in the environment. The interdisciplinary team at SWGHC uses a collaborative process with the patient, physician, family/significant other and the health care associates to establish a safe environment, to promote healing and ensure comfort.

II. OBJECTIVES:

An organizational approach to patient management with multiple chemical sensitivities includes:

A. Method to ensure patient is placed in a safe environment.
B. Method to facilitate identification of a MCS patient.
C. Method to verify competency of all associates providing direct and supportive care to the patient with MCS
D. Method to ensure patient's participation in developing their care plan.
E. Method to ensure patient/their families/significant others are educated about the need to communicate about any special care required.

III. OVERSIGHT AND RESPONSIBILITY

A coordinated organizational program to care for MCS patients will be developed by an interdisciplinary team. This committee will have the responsibility for assuring that all provisions of this policy are adhered to throughout the organization. The team will have representatives from:

A. Medical Staff
B. Nursing Services
C. Central Sterile Supply
D. Protection Services

SOUTHWEST GENERAL HEALTH CENTER
STANDARD OF PRACTICE

PAGE	MULTIPLE CHEMICAL SENSITIVITY SYNDROME	POLICY
2 OF 7		742

E. Nutritional Services
F. Plant Operations
G. Environmental Services
H. SSA's
I. Pharmacy
J. Social Services
K. Administration

IV. SPECIFIC ROLES AND RESPONSIBILTIES OF INTERDISCIPLINARY TEAM

A. Medical Staff -Physician: Provides special instructions, treatments, diagnostic tests and medication orders. No treatments/medications should be administered to an MCS patient without prior approval of patient's private physician unless a life threatening emergency exists.

B. Nursing Services
Role and responsibilities:

1. Identify the patient with MCS
2. Provide a safe patient care environment.
3. Develop an awareness, sensitivity and respect of patients' physical and emotional needs.
4. Develop a plan of care on daily basis with minimum of one staff member per each shift to attend medical needs of the patient.
5. Comply with the following when caring for the MCS patient:
   a) be perfume and scent free (ie., no hair spray, no mousse gels, lotions, cigarette/smoking smells).
   b) Do not use aerosol products (ie hair spray, deodorants). Non-scented, potassium salts, pump deodorant is acceptable. Baking soda (dry).
   c) Do not wear new clothing which has not been laundered.
   d) Do not wear clothing which has been freshly dry-cleaned.
   e) Use only latex free gloves
   f) Wash hands and apply gloves before entering the patient's room.
   g) Be alert for any environmental triggers when following normal hospital procedures.

C. Central Sterile: Provides and ensures the unit with

1. Latex free products

2. Adequate supply of sterile linens

SOUTHWEST GENERAL HEALTH CENTER
STANDARD OF PRACTICE

PAGE	MULTIPLE CHEMICAL SENSITIVITY SYNDROME	POLICY

3. Adequate supply of other medical core items (ie. Sponges, dressings, securing devices).
4. Patient can provide their own linens if other methods are not satisfactory.

D. Protection Services: Provides assistance from the vehicle to hospital in a safe manner. (Turn vehicle engines off)

E. Nutritional Services: Recognizes different food sensitivities and follows certain guidelines to accommodate and meet individualized needs of the MCS patient.

Special provisions may include but will not necessarily be limited to the following:

1. No processed foods of any kind including instant oatmeal, instant potatoes, and other prepackaged mixes, ie., gravies, sauces, and flavor packets as they may contain many additives.
2. Use no dyes, preservatives, sulfites, artificial flavoring or MSG.
3. Use no aerosol cooking sprays.
4. Use no artificial sweeteners.
5. Distilled water in glass containers to be provided by Nutrition Services, or patient may supply his/her own tolerated water for drinking.
6. Serve beverages which have not been processed with chemicals.
7. Nutrition Services will provide lactose free milk or a substitute such as soy or rice milk to those who require it.
8. Rigidly follow physician's orders regarding food restrictions.
9. Review food allergies within the food service to avoid allergic reactions.
10. Permit patient to supply his/her own tolerated food products. Nursing will provide a proper storage area for them.
11. Do not serve food or liquids in plastic or Styrofoam. Use only glass or ceramic dishes and cups which have been well rinsed to remove all traces of soap and chemical residues. Cellophane or plastic wrap packaging on room temperature food (i.e., crackers) is typically not a problem, however, caution must be used if toxic inks are used. Anything noticeably odorous can be a problem.
12. Remove treated i.d. menu paper from the tray and replace tray liners that may have become wet during transport.

F. Plant Operations: Plant Operations will not perform remodeling or painting within close proximity to MCS patient's room. These activities can be coordinated with the leadership of patient care area.

SOUTHWEST GENERAL HEALTH CENTER
STANDARD OF PRACTICE

PAGE	MULTIPLE CHEMICAL SENSITIVITY SYNDROME	POLICY
4 OF 7		742

G. Environmental Services: will perform terminal cleaning.

1. Refer to Environmental Services Policy for MCS room cleaning.
2. Staff will check with the floor nurse before entering the patients room.
3. Environmental Services will coordinate with the patient's nurse for cleaning of the patient's room or performing any special cleaning tasks in the general area (i.e., floor waxing or floor wax removal in the halls). Whenever there is a question of what may affect the health of an MCS patient, the floor nurse must be consulted.
4. Scented products, air fresheners, deodorizers or other additives should not be placed in any vacuum cleaner bag used anywhere in the health center. Use only unscented vacuum cleaner bags.
5. Do not use any other housekeeping products (garbage bags, paper towels, cleaning solutions) which contain fragrances or pesticides. These products should be stored in an area separate from disinfectants, soaps and other cleaning products. Do not store toilet paper, facial tissues or other patient items near fragranced or pesticide products.

H. SSA's: Will perform daily cleaning of the patient's room by using the following guidelines.

1. SSA's must wear clean gowns and caps when cleaning the room of MCS patient when patient is in the room.
2. Do not use any other housekeeping products (any plastic bags, paper towels, cleaning solutions which contain fragrances or pesticides). Do not use any air fresheners or deodorizers in patient's room.
3. Dust with a clean cotton cloth moistened with only water.
4. Use baking soda or Bon Ami cleanser for tubs, sinks and toilet.
5. Remove trash at least twice daily. Do not use plastic liners.
6. Do not leave patient trays in the room after meals.

SOUTHWEST GENERAL HEALTH CENTER
STANDARD OF PRACTICE

PAGE	MULTIPLE CHEMICAL SENSITIVITY SYNDROME	POLICY
5 OF 7		

I. Pharmacy
Provides pharmaceutical care guidelines to patient, family and health care team members. The following guidelines are helpful in providing medications to patients with MCS:

1. Have patient bring medications to the hospital that he/she is currently using. If the physician desires the patient to continue using these medications, an order shall be written to state such.

2. Use glass bottles for IV solutions and any prescription medications that are to be administered intravenously.
3. Do not use any substitutions or generic drugs for medications ordered without patient or MD approval.
4. Be alert for standard ingredients MCS patients typically react to including but not limited to dyes, preservatives, artificial sweeteners and flavoring. Consider capsules instead of tablets.
5. Monitor medication by listing the patient's specific allergies on the patient's medication profiles.

J. Social Services
Provides psychological support and interventions, assists patient and family with community resources and discharge planning.

K. Administration
Provides support and assistance in developing a safe environment for MCS patient.

PROCEDURE:

A. Admitting will adhere to the following to assist all health care center personnel in caring for the patient:
   1) Flag patient's chart clearly and boldly with MCS under the allergies.
   2) Flag patient's chart to notify all other health center departments in advance of treating the patient so proper precautions can be made for necessary equipment and special supplies.
   3) Indicate "MCS" on patient's allergy band.

SOUTHWEST GENERAL HEALTH CENTER
STANDARD OF PRACTICE

PAGE	MULTIPLE CHEMICAL SENSITIVITY SYNDROME	POLICY
6 OF 7		742

B. Emergency Department:
Will assist health care center personnel in diminishing any unnecessary discomfort and possible risks when MCS patient is brought into the Emergency Room. The following is initiated:

1) Immediately contact patient's physician for special instructions.
2) Immediately isolate patient from all other patients and visitors.
3) Place patient in an area which is not used to store any medical supplies or medications.
4) Keep a supply of sterile linens and gowns in the emergency room area.
5) Provide the least toxic pharmaceutical supplies and equipment.
6) Coordinate with all other health center departments to meet patients' needs.
7) Monitor the general environment the patient is placed in.

C. Patient's Room
Staff will implement numerous measures to prevent unnecessary exposure.

Prior to patient's occupancy:

- Contact Environmental Services for terminal cleaning of the room.
- Place new sharps container in the room
- Contact CSS for sterile linen.

During Patient's Occupancy:

- Patient should be isolated from other patients and their visitors at all times to prevent reactions to products these people are wearing or using.
- Place sign on patient's door stating: "Check at the nurses station before entering room".
- Keep patient's door closed at all times and if necessary provide a clean cloth to seal bottom of door from hall odors.
- Health care center personnel must wash their hands and apply hypo allergenic, non-latex gloves prior to entering the room of the MCS patient as these activities can trigger reactions in the patient.

SOUTHWEST GENERAL HEALTH CENTER
STANDARD OF PRACTICE

PAGE	MULTIPLE CHEMICAL SENSITIVITY SYNDROME	POLICY
7 OF 7		742

- No live plants or flowers permitted in the patient's room (mold and pesticides trigger MCS reactions).
- No newspapers or treated paper permitted in patient's room. (3-part copy papers or chlorinated papers can be highly toxic and may affect breathing).

APPROVED:

Trilok C. Sharma, M.D. President, Medical Staff Southwest General Health Center	L. Jon Schurmeier, President Southwest General Health Center

Appendix C – MULTIPLE CHEMICAL SENSITIVITY (MCS) PROTOCOL
Southwest General Health Center (SWGHC)
Middleburg Heights, OH

INITIATED	DISCONTINUED
Date	Date
Time	Time
RN	RN

SOUTHWEST GENERAL HEALTH CENTER

NURSING SERVICES

MULTIPLE CHEMICAL SENSITIVITY (MCS) PROTOCOL

PURPOSE: To outline the management and nursing responsibilities caring for a patient experiencing multiple chemical sensitivity (MCS).

LEVEL: Independent

SUPPORTIVE DATA: MCS is an acquired chronic disorder characterized by recurrent symptoms occurring in response to low levels of exposure to multiple unrelated chemicals. The symptoms generally occur in one of four categories: central nervous system, circulatory, respiratory and mucous irritation or metabolic that would include enzymes, blood, kidneys, GI tract, etc.. Patient with a history of maladaptive reactions to chemicals found in perfumes pesticides, detergents, household cleaners, etc. may have or develop multiple chemical sensitivities. Approximately 75% of those affected are women, possibly due to endocrine disruption. People in their 30s and 40s are most strongly affected as well as children and others who are more susceptible to the effects of pesticides and products containing toxic chemicals. The population most strongly identified with this condition include: industrial workers, teachers, nurses, sick building occupants and those living in chemically contaminated communities. Refer to *Latex Sensitivity/Allergy Protocol* and *Hospital Policy #742 Multiple Chemical Sensitivity (MCS) Patient.*

CONTENT:

1. Identify individuals at risk on admission in Emergency Room or Admitting.

Prior to Admission

2. Assign the patient to private room.
3. Contact CSR for free tote (or nursing supervisor during night shift).
4. Notify Environmental Services, Central Sterile, Pharmacy, Nutritional Services, and SSA of MCS patient admission.

Admission Assessment

5. Assess all patients on admission for allergies and maladaptive reactions.
6. Place green allergy band on patient; mark Multiple Chemical Sensitivity (MCS).
7. Place sign on patient's door stating:

"Check at the nurses station before entering patient's room."

Admission Assessment (cont'd)

8. Enter Multiple Chemical Sensitivity on all the orders sent in Cerner in Comments Box.

9. Observe patient for following symptoms.

- Fatigue
- Memory loss
- Depression
- Nervousness
- Lack of motivation
- Visual problems
- Hearing problems
- Dizziness
- Sleep disorders
- Edema
- Disorientation
- Confusion
- Irritability
- Loss of logic sequencing ability
- Loss of coordination
- Hoarseness
- SOB
- Headache
- Chest pain
- Joint pain
- Digestive difficulties
- Sun or other rashes
- Cold or heat sensitivity
- Nausea
- Tingling or numbness of extremities
- Sinusitis
- Pallor
- Anemia
- Salivation (usually from pesticides)

10. Refer to Latex Sensitivity/Allergy Protocol

Patient Care

11. Report signs and symptoms exhibited by patient to physician.

12. Obtain physician order for a special diet.

13. Encourage patient to select their own menu.

14. Allow patient to supply his/her own tolerated food products and dietary supplements.

15. Retain patients dietary requirements in the patient's medical record for future reference.

16. Encourage use of personal respirator and other protection methods while in Health Care Center.

Patient Safety

17. Reinforce all hospital employees and visitors to check with patient's nurse prior to entering patient's room.

18. Maintain patient isolation from other patients and their visitors at all times.

19. Transport patient with R-95 mask or personal respirator.

Patient Safety (cont'd)	20.	Refrain staff caring for patient from wearing perfumes, scented lotions, hair spray, deodorants or other scented products.
	21.	Educate hospital staff to wash their hands with unscented soap.
	22.	Apply hypo-allergenic, non-latex gloves prior to entering the room.
	23.	Instruct patient's family not to bring plants or flowers to the patient's room.
	24.	Restrict newspaper in patient's room.
Patient Education	25.	Discuss with patient/family Multiple Chemical Sensitivity if newly diagnosed patient.
	26.	Reassure the patient with understanding of their chemically sensitive condition.
	27.	Refer patient to Social Services to provide list of Community Services.
Documentation	28.	Document Multiple Chemical Sensitivity in the patient's medical record, in the front of the chart, medication record and computer system.
	29.	Record implementation/modification/discontinuation of protocols.
	30.	Document vital signs and assessment findings on appropriate flow sheet.
	31.	Document evaluative statement of the patient's response to interventions and lack of complications.
Emergency Interventions	32.	If known, remove the offending object or person from patient's room.
	33.	If necessary, remove patient from room to fresh air outside the building.
	34.	Utilize charcoal and baking soda to absorb and remove odors from the room. Open windows if possible.
	35.	Refer to patient's personal emergency protocol for reducing and diluting chemical reactions (water, food, baking soda, tri-salts, etc.)

Emergency Interventions (cont'd)

36. Communicate and cooperate with the patient whenever possible as the patient generally knows what will help.

REFERENCES:

Multiple Chemical Sensitivity Syndrome, September 1, 2000, American Academy of Fa.
Mental Health Network, Editorial: April 2000.
SWGHC Pharmacy
Temple, Toni, Healthier Hospitals, 1996.

APPROVED: ICU QA 4/02; SC 05/02
REVIEWED/
REVISED: New 09/01, 3/02
DISTRIBUTION: Generic

National Institute of Building Sciences (NIBS)
Indoor Environmental Quality (IEQ) Project
Design & Construction Committee

Table of Contents

INTRODUCTION

The Building Design & Construction Committee was charged with making recommendations for designing commercial and public buildings that would be more accessible for people with multiple chemical and/or electromagnetic sensitivities and provide healthier environments for all occupants.

The Committee found that major access barriers for chemically sensitive individuals are factors that contribute to poor air quality, such as pesticides, new carpets, tobacco smoke, inadequate ventilation, mold, certain building materials, and building activities that generate air pollutants. For electromagnetically sensitive individuals, access barriers include fluorescent lighting, unshielded transformers and wiring, security and scanning equipment and numerous other electrical appliances.

The recommendations that follow, therefore, focus on minimizing or eliminating these barriers through designing

- for pest prevention to reduce the need for or the use of pesticides,
- for preventing moisture and mold growth,
- for optimum ventilation via HVAC systems and operable windows,
- for exhausting air contaminants,
- for minimizing use of carpet and other flooring that emit volatiles, and
- for shielding occupants from electromagnetic fields.

Although many building materials can be problematic for chemically sensitive people, the Committee made minimal suggestions regarding product choices as this was the charge of the Building Products and Materials Committee.

Recommendations for Future Actions

The Committee recommends that the Access Board, NIBS, or other entity create a Design Manual using the outline in this report. This Manual would provide more detailed guidance than is provided here.

The Committee acknowledges that while the scientific evidence may be inconclusive about whether ambient electromagnetic fields pose a substantial health risk to the general population, the presence of EMF is an access barrier for people who are electromagnetically sensitive. Therefore, the Committee recommends that measures be taken to reduce EMF whenever possible in order to increase access for these individuals as well as taking a precautionary approach to protecting the health of all.

RECOMMENDATIONS

Site and General Building Design

Select site to minimize potential exposure to air and soil pollutants and electromagnetic fields (EMF). (Appendix 1)

Visit the site on several occasions to assess site criteria.

Note microclimate: wind direction, sun exposure.

Avoid sites near wetlands/stagnant water, low lying areas; sites should be well above 100 year flood plain.

To minimize moisture infiltration at the foundation, avoid earth berm construction and provide positive
drainage from building.

Avoid below-grade occupied space.

Avoid tuck-under parking and indoor parking.

Roof gardens should be avoided because soil and water can foster mold growth. (Appendix 2)

Arrange drop-offs, loading docks, helicopter pads, and other vehicular access points to eliminate or minimize exhaust fumes from entering building directly or being drawn into the HVAC system.

Avoid the use of indoor plants because they can attract pests, stimulate pesticide use, trigger allergies, and foster mold growth.

If smoking on site is permitted, dedicate an outdoor location that is remote from entries, main pedestrian paths and air intakes.

Group and isolate uses within a building that emit contaminants and could affect air quality.

High ceilings are preferred in order to dilute contaminants.

Avoid decorative indoor fountains.

Enclosure

Design for a tight building envelope to maximize the performance of the HVAC system. Meet or exceed Energy Star leakage area (less than 1.25 s.i./100 sf. (Reference 1)

- Building should be able to be sealed off from exterior events that would raise outdoor pollutant levels such as, toxic spills, pesticide spraying, fires, traffic accidents, and rush hour traffic.

- Operable windows are preferred. Being able to open windows is an important access issue for chemically sensitive individuals and can be beneficial for other occupants in certain situations. Operable windows should be detailed to minimize air infiltration.

Design to prevent pest problems. (Appendix 3)

- Use inert pest resistant materials. When treatment of wood is required, treating with disodium octaborate tetrahydrate may be among the safer options.
- Incorporate pest barriers such as termite shields, window screens, and bird screens in construction details. Bird and bat droppings pose great IAQ risks.
- Some pesticides such as boric acid are considered environmentally safe. If used, granular or gel forms are preferred. Care should be taken to ensure that particles do not infiltrate interior habitable space.

Shield occupants from external sources of EMF. Windows with low e glazing, metal roof, and siding components may reduce certain interior EMF. (Reference 2)

Roof Design

- Pitched roofs are preferred, because they shed water quickly, clean the roof of pollutants and potential toxins, and are less prone to leakage.
- Inert roofing materials, such as coated metal or clay tile, are ideal. Note that galvanized metal presents a rust hazard and should be avoided.
- Flat roofs are not preferred. If used, membrane and high albedo (highly reflective to heat) type are recommended. Asphalt or modified bitumen built-up roofs are less preferable. (Reference 3)

Wall Design

- Use best design practices to prevent moisture and condensation within walls. Calculate dew points for each exterior wall (and roof) type to verify performance at each condition. Provide detail for all flashing and counter-flashing locations.

Foundation Design

- Provide under-slab vapor barriers, insulation, and damp-proofing to prevent moisture infiltration and condensation.

Protect stored building materials from water damage and mold growth.

Avoid use of water-damaged or mold-affected materials.

Plumbing, Mechanical and Electrical Equipment

Properly insulate pipes to prevent condensation, especially within walls.

Use modeling software to determine airflow and to ensure isolation of pollutant sources and adequate ventilation.

Ventilate areas occupied by people with chemical sensitivities with goal of eliminating odors (ideally entire building). These ventilation rates meet or exceed all worldwide standards. (Reference 4)

Provide local control of temperature and airflow (ideally for every occupant). (Reference 5)

Utilize Displacement Air Distribution method to move pollutants away from occupants.

Dedicate building as Smoke-Free. (Reference 6)

Isolate mechanical equipment from occupied areas.

Provide direct exhaust from rooms and areas that have pollutant-generating sources or activities. These include but are not limited to: (see Appendix 5)

- Bathrooms (code requirement).
- Kitchens or office kitchenettes (this is in addition to code-required hoods or stove exhausts).
- Copy and print rooms.
- Computer rooms.

Ductwork

- Avoid insulation inside ductwork. Use external insulation wrap of non-friable (airborne particle creating) material.
- Oil coatings used in fabrication of sheet metal stock can affect air quality. Prior to installation, thoroughly clean ductwork with a low VOC product. Use methods that do not leave residue or cause oxidation. (Reference 7)

Prohibit the use of fragrances and disinfectants in air distribution systems.

Maintain relative humidity between 30%-50%.

Locate outside air louvers away from pollutant sources.

Filtration (Reference 8)

- Carbon and HEPA filters are preferred.
- Avoid ozone generating air-purification systems.
- Avoid electrostatic air cleaning due to ozone.

In renovation work, re-evaluate HVAC system performance to ensure that original design standards are met.

Shield occupants from internal EMF. Design electrical systems to minimize EMF. Maximum recommended magnetic field levels of 2.5 milligauss (preferably 1 milligauss in occupied areas) and as low as technically achievable in areas to be occupied by people with sensitivities.

Finishes and Furnishings

Refer to Products and Materials Group report for specific recommendations on materials.

Floor Coverings

- Use inert materials wherever possible, such as, but not limited to:
  - Stone, tile, terra-cotta, brick, ceramic tiles,
  - Terrazzo,

  - Sealed concrete.
- Minimize the use of carpeting. Note that carpet that meets Carpet and Rug Institute Green Label Plus standards can still be problematic for chemically sensitive people. (Appendix 4)
- Use carpet systems that allow for small area replacement, such as certain of the self-adhesive backing carpet squares.
- Avoid glue-down carpet installations or use low-VOC adhesives. (see Products & Materials Committee recommendations)
- Cork and linoleum may contain linseed oil and should be avoided. Rubber flooring can also pose problems for chemically sensitive individuals and should be avoided.
- Use low-or no VOC materials for all flooring. (Appendix 4)

Construction Related Activities for Renovations

Provide advance notice to all occupants of any upcoming renovation work.

Post signs to alert occupants of renovation work.

Provide alternate accessible locations for affected individuals when occupied space will be rendered inaccessible due to the renovation.

Physically isolate renovation work areas from occupied portions of building.

Isolate the HVAC system from renovation work.

Implement a dust-control plan that identifies work methods and cleanup procedures.

Provide negative pressure in area of renovation work.

Occupancy

Establish policies for renovation and chemical usage in lease agreements.

Designate a Smoke-Free building.

Leases should include language to ensure that occupant activity does not degrade original design standards and building performance.

Provide a list of areas and uses requiring separate exhaust air systems.

Designate areas free from use of cell phones, two-way radios, and wireless equipment.

Commissioning

Develop a commissioning plan that includes the items listed above.

After construction or renovation provide a minimum flush-out period of two weeks prior to occupancy.

Re-commission buildings periodically. Building use shall be taken into account when determining the re-commissioning schedule.

Exterior Landscaping

- Gardens (see Appendix 6)
  - Design gardens that can be maintained organically without pesticides.
  - Avoid plants with fragrances that may provoke allergies.
  - Exterior gardens and landscape should be free of all plantings that require pesticides, synthetic fertilizers, lime, or other chemical applications.
  - Use indigenous plant materials that are hardy, naturally pest-resistant, require minimal maintenance, and low water use.
  - Use xeriscaping principles.

APPENDICES

Appendix 1 - Site Selection: Potential Sources of Pollutants and EMF.

The Committee recognizes that few, if any, building sites are likely to be free of all the pollutant sources listed below. The recommendation is to minimize proximity to as many of these sources as possible in order to maximize outdoor environmental quality and hence indoor environmental quality.

Table A-1 Potential Sources of Pollutants and EMF

General (Air, Soil)	Engine Exhaust	Pesticides	Industrial/ Commercial	EMF
Recognized area of poor air quality Smog Smoke (chimney, industrial, etc.) Superfund Sites Brownfields Landfills Hazardous waste sites Compost sites Underground storage tanks Floodplains Wetlands Filled-in wetlands Military bases	Heavy traffic Highways Interstates Diesel exhaust Airports	Agriculture (unless organic) Golf courses Mosquito spraying Parks & Forests Roadside spraying Dairies Chicken & hog farms Other intensive livestock operations	Refineries Mines Chemical plants Cement plants Power plants Manufacturing Logging/Pulp mills Incinerators Sewage treatment plants Gas stations Dry cleaners Other commercial sources that emit air pollutants (See Appendix 5 on Use and Occupancy)	Substations Cell phone towers Radio towers Transponders Transformers High tension lines Electrical distribution lines Radar installations Military bases Airports Electrical Transportation Power-generating dams

Appendix 2 - Roof Gardens

Roof gardens involve a range of potential issues related to moisture penetration and mold growth. Flat roofs are prone to pooling water and leaking. Foot traffic can cause or accelerate deterioration leading to leaking. Roof repair is more difficult under gardens. Plants may attract pests that subsequently encourage pesticide use. Planting soils can create dust. Plants can emit volatile fumes and pollen. Plants can drop leaves and fruit that rot and become moldy. Selected plants should be low allergen plants without strong fragrance (See Exterior Landscaping above). If used, roof gardens should be located away from air intakes, operable windows, and doors. Design should ensure that moisture will not penetrate the roof membrane or cause conditions of standing water.

Appendix 3 - Pest Prevention

Exterior Design:

Remove lights on or near building that may attract night-flying insects.

Maintain a plant-free zone of about 12 inches around buildings to discourage insects from entering.

Design weep-holes in window frames to prevent access by paper wasps. Design windows to prevent harborage and access for pests, without clear passageways to inside.

Correct structural features that provide opportunities for bird roosting and nesting.

Avoid locating decorative lattices over entrances to food services facilities that may inadvertently serve as bird roosts.

Install bird-proof barriers that are designed to prevent both pigeon and sparrow access to preferred nesting sites.

Design exterior light fixtures so that birds cannot roost or nest on or in them.

Fit eave roof tiles with bird stops (that will also exclude bats, bees and wasps).

Correct structural features that provide opportunities for rodent harborage and burrowing.

Screen or otherwise eliminate animal access under decks, porches, stairways. Seal porches and ramps to the building foundation with ¼-inch hardware cloth screen mesh to form a barrier to digging pests such as rats and skunks. This screen must extend 12 inches into the ground and must have a right-angled, 6 inches wide, outward extending shelf to prevent burrowing under the screen.

Screen ventilation louvers with ¼-inch hardware cloth screen mesh to exclude birds, rodents, cats, etc., (coordinate with mechanical requirements).

Maintain a 2-foot pea gravel strip around buildings to prevent rodent burrowing.

Use a 3" layer of sand barrier underneath slab construction. Use 1-3 mm particle size in place of unsifted sand to provide a permanent sand barrier to termites (both western subterranean and Formosan termites). This will prevent termites from penetrating cracks in slab construction.

For wood not in contact with the ground or concrete, use wood pre-soaked in disodium octoborate tetrahydrate.

Refuse and Recycling Areas:

Place outdoor garbage containers, dumpsters, and compactors on hard, cleanable surfaces and away from building entrances (at least 50 feet from doorways). Design site with properly graded concrete or asphalt pads to help prevent rats from establishing burrows beneath them.

Design site with solid enclosure that extends all the way to the ground. Use metal or synthetic materials, as opposed to chain-link, wood, etc. to prevent rodents from gnawing and climbing the enclosure.

Design trash storage areas that can be closed off from the rest of the building.

Locate storage areas for boxes, paper supplies, and other materials in areas separate from where food or trash is stored. When stored together, these materials put food and shelter together, attracting pests.

Landscaped Areas

Choose proven performers, plants known to do well in the intended planting area. Avoid plants with history of pest problems. Use resistant plant species and cultivars when available. Check with your university or cooperative extension service for recommendations.

Give preference to plants that shed a minimum of seeds and fruits, that may attract and support insects, rodents, and undesired birds.

Design with diversity. Include a wide variety of plants in the landscape to reduce the pest damage potential.

Provide a properly prepared site. Site selection is critical; the site must be compatible with the plants' requirements.

Design landscaped areas with flexibility to allow for campus additions, which may change drainage, exposure to sunlight, ventilation, or other plant requirements.

Avoid crowding of landscape plantings.

Group plantings with similar cultural requirements.

Install or retrofit fence lines and other turf or landscape borders with concrete mowing strips.

Avoid planting vegetation directly against buildings as this provides shelter and sheltered runways for rodents. For the same reason, avoid planting dense vegetation that completely covers the ground.

Do not plant vines which climb building walls, as these create runways for rodents and harborage for undesired bird species.

Plant trees away from buildings to prevent easy access to buildings for insects and rodents.

Give careful consideration to placement of deciduous trees. Leaves which accumulate along foundations provide harborage and sheltered runways for rodents.

Interior

Food Preparation and Serving Areas (main kitchen, dining room, teachers' lounge, snack area, vending machines, and food storage rooms):

- Ensure that new kitchen appliances and fixtures are of pest-resistant design, i.e., open design, few or no hiding places for roaches, freestanding and on casters for easy, thorough cleaning.
- Provide space under and around appliances and equipment in kitchen areas to allow maximum ventilation and ease of (steam) cleaning.
- Use coving at floor-to-wall junctures to minimize build-up of debris and to facilitate cleaning.
- Slope floors in kitchen areas to provide good drainage after cleaning.
- Do not install pegboard in kitchens, animal rooms, or laboratories.
- Insure that all pipe insulation has a smooth surface and that there are no gaps between pieces.
- Refrigerate trash/recycling storage rooms.

Classrooms and Offices

Ensure that new office and classroom furniture that is rarely moved (e.g., staff desks, bookcases, filing cabinets) is designed to permit complete cleaning under and around the furniture, or to allow ready movement for cleaning purposes.

Design or retrofit construction to provide adequate ventilation, preventing trapped moisture and condensation.

Storage Areas

Equip area with self-closing doors.

Building Perimeter

Seal all plumbing and electrical service entrances.

Keep doors closed tightly; equip doors with self-closures and door sweeps.

Appendix 4 - Carpet

Stone, terra cotta, granite, marble, terrazzo, ceramic, brick, or sealed concrete flooring is best tolerated by individuals with chemical sensitivities. Wood flooring that has not been recently stripped or refinished is also often well tolerated by people with chemical sensitivities.

Carpet systems contain a myriad of chemicals in their fiber, dyes, backing, padding, bonding agents, adhesives, antimicrobials, flame retardants, and stain resistance, anti-static, and color fast agents. They also are reservoirs for tracked-in pesticides, dust, dust mites; foster mold growth; and absorb and remit volatile organic chemicals like fragrances and

paint fumes. In addition, many solvent-based agents used to clean carpets emit toxic fumes.

The Carpet and Rug Institute (CRI) has established a rating system and testing program (Green Label Plus) that may be used in lieu of the emissions testing criteria of California's Collaborative for High Performance School (CHPS) Section 01350 (See Products & Materials Committee).

Some people with chemical sensitivities have found that carpet squares with self-adhesive backing have been the best tolerated new carpeting. Others have reacted adversely to such products. More research is necessary to determine what factors in these carpets and/or which brands are best tolerated.

Older carpets are usually better tolerated by people with chemical sensitivities than new ones, as long as they have not become moldy.

Recommendations regarding carpeting (design, materials, and O&M issues):

- Minimize the use of carpeting.
- Use areas rugs in place of carpeting whenever possible.
- Consider using self-adhesive carpet squares.
- Tack rather than glue down (unless using self-adhesive carpet).
- If glue down, use low or no VOC adhesive.
- Air out carpet for at least two weeks prior to installation.
- Exceed building flush-out of two weeks if possible.
- Reduce the need for and the frequency of carpet replacement through good maintenance (e.g., thorough vacuuming and frequent cleaning with low toxic products and procedures -- see recommendations by O&M).
- Minimize amount of carpet that is replaced, limit replacement to damaged areas. (A major advantage of carpet square systems is that smaller sections can be replaced).

Appendix - 5 Use and Occupancy

Non industrial businesses/activities that may generate chemical pollutants include, but are not limited to:

Hair and Nail Salons	Dry Cleaners	Labs (eyeglasses, medical, etc.)
Spas	Laundromats	Dental offices
Restaurants	Nurseries (Plants)	Dialysis Centers
Grills & BBQ	Landscaping, Pest Control	

Furniture stores Woodworking and crafts shops Art/Pottery studios Auto Parts Taverns/Bars Tobacco Shops Tattoo Parlors	Florists Candle/Soap/bath shops Pet Shops Photo/Printing/Copy shops Specialty foods stores Leather goods stores Perfume shops or departments	

Areas that should be vented directly to the outside include: kitchens, labs, computer rooms, copy/fax areas, printer or blueprint rooms, storage areas for toxic materials, showers, locker rooms, and areas where animals are present.

Appendix 6 - Landscaping

Use low allergen plants (See Ogren Plant Allergy Scale).

Plant female trees and shrubs (they do not produce pollen).

Avoid the use of plants that have strong fragrances, such as jasmine, lavender, peppermint, and roses.

Avoid or minimize lawn/turf areas to reduce mowing emissions and chemical usage.

Use low growing fine fescue, buffalo grass, or other turf grass which requires little or no mowing.

Use a wide variety of plant materials.

Group plants with similar water and cultural needs.

Do not crowd plants.

Leave gaps in groundcover to create less hospitable habitat for pests.

Plant deciduous shade trees on the south and west sides of buildings. The shade reduces interior temperatures and reduces A/C usage during summer months.

Use low or no VOC paints, stains and finishes on outside equipment including benches, poles, decks, and other outdoor equipment (See recommendations from Building Products & Materials group.)

Avoid organic mulches (cocoa beans, peat moss, bark, wood chips) as they emit volatile fumes and may harbor mold.

Avoid railroad ties as they contain creosote.

Utilize stone, clay, concrete, and other hard, non-volatile materials to create borders and frame gardens.

REFERENCES

Reference 1

ASHRAE Fundamentals Handbook, 2001, 25.19:

http://www.infiltec.com/inf-larg.htm

http://www.argonair.com/pdf/Myth%20About%20Bldg%20Env.pdf

Reference 2

P.Levallois, et al., "Prevalence and Risk Factors of Self-Reported Hypersensitivity to Electromagnetic Fields in California" and "An Evalutaion of the Possible Risks from Electric and Magnetic Fields (EMF) From Power Lines, Internal Wiring, Electrical Occupations and Appliances."
http://www.dhs.ca.gov/ps/deodc/ehib/emf/RiskEvaluation/Appendix3.pdf.

Case study for EMF control (Research Triangle)

http://www.ncgreenbuilding.org/site/ncg/public/show_project.cfm?project_id=120

"EMF reduction: The team reviewed available literature on EMF and their threat to health and determined that while EMF radiation could be measured, its threat to humans had not yet been proven or disproved. Nevertheless, the team recommended adopting a philosophy of prudent avoidance toward EMF risks and undertook modifications of the building design to reduce occupant exposure. EMF radiation can be mitigated by distance and by shielding. Distance offers maximum protection and is "low-tech," while the costs associated with shielding are high and the results are difficult to measure. Consequently, the design team chose to create "buffer zones" to reduce prolonged exposures in portions of the building that are occupied for long periods of time, such as the laboratories and offices. The largest sources of EMF were identified as the building's transformers, the electrical rooms with their many cables, and the electrical conduit that was routed under the building atria. As a first step circulation and utility spaces were used to maximize the separation between a source and any potential receptors."

Reference 3

Fumes from activities involving the installation and repair of modified bitumen roofs.

http://environmentalchemistry.com/yogi/chemicals/cn/Asphalt%A0fumes.html

Reference 4

Chapter 59, Indoor Air Quality Handbook CFD (Computational Fluid Dynamics) Method for indoor Air Quality Studies. Qingyan Chen, Leon Glicksman, MIT

Reference 4

Ventilation rate to remove odors falls between 14-50 (l*s)/person or 28-100 cfm depending upon the type of odors to be removed. Ventilating to remove odor will exceed all requirements for Ventilation rates for human comfort.

(Levin, *Indoor Air Quality Handbook*, McGraw-Hill table 60.2)

ASHRAE 62.1-2004 Ventilation for Acceptable Indoor Air Quality

Reference 5

LEED ™ 6.1, 6.2 Controllability of Systems

- Provide one operable window and one lighting control zone per 200sf of area within 15' of an exterior wall.
- Provide controls for each individual for airflow, temperature, & lighting

ASHRAE 55-1992 Addenda 1995 Thermal Environmental Conditions for Human Occupancy

Recommend maximum of 60% RH

ASHRAE 55-2004 Thermal Environmental Conditions for Human Occupancy

(based on satisfactory thermal comfort for 80% of people. 71d in winter, 76d in summer.)

Reference 6

LEED ™ Prerequisite 2.0 ETS (Environmental Tobacco Smoke) control

www.epa.gov/iaq/pubs/etsbro.html

Reference 7

LEED ™ Credit 3.1 SMACNA (Sheet metal and air conditioning National Contractors Association) IAQ Guidelines for Occupied Buildings under Construction.

Reference 8

Air Filtration

http://www.epa.gov/etv/centers/center10.html

Chapter 9 Air Cleaning, Particles of Air Quality Handbook.

BIBLIOGRAPHY

ANSI/ASHRAE Standard 62.1-2004, Ventilation for Acceptable Indoor Air Quality

ANSI/ASHRAE Standard 62.2-2004, Ventilation and Acceptable Indoor Air Quality in Low-Rise Residential Buildings

ALA Guidelines (American Lung Association)
http://www.healthhouse.org/build/Guidelines.asp

ATSDR Toxicological Profiles Agency for Toxic Substances and Disease Registry
http://www.atsdr.cdc.gov

California Office of Environmental Health Hazard Analysis
http://www.oehha.ca.gov/air/chronic_rels/index.html)

Carpet
http://www.carpet-rug.org/index.cfm
http://www.carpet-rug.org/drill_down_2.cfm?page=8&sub=3&requesttimeout=350

Diesel and Health in America: The Lingering Threat www.catf.us/goto/dieselhealth

EMF

http://www.cep.ca/reg_ontario/files/health_safety/emf_school_guidelines.pdf

http://vitatech.net/q_a.html

http://www.emf-meter.com/emf-exposure-limits.htm

Council on Wireless Technology Impacts: http://www.energyfields.org
http://www.asilo.com/aztap1
http://www.emfservices.com/index.htm
http://www.latitudes.org/articles/electrical_sensitivity_articles.html
http://www.FEB/Links.html

www.lessemf.com

"Electromagnetic Shielding: A Handbook Series on Electromagnetic Interference and Compatibility" Vol. 3. By Donald R.J. White and Michael Mardiguian, 1988.
http://www.amazon.com/exec/obidos/tg/detail/-/0944916031/ref=pd_ecc_rvi_1/002-9659512-8208838?%5Fencoding=UTF8&v=glance.

"Controlling Radiated Emissions by Design" By Michel Mardiguian, 1992.
Available from the Electromagnetic Compatibility Lab, University of Missouri – Rollo,
http://www.emclab.umr.edu/emcbooks.html

EDN's Designer's Guide to Electromagnetic Compatibility, by Daryl Gerke, P.E. and Bill Kimmel, P.E.
of Kimmell Gerke Associates, Ltd, St. Paul, MN
"EDN: The Design Magazine of the Electronics Industry" supplement, January 20, 1994.

Report by Lucinda Grant – World Health Organization (WHO) International Seminar and Working Group on EMF Hypersensitivity; October 25-27, 2004.

EPA Draft Guidance for Green Buildings: Eight Central Principles, Dave Mudarri
http://www.housingzone.com/news2.asp?topicId=14531&docId=l:25891088

Greening Your Homes series www.clevelandgbc.org

Green Guide for Healthcare from Healthcare Without Harm
http://www.gghc.org/

Green Building: Project Planning & Cost Estimating RS Means 2002

Indoor Air Quality Handbook McGraw-Hill 2003

LEED Rating System for New Construction USGBC 2002

Myths About Building Envelopes, 1999, Persily, NIST.

New Jersey Idling Regulations
http://www.state.nj.us/dep/aqm/sub14v2001-10-01.htm

Pest Prevention Through Site Design California Department of Pesticide Regulation
http://www.cdpr.ca.gov/cfdocs/apps/schoolipm/managing_pests/71_pest_prevention

Program Needs for Indoor Environments Research (PNIER), U.S. EPA, 402-B-05-001, March 2005, www.epa.gov/iaq/pubs/pnier.pdf

Residential Environmental Guidelines

Hugh L. Carey Battery Park City Authority

Responding and Preventing Indoor Air Quality Problems in Schools
Terry Brennan, Camroden Associates, Inc.

SMACNA "*IAQ Guideline for Occupied Buildings under Construction*."

COMMITTEE

Active
Chair – Roger Morse, AIA, Morse-Zentner Associates
William S. Anderson, Architect
Mary Lamielle, National Center for Environmental Health Strategies
Ann McCampbell, Multiple Chemical Sensitivities Task Force of New Mexico
Susan Molloy, National Coalition for the Chemically Injured
Toni Temple, Ohio Network for the Chemically Injured

Contributing
Terry Brennan, Camroden Associates
Jack Carman, *ASLA and Sustainable and Therapeutic Garden Group members for their input*
Design for Exterior Landscaping Recommendations
Jim LaRue, Healthy House Institute
David Rousseau, Archemy Consulting, Ltd.
Dave Rupp, Cabinet King, Inc.

Commenting
Josh Roehm PE, Scheeser, Buckley Mayfield Engineers

National Institute of Building Sciences (NIBS)
Indoor Environmental Quality (IEQ) Project
Building Products & Materials Committee

Table of Contents

Introduction

The goal of the NIBS – IEQ Products & Materials Committee was to develop procedures and guidelines to aid persons in making informed material selections in order to construct a building that will be accessible to persons with multiple chemical sensitivities (MCS) and/or electromagnetic sensitivities (EMS). The NIBS IEQ-Materials Committee has reviewed existing standards and guidance for materials selection in building construction. The group has determined that certain features of the existing standards offer a reasonable starting point for the selection of building materials, and in some respects can offer a more accessible environment to persons with MCS and/or EMS. These existing standards are designed to create healthier indoor air quality by making appropriate building material selections, among other things. Though the existing standards may not result in material selections that will make a building accessible to the majority of persons with MCS and/or EMS, they will produce a healthier building, than one constructed without regard to these standards. Healthier buildings would be useable by people with other health conditions such as asthma and other respiratory conditions, allergies and migraine headaches.

The NIBS IEQ Materials Committee has attempted to take the best ideas or practices from the existing standards and guidelines to recommend material selections that will provide for healthier, more accessible buildings. If a designer follows the suggestions provided herein, it will result in a building that has the lowest chance of IEQ problems stemming from the materials and that has the best likelihood of being accessible to persons with MCS and/or EMS.

The standards reviewed by the Materials Group include:

- Collaborative for High Performance Schools (CHPS) Section 01350
- Green Guard Environmental Institute - Certification Standards for Low Emitting Products for the Indoor Environment
- Green Seal – Environmental Standards
- Green Guidelines for Healthcare – Materials and Resources
- Reducing Occupant Exposure to Volatile Organic Compounds (VOCs) from Office Building Construction Materials: Non-Binding Guidelines - California Department of Health Services

Two of the key elements involved in the materials selection process are a component content screening (what chemicals and compounds are known to be a part of the material) and an emissions testing protocol. Both the California Section 1350 Specification and the Green Guard Standards recommend emissions testing based on the ASTM Method ASTM standards D-5116-97 and D- 6670-01. The Committee believes that both of these elements must be involved in making appropriate building material selections.

Overview - Design

The Products & Materials Committee believes that particular attention is critical during building design to assure that the needs of chemically and electromagnetically sensitive people are accommodated to the greatest extent possible. In general, this means selection of construction materials that are low-emitting or non-emitting and selection of finishes that do not absorb or react with chemicals emitted by other materials or products in the building. To begin to address some of the concerns of electromagnetically sensitive persons, areas of the building can be designed to have reduced electromagnetic fields. By making indoor environments that are safer for the most vulnerable among us, we can create indoor environments that are healthier for everyone, especially children.

Generally, this means selection of materials that are “hard” or non-porous where possible so that any chemicals that contact these materials are not retained in and re-emitted from them. Also, particular attention should be paid to selection of materials that will not require VOC-emitting chemicals later as part of maintenance. For instance, in designing building foundations and structures, particular attention should be paid to the need for preventing termite problems, since the pesticides commonly used to control termites can have a deleterious effect on humans, especially persons with multiple chemical sensitivities. So, even though the material itself might be low-emitting, the use of products meant to “preserve, protect, or maintain” the material selected might emit volatile fumes that degrade indoor environmental quality and result in a building that is not suitable for persons with MCS.

In addition, during building design particular attention must be paid to choice of electrical appliances, equipment and products that may produce higher than necessary electromagnetic fields. The NIBS-IEQ Materials Committee recognizes that there are selections that can be made during building design and construction that can provide a more healthful environment for persons with electromagnetic sensitivities. A few of these considerations are:

- Incorporation of a foil vapor barrier or other metal shielding feature into the walls around electric equipment can reduce certain electromagnetic fields.

- Wireless ("bluetooth" type) connections should be avoided, or areas of their use should be "contained" by using foil-backed drywall or other incorporation of a foil or metal barrier.
- New construction should use twisted metal clad wiring and/or twisted wire placed in metal conduit.
- Fiber optic connectivity is preferred for computer networks communication because these data lines may be run without concern for stray emissions.

Overview – Building Operations and Maintenance

Vigilance is required to assure that materials brought into the building throughout the course of its life are consistent with the standards provided herein, and are consistent with the design intent of the building.

For example, the Products & Materials Committee realizes that building operations and maintenance products might introduce materials that are not consistent with the initial design for an accessible, healthy building.

Building managers must also pay close attention to materials brought into the building environment by tenants or others to assure that these materials are consistent with provision of an accessible, healthy building for persons with multiple chemical sensitivities, electromagnetic sensitivities, and/or other health disorders. For instance, a tenant may bring furniture in that does not meet the design criteria presented in this document, and these materials could have detrimental effects on air quality within the entire building, depending on the design of the HVAC system. In addition, the chemicals and compounds used for maintenance can degrade environmental quality and seriously affect persons with multiple chemical sensitivities. Other products that can have detrimental effects on IEQ and/or certain individuals include paints and other finishes, carpeting, appliances and other electrical equipment, and others.

CHPS Section 01350 Part 1.3B and 1.4D and GREENGUARD Allowable Emission Levels

The NIBS – IEQ Products & Materials Committee believes that the CHPS Indoor Air Quality Emissions Testing Standards and the Green Guard Allowable Emission Levels offer tested and reviewed approaches to material and product selection for buildings. Given the range of guidance and standards available for material selection, these two standards provide the most widely accepted processes for making material selections to construct buildings that are healthier for the general public. It should be noted that the NIBS –IEQ Products & Materials Committee does not believe that either of these standards offers an entirely acceptable solution for persons with MCS and EMS. However, they provide a starting point in making material selections, and they provide the best available guidance on component screening and materials emission limits. Making materials selections that meet either the CHPS or the Green Guard allowable emission levels should be considered an absolute minimum requirement in creating a building or environment that is accessible to persons with MCS and EMS. No designer or other person making material selections should choose any materials that do not at least meet these standards. Even then, the other considerations discussed herein should be a part of the selection process to provide the best

opportunity that the building will provide an environment accessible to persons with MCS and EMS.

The Green Guard Certification Standards list allowable emissions for a range of building products. A designer or other individual making a material selection must investigate product literature, for the material under consideration, to determine if the product meets at least the Green Guard standards. The Green Guard web site lists products that have been tested and have met their standards. However, it is possible that a product manufacturer has not submitted their product for certification to either Green Guard or CHPS. In this case, the person making a material selection must seek any published emissions testing data and product component data available from the manufacturer. Some manufacturers publish data on emissions from their products, and other manufacturers are moving quickly to provide such data. If such data is not currently published, the manufacturer must have the product or material tested in accordance with the testing regimen specified in the Green Guard or CHPS 01350 Certification Standards.

The CHPS Section 01350 protocols and the Green Guard Certification for IAQ data require the same chamber testing. The CHPS protocols and calculations go further than the Green Guard Certification Standards in that the designer is required to take published emissions rates and perform calculations based on the amount of material to be installed in the building and the zones and air handling capabilities of the HVAC systems in those zones. Also, the allowable emission level for formaldehyde is lower in the CHPS standard than the Green Guard standard. See the discussion below for more information on formaldehyde.

For both standards, all building materials are required to be tested in dynamic environmental chambers following ASTM standards D-5116-97 and D-6670-01, the U.S. Environmental Protection Agency's testing protocol for furniture and the State of Washington's protocol for interior furnishings and construction materials. Products are measured for emission levels according to the parameters set forth in the ASTM Standard for emissions testing.

California - Practice for Testing of VOC’s from Building Materials Using Small Chambers

http://www.dhs.ca.gov/ps/deodc/ehlb/iaq/VOCS/Practice.htm

The allowable emission levels of both standards can be found by clicking on the links below. In some cases, the Green Guard standards may appear to have lower standards for emissions of some VOCs than the CHPS Section 1350 standards. However, the person selecting materials for the building must bear in mind that the CHPS standard requires a detailed calculation for the building, the amount of material to be installed and the air change rate of the HVAC systems. Green Guard emissions standards are based on a “standard” model of a building, and a “standard” exchange rate of fresh air in the building.

CHPS Section 01350 http://www.chps.net/manual/documents/Sec_01350.doc

CHPS Compliant Materials Table http://www.chps.net/manual/lem_table.htm

Green Guard Allowable Emission Levels
http://www.greenguard.org/DesktopDefault.aspx?tabindex=3&tabid=16

Green Guard Certified Product Guide
http://www.greenguard.org/DesktopDefault.aspx?tabindex=1&tabid=12

Additional Resources

California Department of Health Services IAQ Program Voluntary Guidelines for Reducing Occupant Exposure to VOCs

http://www.dhs.ca.gov/iaq/VOCS/VOC_guidelines_1996.html

California Materials Emissions Study
http://www.ciwmb.ca.gov/Publications/default.asp?pubid=1027

U.S. EPA Indoor Environment Program web site -- VOCs
http://www.epa.gov/iaq/voc.html

Formaldehyde

Formaldehyde is widely used by industry to manufacture building materials and numerous consumer products. It is also a by-product of combustion and certain other natural processes. Formaldehyde, by itself or in combination with other chemicals, serves a number of purposes in manufactured products. For example, it is used to add permanent-press qualities to clothing and draperies, as a component of glues and adhesives, and as a preservative in some paints and coating products.

In building materials, the most significant sources of formaldehyde are likely to be pressed wood products made using adhesives that contain urea-formaldehyde (UF) resins. Pressed wood products include: particleboard (used as sub-flooring and shelving and in cabinetry and furniture); hardwood-veneer plywood paneling (used for decorative wall covering and used in cabinets and furniture); and medium density fiberboard (used for drawer fronts, cabinets, and furniture tops). Medium density fiberboard contains a higher resin-to-wood ratio than any other UF pressed wood product and is generally recognized as being the highest formaldehyde-emitting pressed wood product.

Other pressed wood products, such as softwood plywood and flake or oriented strandboard, are produced for exterior construction use and contain the dark, or red/black-colored phenol-formaldehyde (PF) resin. Although formaldehyde is present in both types of resins, pressed woods that contain PF resin generally emit formaldehyde at considerably lower rates than those containing UF resin.

The NIBS – IEQ Products & Materials Committee is concerned about human exposure to formaldehyde, especially for individuals with multiple chemical sensitivities. The widespread use of formaldehyde, its known health effects, and the hyper-sensitivities of certain individuals create this concern. It may not be possible to make material selections that are completely free of formaldehyde, but where possible, the individual making material selections should make every effort to avoid products manufactured with formaldehyde. New soy-based adhesives are coming on to the market to replace formaldehyde resins used in many manufactured wood products. It may soon be possible to choose alternative products that are not formulated with this volatile organic compound (VOC).

The California Office of Environmental Health Hazard Assessment has determined that the lowest, reasonably achievable level of formaldehyde (because it is equal to ambient air

concentrations) is 33 (milligrams per cubic meter) ug/m^3, or 23 (parts per billion) ppb. Thus, the CHPS 01350 standard requires that a material must not emit a level of formaldehyde that results in a concentration of ½ of this level, or 16 ug/m^3 (11 ppb). This limit is lower than the allowable emission level of the Green Guard standard. The NIBS – IEQ Products & Materials Committee believes that the 16 ug/m^3 (11 ppb) level is a minimum requirement for formaldehyde emissions from building materials.

Following is a list of typical building materials and some considerations for selection. Note that the considerations listed below are in addition to the recommended emissions standards from CHPS 1350 and Green Guard.

Adhesives and Sealants

One objective of the IEQ-Products & Materials Committee is to reduce the quantity of indoor air contaminants created by adhesives and sealants that are potentially irritating and/or harmful to occupants of buildings. The use of VOC-emitting adhesives and/or sealants should be minimized to the greatest extent possible in order to create an accessible, comfortable environment for the greatest numbers of people.

The designer should specify application of only the minimum amounts of these materials necessary for satisfactory completion of each installation task. Additionally, the designer should select products that have the lowest possible VOC emissions, according to the emissions testing information provided, while still meeting other performance requirements. Caution should be exercised when interpreting adhesive emission data because such data are usually provided without the associated installed products (e.g., flooring materials) and emissions from installed assemblies may differ from manufacturers' reported adhesive emission rates. If possible, adhesives that contain formaldehyde should be avoided.

The Committee also recommends that paints and finishes be selected that do not contain biocides.

In any building where adhesive use is necessary, it is a good practice to ensure that maximum ventilation is supplied during and after application of these products.

Appliances

Appliances can emit volatile fumes as well as create electromagnetic fields.

Electromagnetic fields and radiofrequencies can jeopardize the functioning and safe access of electromagnetically sensitive individuals. Examples of indoor appliances which can provoke health problems include:

- cell and portable telephones,
- fluorescent lights,
- unshielded transformers and wiring,
- battery re-chargers,

- wireless devices including computers and personal communication services ("PCS"),
- security and scanning equipment,
- numerous common work place and household electronic appliances.

Many electrical appliances and equipment can be improved to varying degrees by appropriate shielding, and/or by being located in areas remote from vulnerable individuals.

It is not recommended that such equipment be eliminated from the built environment, but that exposure of vulnerable individuals to such equipment be voluntary or easily avoidable.

Ceilings

Of particular concern to the NIBS-IEQ Products & Materials Committee are T-bar suspended ceilings used as return air plenums in buildings, because both sides of the panels come in contact with indoor air. In addition, penetrations for sprinklers, alarms, and smoke detectors may significantly increase the area exposed to emissions. Temperatures near ceiling surfaces and in return air plenums are usually higher than those in occupied zones and, as a result, increased emissions from ceiling materials may occur. The individual selecting ceiling materials should carefully consider the acoustic, fire, and aesthetic requirements for each space prior to material selection. Nonporous materials are now available that combine aesthetic, acoustical, and fire code requirements.

Ceiling materials that contain organic materials present the possibility of mold contamination if the ceiling system becomes wet. Porous ceilings and ceiling finishes can also act as receptors for toxins and VOCs that are brought into the building and later re-emit them. Many ceiling tile products are made using urea formaldehyde. No products using urea formaldehyde should be allowed.

Composite Wood Products (plywood, particle board, OSB, paneling, etc.)

Because they emit formaldehyde and other VOCs, use of composite wood products should be minimized, if not eliminated. If it is absolutely necessary to use such products, the designer should select materials that meet the specified building criteria and are the lowest emitting products available according to emissions testing data. Formaldehyde emissions are of particular concern in composite wood products. Note that VOC-emitting wood preservatives may be used in some of these products. There are a number of manufacturers that are replacing formaldehyde adhesives in composite wood products with non-emitting adhesives and the Committee recommends using these alternative products whenever possible.

Fireproofing

The use of fireproofing chemicals should be minimized when possible. Spray-on fireproofing can cause indoor air quality problems when chemical components are released into the air as a result of mechanical damage, air erosion, or deterioration of the binder. Also because spray-on materials have large, porous surface areas, they can act as sinks for adsorption and re-emittance of VOCs. If possible, seal the surface of spray-on fireproofing to reduce adsorption of VOCs. Ensure that the sealer: (a) will not change fire characteristics of the original fireproofing material; and (b) is not a high-VOC emitter. Also seal any

penetrations of surfaces sprayed with fireproofing material to prevent damage of the material in the vicinity of penetrations.

Flooring and Floor Systems

The NIBS-IEQ Products & Materials committee recommends use of flooring products that are low or non-emitting and are non-porous. Consideration should also be given to maintenance products that will be necessary for the type of flooring selected. For instance, stripping and refinishing of wood flooring introduces hazardous chemicals into the air and are intolerable for persons with multiple chemical sensitivities. When selecting a floor system, the type of adhesives used with the flooring system must also be considered.

Stone, terra cotta, granite, marble, terrazzo, ceramic, brick, or sealed concrete flooring are best tolerated by individuals with chemical sensitivities, and provide a healthy, comfortable environment for the greatest number of people.

Wood flooring that has not been recently stripped or refinished and older vinyl flooring is also often well tolerated by people with chemical sensitivities.

Rubber, linoleum, and cork flooring are not recommended.

The Resilient Floor Covering Institute (RFCI) has recently introduced a new certification program for low emitting flooring products called the FloorScore™ program. The FloorScore program is a building materials emissions testing program that requires both independent laboratory testing and third-party certification to show compliance with CCHPS 01350 VOC emissions limits and includes certified site audit and documented control system requirements. The third-party certifier, Scientific Certification Systems, Inc. (SCS), not only reviews the results of the product VOC emissions report but also reviews raw material inputs and manufacturing processes to ensure that a product is consistently manufactured. SCS conducts site audits of manufacturing plants to ensure a quality management plan exists for continuing compliance of the product as defined in SCS-EC-10-2004 Environmental Certification Program – Indoor Air Quality Performance.

Resilient Floor Covering Institute – “Floor Score” Program

http://www.rfci.com/int_FloorScore.htm

Floor Score List of Certified Products

http://www.rfci.com/int_FS-ProdCert.htm

Carpet systems contain a myriad of chemicals in their fiber, dyes, backing, padding, bonding agents, adhesives, antimicrobials, flame retardants, and stain resistance, anti-static, and color fast agents. They are reservoirs for tracked-in pesticides, dust, dust mites; foster mold growth; and absorb and re-emit volatile organic chemicals like fragrances and paint fumes. In addition, many solvent-based agents used to clean carpets emit toxic fumes.

The Carpet and Rug Institute (CRI) has established a rating system that involves emission testing that is based on CHPS Section 01350, and includes additional requirements. Carpets labeled with the CRI Green Label Plus are expected to have lower emissions than most

carpets. However, even carpets emitting low levels of volatile organic chemicals (VOC's) can cause adverse health effects in certain individuals.

CRI Green Label Plus link
http://www.carpet-rug.org/drill_down_2.cfm?page=8&sub=3&requesttimeout=350

Some people with multiple chemical sensitivities have found that carpet squares with self-adhesive backing have been the best tolerated new carpeting. Others have reacted adversely to such products. More research is necessary to determine what factors in these carpets and/or which brands are best tolerated.

Older carpets are usually better tolerated by people with chemical sensitivities than new ones, as long as they have not become moldy.

Recommendations regarding carpeting (design, materials, and O&M issues):

1. Minimize the use of carpeting
2. Use area rugs in place of carpeting whenever possible
3. Consider using self-adhesive carpet squares
4 Tack rather than glue down (unless using self-adhesive carpet)
5. If glue down, use low or no VOC adhesive
6 Air out carpet for at least two weeks prior to installation
7. Ventilate building with 100% outside (or fresh) air for as long as possible after installation
8. Reduce the frequency of carpet replacement by maintaining them well (e.g., vacuum thoroughly and frequently and clean with low toxic products and procedures – (see recommendations by Operations & Maintenance Committee).
9. Minimize amount of carpet that is replaced, limit replacement to damaged areas (an advantage of carpet square systems is that smaller sections can be more easily replaced).

Insulation

The NIBS-IEQ Products & Materials committee realizes that insulation is an essential component in building systems to assure a comfortable environment. Insulation and insulating materials are generally hidden or covered, however emissions can still be encountered by building occupants. The Committee believes that polystyrene foam insulation is best tolerated by persons with multiple chemical sensitivities. Other insulating products, such as fiberglass, cellulose, or cotton/polyester blend insulating products may produce particulates, harbor mold, or emit problematic volatile fumes, depending on the product and the manufacturing techniques used.

The Committee has particular concerns about interior lined ductwork, due to the insulation's ability to collect and trap chemical contaminants, dusts, microbes and fungi, as well as emissions from the adhesives used to secure the insulation. It is recommended that no interior-lined ductwork be used in the construction of buildings meant to be accessible to persons with MCS.

Lastly, insulation used anywhere in buildings must not contain urea-formaldehyde resins.

Paint

The NIBS-IEQ Products & Materials Committee determined that for some individuals, 100% acrylic paint and paints containing low-VOC emissions can be acceptable. Paints containing styrene-butadiene latex combinations, enamels, strippers and paint thinners are all problematic and should be avoided or their use minimized.

For some individuals, well-hardened enamel paint, baked-on enamel finish, or porcelainized steel provide optimum safety. These products provide a hard, durable surface that can be easily cleaned using non-toxic products.

Paints with biocides or biocide additives (mold/mildew resistant) should not be selected.

Textiles

The NIBS-IEQ Products & Materials committee recommends sparing or no use of textiles in buildings. Though it may be possible to introduce textiles with no emissions, textiles provide a porous medium to trap chemical contaminants, dusts and microbes that can create an unhealthy environment. In addition, the dry cleaning and laundering of textiles pose additional problems due to the cleaning products.

Walls

Gypsum wallboard: Gypsum may be reasonably inert and extremely low in VOC emissions. However, additives used to produce mold-proof gypsum wallboard (i.e., "green board"), fire-resistant gypsum wallboard, or to improve the workability of the slurry during manufacture may include compounds that emit VOCs. Careful product selection and review of emissions testing data is necessary to assure that appropriate materials are chosen. Recycled paper covering both sides of gypsum wallboard may contain chemicals from previous uses, and additives or chemicals used in the production of the paper itself. Note that VOC emissions from gypsum wallboard can sometimes be significantly reduced by “painting” or laminating the surfaces. The more impervious the coating or covering, the greater will be the reduction in VOC emissions from gypsum wallboard. However, VOC emissions from surface treatment materials must be considered.

Gypsum wallboard can act as a sink for other VOCs in indoor air. Avoid exposing unpainted gypsum wallboard to indoor environments where emissions from other VOC sources exist. Taping and topping compounds can contain considerable quantities of VOCs, so emissions testing data for these products are also critically important. Use ventilation and heat to accelerate the drying process of these materials. Protect wallboard from exposure to contaminants and excessive moisture prior to installation.

Where possible, select material to reduce the need for paints, wallcoverings, or porous wall finishes in buildings. Most commercial structures are built using metal studs, a good selection for persons with MCS. Wood studs can emit terpenes and pinenes

Wallcovering

Wallpapers may contain vinyl, plasticizers, styrene-butediene latex combinations and other chemicals that can seal and trap moisture between the wallpaper and the wall fostering mold growth. The water-based pastes and glues used to adhere the wallpaper to the wall may

contain mold retardants and pesticides. Adhesives can emit volatile fumes. For these reasons we recommend that wallpapers not be used.

Conclusion & Recommendations

In order to minimize the level of air pollutants emitted from building materials and create healthier indoor environments, the NIBS Products & Materials Committee recommends that inert, non-porous materials be used to the greatest extent possible. This will increase access for the greatest number of chemically
sensitive individuals. Choosing appliances and other equipment that create the lowest level of electromagnetic fields will increase access for those with electromagnetic sensitivities.

If materials are used that emit volatile fumes, the Committee recommends that these materials meet or exceed the CHPS Indoor Air Quality Emissions Testing Standards or Green Guard Allowable Emission Levels, as well as contain no formaldehyde or biocides. The Committee also recommends that, whenever possible, products and materials be aired out (preferably outside or in a separate well-ventilated space) for two weeks prior to being installed in a building.

While the Committee acknowledges that the CHPS Indoor Air Quality Emissions Testing Standards and Green Guard Allowable Emission Levels are the best current standards for selecting building materials that create healthier buildings, the Committee is concerned that these standards may not sufficiently protect the health of building occupants, especially those with chemical sensitivities and other vulnerable individuals.

Therefore, the Committee supports:

1) Creation of more stringent emission standards and development of a wider range of less volatile and less hazardous building materials, especially in the areas of resilient flooring and carpeting.

2) Full disclosure of product ingredients (on product labels or available upon request) to enable builders to make more informed decisions regarding selection of building materials.

3) Consulting with chemically and electromagnetically sensitive individuals or organizations, especially employees and others who frequently use a building, prior to making final decisions regarding product selection.

Committee Members

Active

Chair – Brent Kynoch, Kynoch Environmental Management, Inc.
Mary Lamielle, National Center for Environmental Health Strategies
Ann McCampbell, Multiple Chemical Sensitivities Task Force of New Mexico
Susan Molloy, National Coalition for the Chemically Injured
Toni Temple, Ohio Network for the Chemically Injured

Contributors

Terry Brennan, Camroden Associates
Dave Rupp, Cabinet King, Inc.

Commentor

Mike Preston, Burt Hill Kosar and Rittelman Associates

US Agencies; US Department of Interior, Letter of the Director of Office of Environmental Policy and Compliance; 2014

United States Department of the Interior

OFFICE OF THE SECRETARY
WASHINGTON, D.C. 20240

FEB - 7 2014

In Reply Refer To: (ER 14/0001) (ER 14/0004).

Mr. Eli Veenendaal
National Telecommunications and Information
Administration
U.S. Department of Commerce
1401 Constitution Avenue, N.W.
Washington, D.C. 20230

Dear Mr. Veenendaal:

The Department of the Interior (Department) has reviewed the above referenced proposal and submits the following comments and attachment for consideration. Because the First Responder Network Authority (FirstNet) is a newly created entity, we commend the U.S. Department of Commerce for its timely proposals for NEPA implementing procedures.

The Department believes that some of the proposed procedures are not consistent with Executive Order 13186 Responsibilities of Federal Agencies to Protect Migratory Birds, which specifically requires federal agencies to develop and use principles, standards, and practices that will lessen the amount of unintentional take reasonably attributed to agency actions. The Department, through the Fish and Wildlife Service (FWS), finds that the proposals lack provisions necessary to conserve migratory bird resources, including eagles. The proposals also do not reflect current information regarding the effects of communication towers to birds. Our comments are intended to further clarify specific issues and address provisions in the proposals.

The Department recommends revisions to the proposed procedures to better reflect the impacts to resources under our jurisdiction from communication towers. The placement and operation of communication towers, including un-guyed, unlit, monopole or lattice-designed structures, impact protected migratory birds in two significant ways. The first is by injury, crippling loss, and death from collisions with towers and their supporting guy-wire infrastructure, where present. The second significant issue associated with communication towers involves impacts from non-ionizing electromagnetic radiation emitted by them (See Attachment).

In addition to the 147 Birds of Conservation Concern (BCC) species, the FWS has listed an additional 92 species as endangered or threatened under the Endangered Species Act. Together with the bald and golden eagle, this represents 241 species of birds whose populations are in trouble or otherwise merit special protection, according to the varying criteria of these lists. The Department suggests that FirstNet consider preparing a programmatic environmental impact statement (see attachment) to determine and address cumulative impacts from authorizing FirstNet projects on those 241 species for which the incremental impact of tower mortality, when

added to other past, present, and reasonably foreseeable future actions, is most likely significant, given their overall imperiled status. Notwithstanding the proposed implementing procedures, a programmatic NEPA document might be the most effective and efficient method for establishing best management practices for individual projects, reducing the burden to individual applicants, and addressing cumulative impacts.

Categorical Exclusions
The Department has identified 13 of the proposed categorical exclusions (A-6, A-7, A-8, A-9, A-10, A-11, A-12, A-13, A-14 A-15, A-16, A-17, and A-19) as having the potential to significantly affect wildlife and the biological environment. Given this potential, we want to underscore the importance of our comments on FirstNet's procedural guidance under Environmental Review and Consultation Requirements for NEPA Reviews and its list of extraordinary circumstances in Appendix D.

Environmental Review and Consultation Requirements for NEPA Reviews
To ensure there are no potentially significant impacts on birds from projects that may otherwise be categorically excluded, the Department recommends including the Migratory Bird Treaty Act and the Bald and Golden Eagle Protection Act to the list of requirements in this section.

Extraordinary Circumstances
To avoid potentially significant impacts on birds from projects that may otherwise be categorically excluded, the Department recommends including species covered under the Migratory Bird Treaty Act and the Bald and Golden Eagle Protection Act to the list of environmentally sensitive resources. Additionally, adding important resources to migratory birds such as sites in the Western Hemisphere Shorebird Reserve Network and Audubon Important Bird Areas to the paragraph on areas having special designation or recognition would help ensure their consideration when contemplating use of a categorical exclusion.

Developing the Purpose and Need
The Department recommends inclusion of language that would ensure consideration of all other authorities to which NEPA is supplemental as opposed to simply the FirstNet mission. As currently written, the procedures are limited to ensuring the purpose and need considers the FirstNet mission. If strictly applied, this approach would severely limit the range of reasonable alternatives, and likely preclude consideration of more environmentally benign locations or construction practices.

Environmental Review Process, Apply NEPA Early in the Process, Where Action is by Non-Federal Entity
The Department recommends that FirstNet be required to coordinate with federal agencies having jurisdiction by law or special expertise on construction and lighting of its network of towers.

Thank you for the opportunity to comment on the draft document. If you have any questions concerning the comments, please contact Diana Whittington, NEPA Migratory Bird lead, at (703) 358-2010. If you have any questions regarding Departmental NEPA procedures, contact Lisa Treichel, Office of Environmental Policy and Compliance at (202) 208-7116.

Sincerely,

Willie R. Taylor
Director, Office of Environmental Policy
and Compliance

Enclosure

Literature Cited

Longcore, T., C. Rich, P. Mineau, B. MacDonald, D.G. Bert, L.M. Sullivan, E. Mutrie, S.A. Gauthreaux, Jr., M.L. Avery, R.C. Crawford, A.M. Manville, II, E.R. Travis, and D. Drake. 2013. Avian mortality at communication towers in the United States and Canada: which species, how many, and where? Biological Conservation 158: 410-419.

U.S. Fish and Wildlife Service. 2008. Birds of Conservation Concern, 2008. United States Department of Interior, Fish and Wildlife Service, Division of Migratory Bird Management, Arlington, VA. 85 pages. *http://www.fws.gov/migratorybirds*.

Enclosure A

Background

The placement and operation of communication towers, including un-guyed, unlit, monopole or lattice-designed structures, impact protected migratory birds in two significant ways.

The first is by injury, crippling loss, and death from collisions with towers and their supporting guy-wire infrastructure, where present. Mass mortality events tend to occur during periods of peak spring and fall songbird bird migration when inclement weather events coincide with migration, and frequently where lights (either on the towers and/or on adjacent outbuildings) are also present. This situation has been well documented in the U.S. since 1948 in the published literature (Aronoff 1949, see Manville 2007a for a critique). The tallest communication towers tend to be the most problematic (Gehring *et al.* 2011). However, mid-range (~400-ft) towers as proposed by the First Responder Network Authority (FirstNet, a newly created entity under the Department of Commerce) can also significantly impact protected migratory birds, as can un-guyed and unlit lattice and monopole towers (Gehring *et al.* 2009, Manville 2007a, 2009, 2013a). Mass mortalities (more than several hundred birds per night) at unguyed, unlit monopole and lattice towers were documented in fall 2005 and 2011 in the Northeast and North Central U.S. (*e.g.*, Manville 2007a). It has been argued that communication towers including "short" towers do not impact migratory birds, including at the population level (*e.g.*, Arnold and Zink 2011), but recent findings have contradicted that assertion (Manville 2007a, 2013a, Longcore *et al.* 2012, 2013).

The second significant issue associated with communication towers involves impacts from non-ionizing electromagnetic radiation emitted by these structures. Radiation studies at cellular communication towers were begun circa 2000 in Europe and continue today on wild nesting birds. Study results have documented nest and site abandonment, plumage deterioration, locomotion problems, reduced survivorship, and death (*e.g.*, Balmori 2005, Balmori and Hallberg 2007, and Everaert and Bauwens 2007). Nesting migratory birds and their offspring have apparently been affected by the radiation from cellular phone towers in the 900 and 1800 MHz frequency ranges – 915 MHz is the standard cellular phone frequency used in the United States. However, the electromagnetic radiation standards used by the Federal Communications Commission (FCC) continue to be based on thermal heating, a criterion now nearly 30 years out of date and inapplicable today. This is primarily due to the lower levels of radiation output from microwave-powered communication devices such as cellular telephones and other sources of point-to-point communications; levels typically lower than from microwave ovens. The problem, however, appears to focus on very low levels of non-ionizing electromagnetic radiation. For example, in laboratory studies, T. Litovitz (personal communication) and DiCarlo *et al.* (2002) raised concerns about impacts of low-level, non-thermal electromagnetic radiation from the standard 915 MHz cell phone frequency on domestic chicken embryos – with some lethal results (Manville 2009, 2013a). Radiation at extremely low levels (0.0001 the level emitted by the average digital cellular telephone) caused heart attacks and the deaths of some chicken embryos subjected to hypoxic conditions in the laboratory while controls subjected to hypoxia were unaffected (DiCarlo *et al.* 2002). To date, no independent, third-party field studies have been conducted in North America on impacts of tower electromagnetic radiation on migratory birds. With the European field and U.S. laboratory evidence already available,

independent, third-party peer-reviewed studies need to be conducted in the U.S. to begin examing the effects from radiation on migratory birds and other trust species.

Discussion

Collision Deaths and Categorical Exclusions

Attempts to estimate bird-collision mortality at communication towers in the U.S. resulted in figures of 4-5 million bird deaths per year (Manville 2005, 2009). A meta-review of the published literature now suggests, based on statistically determined parameters, that mortality may be 6.8 million birds per year in Canada and the U.S.; the vast majority in the United States (Longcore *et al.* 2012). Up to 350 species of birds have been killed at communication towers (Manville 2007a, 2009). The Service's Division of Migratory Bird Management has updated its voluntary, 2000 communication tower guidelines to reflect some of the more recent research findings (Manville 2013b). However, the level of estimated mortality alone suggests at a minimum that FirstNet prepare an environmental assessment to estimate and assess the cumulative effects of tower mortality to protected migratory birds.

A second meta-review of the published mortality data from scientific studies conducted in the U.S. and Canada (Longcore *et al.* 2013) strongly correlates population effects to at least 13 species of Birds of Conservation Concern (BCC, USFWS 2008). These are mortalities to BCC species based solely on documented collisions with communication towers in the U.S. and Canada, ranging from estimated annual levels of mortality of 1 to 9% of their estimated total population. Among these where mortality at communication towers was estimated at over 2% annually are the Yellow Rail, Swainson's Warbler, Pied-billed Grebe, Bay-breasted Warbler, Golden-winged Warbler, Prairie Warbler, and Ovenbird. Longcore *et al.* (2013) emphasized that avian mortality associated with anthropogenic sources is almost always reported in the aggregate, *i.e.*, "number of birds killed," which cannot detect species-level effects necessary to make effective and meaningful conservation assessments, including determining cumulative effects. These new findings strongly suggest the need for at least an environmental assessment by FirstNet, or more likely, an environmental impact statement.

Radiation Impacts and Categorical Exclusions

There is a growing level of anecdotal evidence linking effects of non-thermal, non-ionizing electromagnetic radiation from communication towers on nesting and roosting wild birds and other wildlife in the U.S. Independent, third-party studies have yet to be conducted in the U.S. or Canada, although a peer-reviewed research protocol developed for the U.S. Forest Service by the Service's Division of Migratory Bird Management is available to study both collision and radiation impacts (Manville 2002).

As previously mentioned, Balmori (2005) found strong negative correlations between levels of tower-emitted microwave radiation and bird breeding, nesting, and roosting in the vicinity of electromagnetic fields in Spain. He documented nest and site abandonment, plumage deterioration, locomotion problems, reduced survivorship, and death in House Sparrows, White Storks, Rock Doves, Magpies, Collared Doves, and other species. Though these species had historically been documented to roost and nest in these areas, Balmori (2005) did not observe these symptoms prior to construction and operation of the cellular phone towers. Balmori and Hallberg (2007) and Everaert and Bauwens (2007) found similar strong negative correlations

among male House Sparrows. Under laboratory conditions, DiCarlo *et al.* (2002) raised troubling concerns about impacts of low-level, non-thermal electromagnetic radiation from the standard 915 MHz cell phone frequency on domestic chicken embryos – with some lethal results (Manville 2009). Given the findings of the studies mentioned above, field studies should be conducted in North America to validate potential impacts of communication tower radiation – both direct and indirect – to migratory birds and other trust wildlife species.

Literature Cited

Arnold, T. W., and R.M. Zink. 2011. Collision mortality has no discernable effect on population trends of North American birds. Plos ONE 6:e24708.

Aronoff, A. 1949. The September migration tragedy. Linnaean News-Letter 3(1):2.

Balmori, A. 2005. Possible effects of electromagnetic fields from phone masts on a population of White Stork (*Ciconia ciconia*). Electromagnetic Biology and Medicine 24:109-119.

Balmori, A., and O. Hallberg. 2007. The urban decline of the House Sparrow (*Passer domesticus*): a possible link with electromagnetic radiation. Electromagnetic Biology and Medicine 26:141-151.

DiCarlo, A., N. White, F. Guo, P. Garrett, and T. Litovitz. 2002. Chronic electromagnetic field exposure decreases HSP70 levels and lowers cytoprotection. Journal Cellular Biochemistry 84: 447-454.

Everaert, J., and D. Bauwens. 2007. A possible effect of electromagnetic radiation from mobile phone base stations on the number of breeding House Sparrows (*Passer domesticus*). Electromagnetic Biology and Medicine 26:63-72.

Gehring, J., P. Kerlinger, and A.M. Manville, II. 2009. Communication towers, lights, and birds: successful methods of reducing the frequency of avian collisions. Ecological Applications 19:505-514.

Gehring, J., P. Kerlinger, and A.M. Manville, II. 2011. The role of tower height and guy wires on avian collisions with communication towers. Journal of Wildlife Management 75: 848-855.

Longcore, T., C. Rich, P. Mineau, B. MacDonald, D.G. Bert, L.M. Sullivan, E. Mutrie, S.A. Gauthreaux, Jr., M.L. Avery, R.C. Crawford, A.M. Manville, II, E.R. Travis, and D. Drake. 2012. An estimate of avian mortality at communication towers in the United States and Canada. PLoSONE 7(4) 17 pp, Open Access.

Longcore, T., C. Rich, P. Mineau, B. MacDonald, D.G. Bert, L.M. Sullivan, E. Mutrie, S.A. Gauthreaux, Jr., M.L. Avery, R.C. Crawford, A.M. Manville, II, E.R. Travis, and D. Drake. 2013. Avian mortality at communication towers in the United States and Canada: which species, how many, and where? Biological Conservation 158: 410-419.

Manville, A.M., II. 2002. Protocol for monitoring the impacts of cellular telecommunication towers on migratory birds within the Coconino, Prescott, and Kaibab National Forests, Arizona. Peer-reviewed research monitoring protocol requested by and prepared for the U.S. Forest Service. Division of Migratory Bird Management, USFWS. 9 pp, March 2002.

Manville, A.M., II. 2005. Bird strikes and electrocutions at power lines, communication towers, and wind turbines: state of the art and state of the science – next steps toward mitigation. Pages 1051-1064 *In* C.J. Ralph and T.D. Rich (eds), Bird Conservation Implementation in the Americas: Proceedings 3rd International Partners in Flight Conference, U.S.D.A. Forest Service Gen. Technical Report PSW-GTR-191, Albany, CA.

Manville, A.M., II. 2007a. Comments of the U.S. Fish and Wildlife Service submitted electronically to the FCC on 47 CFR Parts 1 and 17, WT Docket No. 03-187, FCC 06-164, Notice of Proposed Rulemaking, "Effects of Communication Towers on Migratory Birds." February 2, 2007. 32 pp.

Manville, A.M., II. 2007b. U.S. Fish and Wildlife concerns over potential radiation impacts from cellular communication towers on migratory birds and other wildlife – research opportunities. Invited Presentation to "Congressional Staff Briefing on the Environmental and Human Health Effects of Radiofrequency (RF) Radiation," House Capitol 5, Washington, DC. 16 page PowerPoint presentation. May 10, 2007.

Manville, A.M. II. 2009. Towers, turbines, power lines and buildings – steps being taken by the U.S. Fish and Wildlife Service to avoid or minimize take of migratory birds at these structures. Pages 262-272 *in* T.D. Rich, C. Arizmendi, D.W. Demarest, and C. Thompson (eds.). Tundra to Tropics: Connecting Birds, Habitats and People. Proceedings 4th International Partners in Flight Conference, McAllen, Texas.

Manville, A.M., II. 2011. Estimates of annual human-caused mortality to North American birds (with literature citations). Division of Migratory Bird Management, USFWS, for public distribution. 12 pages.

Manville, A.M., II. 2013a. Anthropogenic-related bird mortality focusing on steps to address human-caused problems. A White Paper for the Anthropogenic Panel, 5th International Partners in Flight Conference, Snowbird, Utah. August 27, 2013. 16 page peer-reviewed White Paper.

Manville, A.M., II. 2013b. U.S. Fish and Wildlife Service (USFWS) revised guidelines for communication tower design, siting, construction, operation, retrofitting, and decommissioning -- Suggestions based on previous USFWS recommendations to FCC regarding WT Docket No. 03-187, FCC 06-164, Notice of Proposed Rulemaking, "Effects of Communication Towers on Migratory Birds," Docket No. 08-61, FCC's Antenna Structure Registration Program, and Service 2012 Wind Energy Guidelines. Division of Migratory Bird Management, Arlington, VA. 5 pages.

U.S. Fish and Wildlife Service. 2008. Birds of Conservation Concern, 2008. United States Department of Interior, Fish and Wildlife Service, Division of Migratory Bird Management, Arlington, VA. 85 pages. *http://www.fws.gov/migratorybirds*.

US Agencies; Department of the Army, Confidential Legal Correspondence, Dec. 13, 2006

DEPARTMENT OF THE ARMY
UNITED STATES ARMY INTELLIGENCE AND SECURITY COMMAND
FREEDOM OF INFORMATION/PRIVACY OFFICE
FORT GEORGE G. MEADE, MARYLAND 20755-5995

REPLY TO
ATTENTION OF:

DEC 13 2006

Freedom of Information/
Privacy Office

Mr. Donald Friedman
Confidential Legal Correspondence
1125 Third Street
Napa, California 94559-3015

Dear Mr. Friedman:

References:

a. Your Freedom of Information Act (FOIA) request dated May 25, 2006, to the Department of the Army, Freedom of Information/Privacy Act Division (DA FOIA/PA DIV), for all documents pertaining to the microwave auditory effect, microwave hearing effect, Frey effect, artificial telepathy, and/or any device/weapon which uses and/or causes such effect; and any covert or undisclosed use of hypnosis. On September 5, 2006, the DA FOIA/PA DIV referred a copy of your request to this office. Your request was received on September 11, 2006.

b. Our letter of September 13, 2006, informing you of the search for records at another element of our command and were unable to comply with the 20-day statutory time limit in processing your request.

As noted in our letter, the search has been completed with another element of this command and the record has been returned to this office for our review and direct response to you.

We have completed a mandatory declassification review in accordance with Executive Order (EO) 12958, as amended. As a result of this review, it has been determined that the Army information no longer warrants security classification protection and is releasable to you. A copy of the record is enclosed for your use.

Fees for processing your request are waived.

If you have any questions concerning this action, please feel free to contact this office at (301) 677-2308. Refer to case #614F-06.

Sincerely,

Susan J. Butterfield
Director
Freedom of Information/Privacy Office
Investigative Records Repository

Enclosure

~~SECRET~~
~~NOFORN~~ UNCLASSIFIED

Bioeffects of Selected Nonlethal Weapons(fn 1)

This addendum to the Nonlethal Technologies--Worldwide (NGIC-1147-101-98) study addresses in summary, some of the most often asked questions of nonlethal weapons technology, the physiological responses observed in clinical settings of the biophysical coupling and susceptibility of personnel to nonlethal effects weapons. These results identify and validate some aspects of maturing nonlethal technologies that may likely be encountered or used as nonlethal effectors in the future including:

- Laser and other light phenomena.
- Radiofrequency directed energy.
- Aural bioeffects.

The study of electromagnetic fields and their influence on biological systems is increasing rapidly. Much of this work is taking place because of health concerns. For example, increased concern has arisen regarding the effects of operator exposure to the electromagnetic fields associated with short-wave diathermy devices, high power microwave ovens, radar systems, magnetic resonance imaging units, etc. In addition, much concern has arisen about extremely low frequency (60 Hz power frequency) electric and magnetic fields that originate from high-voltage transmission lines, industrial equipment, and residential appliances. Both occupational and residential long-term exposure have been the focus of epidemiological studies. The studies have suggested possible adverse effects on human health (e.g., cancer, reproduction, etc.). Laboratory research is still being pursued to identify possible mechanisms of interaction. However, other than thermal heating for microwave frequencies, there is no yet agreed-upon mechanism of action. As a consequence, our knowledge base is developed entirely with phenomenological observations. Because of this fact, it is not possible to predict how nonthermal biological effects may differ from one exposure modality to another. It is especially difficult, because of the small data base for fast pulses, to predict biological effects that might be associated with high-power pulses of extremely short duration.

There is, however, a growing perception that microwave irradiation and exposure to low frequency fields can be involved in a wide range of biological interactions. Some investigators are even beginning to describe similarities between microwave irradiation and drugs regarding their effects on biological systems. For example, some suggest that power density and specific absorption rate of microwave irradiation may be thought of as analogous to the concentration of the injection solution and the dosage of drug

administration, respectively. Clearly, the effects of microwaves on brain tissue, chemistry, and functions are complex and selective. Observations of body weight and behavior revealed that rats, exposed under certain conditions to microwaves, eat and drink less, have smaller body weight as a result of nonspecific stress mediated through the central nervous system and have decreased motor activity. It has been found that exposure of the animals to one modality of radiofrequency electromagnetic energy substantially decreases aggressive behavior during exposure. However, the opposite effects of microwaves, in increasing the mobility and aggression of animals, has also been shown for a different exposure modality. Recent published data implicates microwaves as a factor related to a deficit in spatial memory function. A similar type of effect was observed with exposure to a "resonance tuned" extremely low frequency magnetic field. Thus, the data base is replete with phenomenological observations of biological systems "affected" by exposure to electromagnetic energy. (The fact that a biological system responds to an external influence does not automatically nor easily translate to the suggestion of adverse influence on health.) The objective of the present study was to identify information from this developing understanding of electomagnetic effects on animal systems that could be coupled with human biological susceptibilities. Situations where the intersection of these two domains coexist provide possibilities for use in nonlethal applications.

Incapacitating Effect: Microwave Heating

Body heating to mimic a fever is the nature of the RF incapacitation. The objective is to provide heating in a very controlled way so that the body receives nearly uniform heating and no organs are damaged. Core temperatures approximately 41° C are considered to be adequate. At such temperature a considerably changed demeanor will take place with the individual. Most people, under fever conditions, become much less aggressive; some people may become more irritable. The subjective sensations produced by this buildup of heat are far more unpleasant than those accompanying fever. In hyperthermia all the effector processes are strained to the utmost, whereas in fever they are not. It is also possible that microwave hyperthermia (even with only a 1° C increase in brain temperature) may disrupt working memory, thus resulting in disorientation.

Biological Target/Normal Functions/Disease State

The temperature of warm-blooded (homeothermic) animals like the human remains practically unchanged although the surrounding temperature may vary considerably. The normal human body temperature recorded from the mouth is usually given as 37° C, with the rectal temperature one degree higher. Variation between individuals is typically between 35.8° C and 37.8° C orally. Variations also occur in any one individual throughout the day--a difference of 1.0° C or even 2.0° C occurring between the maximum in the late afternoon or early evening, and the minimum between 3 and 5 o'clock in the morning. Strenuous muscular exercise causes a temporary rise in body temperature that is proportional to the severity of the exercise; the level may go as high as 40.0° C.

Extreme heat stress, such that the body's capacity for heat loss is exceeded, causes a pathological increase in the temperature of the body. The subjective sensations produced by this buildup of heat are far more unpleasant than those accompanying fever. In hyperthermia all the effector processes are strained to the utmost, whereas in fevers they are not. The limiting temperature for survival, however, is the same in both cases--a body temperature of 42° C. For brief periods, people have been known to survive temperatures as high as 43 ° C.

In prolonged hyperthermia, with temperatures over 40° C to 41° C, the brain suffers severe damage that usually leads to death. Periods of hyperthermia are accompanied by cerebral edema that damage neurons, and the victim exhibits disorientation, delirium, and convulsions. This syndrome is popularly referred to as sunstroke, or heatstroke, depending on the circumstances. When the hyperthermia is prolonged, brain damage interferes with the central thermoregulatory mechanisms. In particular, sweat secretion ceases, so that the condition is further exacerbated.

Mechanism to Produce the Desired Effects

This concept builds on about 40 years of experience with the heating effects of microwaves. Numerous studies have been performed on animals to identify characteristics of importance to the understanding of energy deposition in animals. As a result of the physics, the relationship between the size of the animal and the wavelength of the radiofrequency energy is most important. In fact, the human exposure guidelines to radiofrequency radiation are designed around knowledge of the differential absorption as a function of frequency and body size. The challenge is to minimize the time to effect while causing no permanent injury to any organ or the total body and to optimize the equipment function. The orientation of the incident energy with respect to the orientation of the animal is also important.

In a study of the effect of RF radiation on body temperature in the Rhesus monkey, a frequency (225 MHz) is purposely chosen that deposits energy deep within the body of the animal. A dose rate of 10 W/kg caused the body temperature to increase to 42° C in a short time (10-15 min). To avoid irreversible adverse effects, the exposure was terminated when a temperature of 42° C was reached. A lower dose rate of 5 W/kg caused the temperature to increase to 41.5° C in less than 2 hours. The reversible nature of this response was demonstrated by the rapid drop in body temperature when RF exposure was terminated before a critical temperature of 42° C was reached. It is estimated for rats that the absorbed threshold convulsive dose lies between 22 and 35 J/g for exposure durations from less than a second to 15 minutes. For 30-minute exposure, the absorbed threshold dose for decrease in endurance is near 20 J/g, the threshold for work stoppage approximately 9 J/g, and the threshold for work perturbation ranges from 5 to 7 J/g. All of the above measures, except convulsions, are types of nonlethal incapacition.

A rough estimate of the power required to heat a human for this technology is on the order of 10 W/kg given about 15 to 30 minutes of target activation. Actual power levels

depend on climatic factors, clothing, and other considerations that affect the heat loss from the individual concerned. A method for expressing dose rate in terms of body surface area (i.e., watts per square meter) rather than body mass (i.e., watts per kilogram) would permit a more reliable prediction of thermal effects across species. However, there are large uncertainties in the ability to extrapolate thermoregulatory effects in laboratory animals to those in human beings.

This technology is an adaptation of technology which has been around for many years. It is well known that microwaves can be used to heat objects. Not only is microwave technology used to cook foods, but it is also used as a directed source of heating in many industrial applications. It was even the subject of the "Pound Proposal" a few years ago in which the idea was to provide residential heating to people, not living space. Because of the apparently safe nature of body heating using microwave techniques, a variety of innovative uses of EM energy for human applications are being explored. The nonlethal application would embody a highly sophisticated microwave assembly that can be used to project microwaves in order to provide a controlled heating of persons. This controlled heating will raise the core temperature of the individuals to a predetermined level to mimic a high fever with the intent of gaining a psychological/capability edge on the enemy, while not inflicting deadly force. The concept of heating is straightforward; the challenge is to identify and produce the correct mix of frequencies and power levels needed to do the remote heating while not injuring specific organs in the individuals illuminated by the beam.

A variety of factors contribute to the attractiveness of this nonlethal technology. First, it is based on a well-known effect, heating. Every human is subject to the effects of heating; therefore, it would have a predictability rating of 100%. The time to onset can probably be engineered to between 15 and 30 minutes; however, timing is the subject of additional research to maximize heating while minimizing adverse effects of localized heating. The onset can be slow enough and/or of such frequency to be unrecognized by the person(s) being irradiated. Safety to innocents could be enhanced by the application and additional development of advanced sensor technologies. Incapacitation time could be extended to almost any desired period consistent with safety. (Given suitable R&D, temperature or other vital signs could be monitored remotely, and temperature could be maintained at a minimum effective point).

Time to Onset

The time to onset is a function of the power level being used. Carefully monitored uniform heating could probably take place in between 15 and 30 minutes. Time to onset could be reduced but with increased risk of adverse effects. Minimum time is dependent on the power level of the equipment and the efficiency of the aiming device.

Duration of Effect

Assuming that the heating is done carefully, reversal of elevated body temperature would begin as soon as the source of heat is removed.

4

Tunability

This concept is tunable in that any rate of heating, up to the maximum capacity of the source, may be obtained. Thus it is suitable for use in a gradual force or "rheostatic" approach. If the situation allows, and the source is sufficiently powerful, there is the possibility to use this technology in a lethal mode as well. Prolonged body temperature above 43° C is almost certain to result in permanent damage to the brain and death.

Distribution of Human Sensitivities to Desired Effects

No reason has been identified to suggest that anyone would be immune to this technology. Individuals with compromised thermoregulatory mechanisms would be susceptible with a lower incident energy density. This would include people with organic damage to the hypothalamus, the part of the brain that integrates the autonomic mechanisms which control heat loss as well as people with compromised somatic features of heat loss (e.g., respiration, water balance, etc.).

The technologies needed for the thermal technology concept are relatively well developed because of the known biophysical mechanism, the universal susceptibility of humans to the mechanism of heating, and because of a well developed technology base for the production of radiofrequency radiation. Because the human body is inhomogeneous, certain organs are, by virtue of their size and geometry, more easily coupled with one radiofrequency wavelength than another. Therefore, to avoid permanent damage to the suspect or to innocent bystanders, it may be necessary to vary the frequency to avoid localized heating and consequent damage to any organ. Additionally, it will be necessary to avoid the conditions thought to be associated with the induction of cataracts. Thus, while the technology of microwave heating in general is mature, adaptation as a nonlethal technology will require sophisticated biophysical calculations to identify the proper regimen of microwave frequencies and intensities; it will also be necessary to optimize existing hardware to meet the biophysical requirements.

Possible Influence on Subject(s)

If the technology functions approximately as envisioned, the targeted individual could be incapacitated within 15 to 30 minutes. Because this technology is focused on a relatively slow onset, it should only be used in situations where speed is not important. The very uncomfortable nature of a high body temperature may be useful in negotiations or possibly for controlling crowds. It would be equally useful on single persons or crowds. Evidence also indicates a disruption of working memory, thus disorientation may occur because of an inability to consolidate memory of the recent (minutes) past.

Technological Status of Generator/Aiming Device

Equipment needed to explore this concept in the laboratory is available today. Design and construction of the RF/microwave generator will depend on the constraints posed by the calculations, potential generation devices, and energy-directing structures. A variety of

options exist for both of these equipment needs. The use of advanced frequency and modulation-agile RF generation and amplification circuitry will be required to assess fully the frequency/power/time envelope of RF heating profiles required. Although much equipment is commercially available, it is likely that custom hardware and software will be necessary because available equipment has not been designed with the need for frequency/intensity variability, which will probably be needed for safety purposes. In addition, the design of antennas and other energy-directing structures will almost certainly involve unique configurations. Since this technology utilizes radiofrequency energy, it can be defeated by the use of shielding provided by conductive barriers like metal or metal screen.

Incapacitating Effect: Microwave Hearing

Microwave hearing is a phenomenon, described by human observers, as, the sensations of buzzing, ticking, hissing, or knocking sounds that originate within or immediately behind the head. There is no sound propagating through the air like normal sound. This technology in its crudest form could be used to distract individuals; if refined, it could also be used to communicate with hostages or hostage takers directly by Morse code or other message systems, possibly even by voice communication.

Biological Target/Normal Functions/Disease State

This technology makes use of a phenomenon first described in the literature over 30 years ago. Different types of sounds were heard depending on the particulars of the pulse characteristics. Various experiments were performed on humans and laboratory animals exploring the origin of this phenomenon. At this time, virtually all investigators who have studied the phenomenon now accept thermoelastic expansion of the brain, the pressure wave of which is received and processed by the cochlear microphonic system, to be the mechanism of acoustic perception of short pulses of RF energy. One study (in 1975) using human volunteers, identified the threshold energy of microwave-auditory responses in humans as a function of pulse width for 2450 MHz radiofrequency energy. It is also found that about 40 J/cm^2 incident energy density per pulse was required.

Mechanism to Produce the Desired Effects

After the phenomenon was discovered, several mechanisms were suggested to explain the hearing of pulsed RF fields. Thermoelastic expansion within the brain in response to RF pulses was first studied and demonstrated in inert materials and was proposed as the mechanism of hearing of pulsed RF fields. A pressure wave is generated in most solid and liquid materials by a pulse of RF energy--a pressure wave that is several orders of magnitude larger in amplitude than that resulting from radiation pressure or from electrostrictive forces. The characteristics of the field-induced cochlear microphonic in guinea pigs and cats, the relationship of pulse duration and threshold, physical measurements in water and in tissue-simulating materials, as well as numerous theoretical calculations--all point to thermoelastic expansion as the mechanism of the hearing phenomenon.

Scientists have determined the threshold energy level for human observers exposed to pulsed 2450-MHz fields (0.5-to 32 micron pulse widths). They found that, regardless of the peak of the power density and the pulse width, the per-pulse threshold for a normal subject is near 20 mJ/kg. The average elevation of brain temperature associated with a just-perceptible pulse was estimated to be about $5x10^{-6}$° C.

Time to Onset

The physical nature of this thermoelastic expansion dictates that the sounds are heard as the individual pulses are absorbed. Thus, the effect is immediate (within milliseconds). Humans have been exposed to RF energy that resulted in the production of sounds.

Duration of Effect

Microwave hearing lasts only as long as the exposure. There is no residual effect after cessation of RF energy.

Tunability

The phenomenon is tunable in that the characteristic sounds and intensities of those sounds depend on the characteristics of the RF energy as delivered. Because the frequency of the sound heard is dependent on the pulse characteristics of the RF energy, it seems possible that this technology could be developed to the point where words could be transmitted to be heard like the spoken word, except that it could only be heard within a person's head. In one experiment, communication of the words from one to ten using "speech modulated" microwave energy was successfully demonstrated. Microphones next to the person experiencing the voice could not pick up the sound. Additional development of this would open up a wide range of possibilities.

Distribution of Human Sensitivities to Desired Effects

Because the phenomenon acts directly on cochlear processes, the thermoelastic pressure waves produce sounds of varying frequency. Many of the tests run to evaluate the phenomenon produced sounds in the 5 kHz range and higher. Because humans are known to experience a wide range of hearing loss due to cochlear damage, it is possible that some people can hear RF induced sounds that others with high frequency hearing loss cannot. Thus, there is a likely range of sensitivity, primarily based on the type of pulse and the condition of the cochlea. Bilateral destruction of the cochlea has been demonstrated to abolish all RF-induced auditory stimuli.

Recovery/Safety

Humans have been subjected to this phenomenon for many years. The energy deposition required to produce this effect is so small that it is not considered hazardous experimentation when investigating responses at the just-perceptible levels.

Possible Influence on Subject(s)

Application of the microwave hearing technology could facilitate a private message transmission. It may be useful to provide a disruptive condition to a person not aware of the technology. Not only might it be disruptive to the sense of hearing, it could be psychologically devastating if one suddenly heard "voices within one's head."

Technological Status of Generator/Aiming Device

This technology requires no extrapolation to estimate its usefulness. Microwave energy can be applied at a distance, and the appropriate technology can be adapted from existing radar units. Aiming devices likewise are available but for special circumstances which require extreme specificity, there may be a need for additional development. Extreme directional specificity would be required to transmit a message to a single hostage surrounded by his captors. Signals can be transmitted long distances (hundreds of meters) using current technology. Longer distances and more sophisticated signal types will require more bulky equipment, but it seems possible to transmit some type of signals at closer ranges using man-portable equipment.

Range

The effective range could be hundreds of meters.

Incapacitating Effect: Disruption of Neural Control

The nature of the incapacitation is a rhythmic-activity synchronization of brain neurons that disrupts normal cortical control of the corticospinal and corticobulbar pathways; this disrupts normal functioning of the spinal motor neurons which control muscle contraction and body movements. Persons suffering from this condition lose voluntary control of their body. This synchronization may be accompanied by a sudden loss of consciousness and intense muscle spasms.

Biological Target/Normal Functions/Disease State

The normal function of the brain is to control all forms of behavior, voluntary control of body, and the homeostatic parameters of the organism. In normal conditions, all the brain structures, neuron populations, networks, and single units function with specific rhythmic activity depending on the incoming sensory information, information from mnemonic structures, and signals from visceral organs. Each single neuron provides specific processing of information it receives and forms a specific pattern of impulse firing as outgoing information. Synchronization of neuron activity is a natural mechanism of the brain function that uses such controlling processes as motivation, attention and memory (experience) in order to organize behavior. For example, motivational processes are considered as activating ascending signals that synchronize the neuron activity of specific brain structures and neuron networks; this activation/synchronization in turn activates specific forms of behavior such as sexual, aggressive, ingestive activities.

In normal functioning the degree of neuronal synchronization is highly controlled. From experiments that record the neuronal activity in different brain areas simultaneously in animals, it is known that correlation of spike activity between neurons (measured by the correlation level of synchronization) changes depending on the stage of behavior, motivation, attention, or activation of the memory processes. However, under some conditions, such as physical stress, heat shock, or strong emotional stress, the level of synchronization may become higher, involving nonspecific large populations of brain neurons and the synchronization may become uncontrollable.

Depending on at which frequency the synchronization rhythm occurs and how many neurons are involved, it may produce different physical effects; muscle weakness, involuntary muscle contractions, loss of consciousness, or intense (tonic) muscle spasms. The higher level of synchronization takes place in persons affected with epilepsy when they experience periodic seizures since they have a pathologic source (e.g., from injury to the brain) of rhythmic synchronization. Because the neurophysiological mechanisms of epileptiform synchronization are better documented, this incapacitating technology is described in terms of epileptogenesis.

The neurophysiological mechanisms active in epileptogenesis involve changes in membrane conductances and neurotransmitter alterations as they affect neuronal interaction. In the process of epileptogenesis, either some neurons are discharging too easily because of alterations in membrane conductances or there is a failure of inhibitory neurotransmission. The actual discharges have been recognized to result from a neuronal depolarization shift with electrical synchrony in cell populations related in part to changes in membrane conductances. The ionic basis and biochemical substrate of this activation have been areas of considerable study but still leave many questions unanswered. What are the basic cellular properties, present in normal cells and tissue, that could contribute to the generation of abnormal activity? What parts of the systems are low threshold and function as trigger elements?

One of the current hypotheses is involved with microcircuitry, particularly local synaptic interactions in neocortical and limbic system structures. In the hippocampus, the role of the trigger element has been long attributed to the CA3 pyramidal cells--a hypothesis based on the fact that spontaneous synchronous burst discharge can be established in CA3 neurons Some studies describe an intrinsically bursting cell type in the neocortex that plays a role similar to that of CA3 cells in the hippocampus and that of deep cells in the pyriform cortex. The intrinsic nature of these cells appears to be an important contributor to the establishment of synchronized bursting in these regions. Another apparent requirement in such a population is for a certain degree of synaptic interaction among neurons, such that discharge of even one cell enlists the activity of its neighbors. Given the presence of these bursting cells and the occurrence of excitatory interactions among them in normal tissue, it may actually be the morphologic substrate for epileptiform discharges.

Another hyptothesis has focused particularly on the role of N-methyl-D-aspartate (NMDA) receptors. Various factors regulate the efficacy of NMDA receptors: their

voltage-dependent blockade by magnesium and modulation by glycine and polyamines. For example, in the low magnesium model, spontaneous synchronous burst discharge in hippocampal pyramidal cell populations is sensitive to NMDA antagonists. That finding suggests that it is the opening of NMDA channels, by relieving the magnesium blockade, that facilitates epileptiform activity.

Significant attention in the literature is also being given to gamma-amino butyric acid (GABA) receptors for the potential role in control of excitability. Changes in GABA inhibitory efficacy can lead to important effects on the excitability of the system. GABAergic inhibitory post-synaptic potentials (IPSPs) have been shown to be quite labile in response to repetitive activation of cortical cell populations, as may occur during epileptiform discharge. Scientists have shown that even a small percentage change in GABA inhibition can have profound effects on neocortical epileptogenesis. These changes in GABAergic inhibition may be the key to an explanation of how repetitive discharge patterns give rise to ictal discharge. Further, there appears to be a significant increase in excitatory postsynaptic potential (EPSP) frequency prior to seizure initiation an observation that is consistent with loss of IPSP efficacy prior to ictal onset.

The above hypotheses describe different mechanisms of epileptogenesis, but it is quite possible that all of these mechanisms take place, and they reflect large variety of types of epileptic seizures. The common principle of the mechanisms proposed is the change of membrane properties (i.e., conductance, permeability etc.) of certain neurons which results in depolarization and burst discharging. Some factors (e.g., trauma) can affect these specific neurons and initiate synchrony for neurons that control internal communication and communication with various muscle systems not associated with vital functions (i.e., heart beating, breathing). High strength pulsed electric fields could also be such a factor.

Mechanism to Reproduce the Desired Effects

Application of electromagnetic pulses is also a conceptual nonlethal technology that uses electromagnetic energy to induce neural synchrony and disruption of voluntary muscle control. The effectiveness of this concept has not been demonstrated. However, from past work in evaluating the potential for electromagnetic pulse generators to affect humans, it is estimated that sufficiently strong internal fields can be generated within the brain to trigger neurons. Estimates are that 50 to 100 kV/m free field of very sharp pulses (~ 1 nS) are required to produce a cell membranic potential of approximately 2 V; this would probably be sufficient to trigger neurons or make them more susceptible to firing.

The electromagnetic pulse concept is one in which a very fast (nanosecond timeframe) high voltage (approximately 100 kV/m or greater) electromagnetic pulse is repeated at the alpha brain wave frequency (about 15 Hz). It is known that a similar frequency of pulsing light can trigger sensitive individuals (those with some degree of light-sensitivity epilepsy) into a seizure and it is thought that by using a method that could actually trigger nerve synapses directly with an electrical field, essentially 100% of individuals would be susceptible to seizure induction. The photic-induced seizure phenomenon was borne out

demonstrably on December 16, 1997 on Japanese television when hundreds of viewers of a popular cartoon show were treated, inadvertently, to photic seizure induction (figure 31). The photic-induced seizure is indirect in that the eye must receive and transmit the impulses which initially activate a portion of the brain associated with the optic nerve. From that point the excitability spreads to other portions of the brain. With the electromagnetic concept, excitation is directly on the brain, and all regions are excited concurrently. The onset of synchony and disruption of muscular control is anticipated to be nearly instantaneous. Recovery times are expected to be consistent with, or more rapid than, that which is observed in epileptic seizures.

Time to Onset

No experimental evidence is available for this concept. However, light-induced seizures latency onset in photosensitive epileptics varies from 0.1 to about 10 seconds. Because of the fact that the electrical impulses triggered by light must spread to other parts of the brain, photic-induced seizures are expected to have a generally slower onset than neural synchrony induced by high-strength pulsed electric fields.

Duration of Effect

For epileptic individuals, the typical duration of a petit mal event or a psychomotor event is 1 minute or 2, possibly longer, while the duration of a grand mal seizure is 1 to 5 minutes. In a non-epileptic individual who is induced by electromagnetic means, the durations of the different events are expected to be roughly the same as the epileptic individual's events after the external excitation is removed.

Tunability

There are many degrees of epileptic seizure in diseased persons, and it seems reasonable that electromagnetic stimulation of neural synchrony might be tunable with regard to type and degree of bodily influence, depending on the parameters associated with the chosen stimulus. Because there are no actual data to build on, these statements must be considered tentative. It is known that in the study of photic-induced seizures, parameters can be varied so that the individual under study does not actually undergo a grand mal seizure. This knowledge gives confidence that the proposed technology would be tunable.

Distribution of Human Sensitivities to Desired Effects

It is anticipated that 100% of the population would be susceptible. The mechanism is one that could act on many individual neuronal cells concurrently and hence does not depend on spreading regions of electrical activity as in the disease state.

Possible Influence on Subjects(s)

If the technology functions approximately as envisioned, the targeted individual could be incapacitated very quickly. Because there have been no reported studies using the

conditions specified, experimental work is required to characterize onset time. Different types of technologies could be employed to influence wide areas or single individuals. Because this technology is considered to be tunable, the influence on subjects could vary from mild disruption of concentration to muscle spasms and loss of consciousness. The subject(s) would have varying degrees of voluntary control depending on the chosen degree of incapacitation.

Technological Status of Generator/Aiming Device

An electric field strength of roughly 100 Kv/m over a time period of 1 nanosecond is approximately the condition thought to be necessary to produce the desired effect when provided to an overall repetition rate of 15 Hz. Such a field may be developed using a radar-like, high-peak-power, pulsed source or an electromagnetic pulse generator operated at 15 Hz. These technologies exist today sufficient to evaluate the disabling concept. Power requirements are not high because the duty factor is so low. Aiming devices are currently available, but a high degree of directionality at long distances will require development. It may be necessary to provide bursts of these nanosecond pulses in order to stimulate the desired effect. As the duty time increases so does the average power requirement for power source. Because there were no open literature reports from which to make inferences, there is some uncertainty about the power levels required.

Range

The effective range could be hundreds of meters.

Defeat Capabilities/Limitations

Shielding can be provided by conductive barriers like metal or metal screen. There are a number of drugs that are capable of inducing convulsive seizures and others, like phenobarbital, diphenyllhydantoin, trimethadione, 2-4 dinitrophenol, and acetazolamide, which are anticonvulsive. Anticonvulsive drugs are known to be helpful in reducing the effect of seizures in epileptic patients, but their ability to reduce the effect of the proposed technology is unknown (possibly no effect) but expected to be less than for photic-induced seizures.

Incapacitating Effect; Acoustic Energy

The nature of the incapacitation consists of severe pressure sensations, nystagmus (a spasmodic, involuntary motion of the eyes), and nausea caused by high intensities of 9140-155 dB). Nystagmus occurs when convection currents are produced (cupula movement) in the lateral ear canal. This cupula movement causes the eyes to move involuntarily; hence, the external world is interpreted as moving. The subject "sees" his surroundings turning round him and at the same time experiences a sensation of turning. Persons exposed to these levels of sound experience nausea.

Biological Target/Normal Functions/Disease State

The two lateral semicircular canals, one located in each inner ear, alert a person to the fact that his upright head is experiencing angular acceleration. Within the ampulla of the canal are several so called hair cells. The cilia of these cells protrude into the lumen of the ampulla where they are encased in a mass of jelly-like material (the cupula) which is attached to the opposite wall of the canal. As the head accelerates, the cilia are bent by an inertial force of the cupula and the viscous liquid in the canal lumen. The bending of the cilia excites hair cells which in turn excite afferent neurons; these then alert the brain that a change of position of the head has occurred. Similar events occur when the head stops moving. The result of a strong hair cell stimulus to the brain is a rapid eye movement, call nystagmus, a feeling of dizziness and disorientation, and a possibility of nausea and vomiting.

Normal hearing is in the range between the frequencies of 20,000 to 16,000 Hz with the optimal sensitivity for most people between the frequencies of 500 to 6000 Hz.

Mechanism to Produce the Desired Effects

Because the end organs for acoustic and vestibular perception are so closely related, intense acoustic stimulation can result in vestibular effects. The hypothesis is that the sound of normal intensity produces oscillations of the endolymph and perilymph, compensated for by oscillations of the round window. High intensity sound produces eddy currents, which are localized rotational fluid displacements. High intensity sound can also produce nonlinear displacement of the stapes, causing a volume displacement, the result of which can be a fluid void in the labyrinth. To fill the void, fluid may be displaced along the endolymphatic duct and/or block capillary pathways, which, in turn, could stimulate vestibular receptors. Stimulation of the vestibular receptors may lead to nausea and vomiting if the sound pressure level is high enough. Conclude that both eddy currents and volume displacement serve to stimulate vestibular receptors in humans, when exposed to high levels of noise.

One study found nystagmum in guinea pigs exposed to high levels of infrasound via stimulation of the vestibular receptors. However, the same lab was unable to produce nystagmus in human subjects at 5- and 10-second exposures to a pure tone at 135 dB, broadband engine noise, or a 100 Hz tone at 120 dB, pulsed three times/s or 2 minutes. The same research was unable to elicit nystagmus at levels up to 155 dB, and also equally unable to produce nystagmus using infrasound levels of 112-150 dB in guinea pigs, monkeys, and humans. However, research with audible components in the sound spectrum with guinea pigs and monkeys produced nystagmus. Other researchers report other vestibular effects in addition to nystagmus at the following thresholds: 125 dB from 200-500 Hz, 140 dB at 1000 Hz, and 155 dB at 200 Hz. Decrements in vestibular function occur consistently for broadband noise levels of 140 dB (with hearing protection).

Human subjects listened to very high levels of low-frequency noise and infrasound in the protected or unprotected modes. Two-minute duration as high as 140 to 155 dB produced a range of effects from mild discomfort to severe pressure sensations, nausea, gagging,

and giddiness. Effects also included blurred vision and visual field distortions in some exposure conditions. The nature and degree of all effects was dependent on both sound level and frequency with the most severe effects occurring in the audible frequency range (as opposed to infrasound), at levels above about 145 dB. The investigators found no temporary threshold shift (TTS) among their subjects, and the use of hearing protectors greatly alleviated the adverse effects.

Since the early days of jet-engine testing and maintenance, anecdotal evidence has appeared linking exposure to intense noise, with such complaints as dizziness, vertigo, nausea, and vomiting. As a result of siren noise at 140 dB, subjects consistently reported a feeling of being pushed sideways, usually away from the exposed ear, and one subject reported difficulty standing on one foot.

These effects were not as dramatic as from the jet-engine (broadband) noise at 140 dB. This research concludes that the threshold of labyrinthine dysfunction is about 135 to 140 dB and that these effects occur during, but not after, exposure.

Time to Onset

No times to onset of nausea or nystagmus were identified in the literature but is presumed to be relatively immediate based on effects to the labyrinth system occurring during, but not after, exposure to sound pressure levels of 135 to 140 dB.

Duration of Effect

The incapacitation lasts only as long as the incapacitating sound is present.

Tunability

Based on the data presented above, it is unclear whether the degree of nausea or nystagmus is tunable, but similar symptoms caused by other stimuli are variable in degree.

Distribution of Human Sensitivities to Desired Effects

It is most probable that all individuals will be susceptible to this stimulus with the exception of those with a disease or defect (i.e., deaf mutes) of some part or parts of the vestibular system. Data showed no consistent decrease in vestibulo-ocular reflects with increased age.

Recovery/Safety

Normal subjects are likely to recover immediately and experience no or unmeasurable changes in hearing unless well known frequency-intensity-time factors are exceeded. This is based on studies which found no temporary threshold shift in hearing of subjects tested at low frequency. Occupational safety personnel generally recognize that 115

dB(A) is to be avoided and that 70 dB(A) is assumed safe. Is believed that the noise energy with predominating frequencies above 500 Hz have a greater potential for hearing loss than noise energy at lower frequencies. Occupational standards for noise state that a person may be exposed continuously for 8 hours to 90 dB(A) or 15 minutes to 115 dB(A).

Possible Influence on Subject(s)

Induction of nystagmus and nausea will have variable effects on individuals. Effects may be sufficiently incapacitation to allow offensive advantage; the perception of sickness may make a subject susceptible to persuasion. It would be difficult to target single individuals at the present level of sound directing technology. This technology may be better suited for groups of people.

Technological Status of Generator/Aiming Device

Sound generating technology is well developed but not highly portable. Aiming devices are poorly developed.

Range

Under normal circumstances the sound pressure level decreases 6 dB(A) when the distance from the source is doubled. For example if the sound is 100 dB(A) at 100 ft, at 200 ft the sound would be 94 dB(A). At very high sound levels, certain conditions may lead to nonlinear effects in propagation and greatly increase range accuracy.

Defeat Capabilities/Limitations

Negative effects of audible sound are greatly decreased if hearing protection is worn. High frequency sound is more easily blocked than low frequency sound due to wavelength effects.

Laser-Induced Biological Effects

Their are three basic damage mechanisms associated with exposure to laser radiation: chemical, thermal, and mechanical or acoustic-mechanical.

The laser-induced, chemical alterations in irradiated tissue are referred to as photochemical damage. The likelihood of laser radiation in the blue-light portion of the electromagnetic spectrum (.380 to .550 microns) inducing photochemical reactions progressively decreases with increasing wavelength. Photochemical effects are not observed upon exposure to radiation with wavelengths exceeding .550 to .650 microns because the kinetic energy associated with these photons is insufficient to initiate a photochemical change.

On the other hand, the thermal effect is a primary mechanism for laser-induced injury. The extent of the injuries induced depends upon the wavelength and energy of the incident radiation, duration of exposure, and the nature of the exposed tissue and its absorption characteristics. Generally, this mechanism predominates in the visible and the near-infrared (.760 to 1.4 microns) portions of the electromagnetic spectrum and for almost all CW and pulsed exposures between 0.1 milliseconds and 1 to 5 seconds.

The third injury mechanism associated with exposure to laser radiation is the mechanical or acoustical-mechanical effect. The radiant energy is absorbed into the tissue and, as a result of rapid thermal expansion following a short (1 nanosecond to 0.1 millisecond) laser radiation pulse, a pressure wave is generated that may result in explosive tissue injury.

Generally, all three mechanisms operate concurrently in an irradiated animal. Thermal effects currently predominate for continuous wave (CW) lasers, while mechanical effects are of increased significance for pulsed-mode lasers. With even higher power, one must also consider nonlinear phenomena such as multiphoton absorption and electromagnetic field effects.

The organs most susceptible to external laser radiation are the skin and eyes. The severity of injury is affected by the nature of the target, the energy density delivered to the target, the frequency and power of the laser, atmospheric attenuation of the beam, and the use of filtering or amplifying optics by the target, etc.

The primary effect on the skin is thermal damage (burns). The severity varies from slight erythema or reddening to severe blistering or charring, depending on such factors as total energy deposition, skin pigmentation, and the tissue's ability to dissipate heat.

The eye is particularly susceptible to intense pulse of laser radiation because of its unique sensitivity to light. The focusing effect is similar to that of a magnifying lens, which focuses the energy on a particular spot. Since the cornea and lens of the eye amplify the intensity of the light incident upon the retina, the retina is extremely sensitive to visible and near-infrared light, and damage to the retina may result in temporary or permanent loss of visual acuity. Laser eye injuries vary according to incident power, spot size, beam angle, temporal mode (CW or pulsed), and pulse repetition frequency. Reported effects include corneal lesions, burns, cataracts, and retinal lesions.

Some high-power lasers can cause antipersonnel effects by the deposition of thermal energy. These lasers must operate at a wavelength that is readily absorbed by the skin or the cornea. These generally include the far- and mid-IR regions (10 to 12 microns and 3 to 5 microns) as well as the ultraviolet region (<0.4 microns). However, ultraviolet wavelengths generally do not propagate well in the atmosphere, so the primary threat wavelengths to be considered are between 3 and 12 microns. Although relatively modest amounts of far-IR laser power are required to produce superficial burns on the skin at short ranges, and efforts to design rheostatically lethal laser weapons are on going.

Nonlethal blinding laser weapons generally use collimated beams with very low beam divergence, and the energy contained in the beam diminishes relatively slowly over great distances. Imaging systems such as eyes and EO vision systems have focusing optics that bring the incident plane wave of light to focus at the sensor plane. This results in a high optical gain (greater than 100,000 for eyes), which makes the associated sensor vulnerable to relatively low fluences of laser energy.

The effects of lasers on eyes are threefold:

- Dazzling or induced glare.
- Flashblinding or loss of night adaptation.
- Permanent or semipermanent blinding.

The severity of laser eye injuries varies according to the incident power, spot size, beam angle, pupil diameter (ambient light conditions), temporal mode (CW or pulsed), and PRF of the laser. Reported effects include corneal burns, cataracts (a permanent cloudiness of the lens), and retinal burns and perforations. Low-energy laser weapons are capable of causing the latter.

Exposure to relatively low laser energies can produce temporary changes in the ability to see without producing permanent injury. Exposure to laser light can produce an effect called glare or dazzle, which is similar to the temporary loss of vision experience when viewing the headlights of an oncoming car. The visual effects last only as long as the light is present in the field of view (FOV). At slightly higher energy exposures, the same laser radiation can saturate or flashblind the photoreceptor cells, resulting in after images that fade with time after exposure. Only visible radiation will induce veiling glare or after images; near-IR radiation will not produce these effects even though the radiant energy reaches the photoreceptor cells. Flashblindness and dazzle, while not permanent injuries, can cause discomfort and temporary loss of vision. Some studies have shown that dazzle and flashblindness can seriously impact mission performance, especially in highly visual tasks such as piloting an aircraft or aiming.

Blinding is the permanent or semipermanent loss of visual acuity. The effect can last from several hours onward and generally is evidenced by a dark spot in the field of vision. This spot is called a scotoma. The impact of the scotoma on visual acuity will vary with the size and position of the injury. Human vision is greatly affected when the laser damage is to the central vision area of the retina called the fovea. Nonfoveal laser damage may be less severe or even go unnoticed because it affects only the peripheral vision. The most serious retinal injuries occur when the incident light is so intense that a perforation in the retina is formed, resulting in a hemorrhage into either the subretinal layer or, in the most severe cases, the vitreous humor of the eye. Less severe exposures result in lesions on the retina.

Footnote:

1-(U) This appendix is classified FOR OFFICIAL USE ONLY in its entirety.

17

Information Cutoff Date: 17 February 1998

~~**Derived from: Multiple Sources**~~
~~**Declassify on: Source marked "OADR"**~~
~~**Date of Source: 17 February 1998**~~

~~*SECRET*~~
~~*NOFORN*~~

US Agencies; US Environmental Protection Agency (EPA) Letter to EMR Network; Jul. 6, 2002

M6

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
WASHINGTON, D.C. 20460

JUL 16 2002

OFFICE OF
AIR AND RADIATION

Ms. Janet Newton
President
The EMR Network
P.O. Box 221
Marshfield, VT 05658

Dear Ms. Newton:

This is in reply to your letter of January 31, 2002, to the Environmental Protection Agency (EPA) Administrator Whitman, in which you express your concerns about the adequacy of the Federal Communications Commission's (FCC) radiofrequency (RF) radiation exposure guidelines and nonthermal effects of radiofrequency radiation. Another issue that you raise in your letter is the FCC's claim that EPA shares responsibility for recommending RF radiation protection guidelines to the FCC. I hope that my reply will clarify EPA's position with regard to these concerns. I believe that it is correct to say that there is uncertainty about whether or not current guidelines adequately treat nonthermal, prolonged exposures (exposures that may continue on an intermittent basis for many years). The explanation that follows is basically a summary of statements that have been made in other EPA documents and correspondence.

The guidelines currently used by the FCC were adopted by the FCC in 1996. The guidelines were recommended by EPA, with certain reservations, in a letter to Thomas P. Stanley, Chief Engineer, Office of Engineering and Technology, Federal Communications Commission, November 9, 1993, in response to the FCC's request for comments on their Notice of Proposed Rulemaking (NPRM), Guidelines for Evaluating the Environmental Effects of Radiofrequency Radiation (enclosed).

The FCC's current exposure guidelines, as well as those of the Institute of Electrical and Electronics Engineers (IEEE) and the International Commission on Non-ionizing Radiation Protection, are thermally based, and do not apply to chronic, nonthermal exposure situations. They are believed to protect against injury that may be caused by acute exposures that result in tissue heating or electric shock and burn. The hazard level (for frequencies generally at or greater than 3 MHz) is based on a specific absorption dose-rate, SAR, associated with an effect

that results from an increase in body temperature. The FCC's exposure guideline is considered protective of effects arising from a thermal mechanism but not from all possible mechanisms. Therefore, the generalization by many that the guidelines protect human beings from harm by any or all mechanisms is not justified.

These guidelines are based on findings of an adverse effect level of 4 watts per kilogram (W/kg) body weight. This SAR was observed in laboratory research involving acute exposures that elevated the body temperature of animals, including nonhuman primates. The exposure guidelines did not consider information that addresses nonthermal, prolonged exposures, i.e., from research showing effects with implications for possible adversity in situations involving chronic/prolonged, low-level (nonthermal) exposures. Relatively few chronic, low-level exposure studies of laboratory animals and epidemiological studies of human populations have been reported and the majority of these studies do not show obvious adverse health effects. However, there are reports that suggest that potentially adverse health effects, such as cancer, may occur. Since EPA's comments were submitted to the FCC in 1993, the number of studies reporting effects associated with both acute and chronic low-level exposure to RF radiation has increased.

While there is general, although not unanimous, agreement that the database on low-level, long-term exposures is not sufficient to provide a basis for standards development, some contemporary guidelines state explicitly that their adverse-effect level is based on an increase in body temperature and do not claim that the exposure limits protect against both thermal and nonthermal effects. The FCC does not claim that their exposure guidelines provide protection for exposures to which the 4 W/kg SAR basis does not apply, i.e., exposures below the 4 W/kg threshold level that are chronic/prolonged and nonthermal. However, exposures that comply with the FCC's guidelines generally have been represented as "safe" by many of the RF system operators and service providers who must comply with them, even though there is uncertainty about possible risk from nonthermal, intermittent exposures that may continue for years.

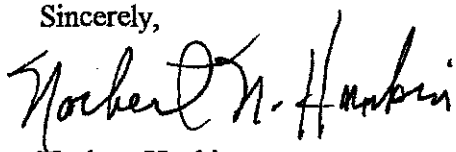
The 4 W/kg SAR, a whole-body average, time-average dose-rate, is used to derive dose-rate and exposure limits for situations involving RF radiation exposure of a person's entire body from a relatively remote radiating source. Most people's greatest exposures result from the use of personal communications devices that expose the head. In summary, the current exposure guidelines used by the FCC are based on the effects resulting from whole-body heating, not exposure of and effect on critical organs including the brain and the eyes. In addition, the maximum permitted local SAR limit of 1.6 W/kg for critical organs of the body is related directly to the permitted whole body average SAR (0.08 W/kg), with no explanation given other than to limit heating.

I also have enclosed a letter written in June of 1999 to Mr. Richard Tell, Chair, IEEE SCC28 (SC4) Risk Assessment Work Group, in which the members of the Radiofrequency Interagency Work Group (RFIAWG) identified certain issues that they had determined needed to be addressed in order to provide a strong and credible rationale to support RF exposure guidelines.

Federal health and safety agencies have not yet developed policies concerning possible risk from long-term, nonthermal exposures. When developing exposure standards for other physical agents such as toxic substances, health risk uncertainties, with emphasis given to sensitive populations, are often considered. Incorporating information on exposure scenarios involving repeated short duration/nonthermal exposures that may continue over very long periods of time (years), with an exposed population that includes children, the elderly, and people with various debilitating physical and medical conditions, could be beneficial in delineating appropriate protective exposure guidelines.

I appreciate the opportunity to be of service and trust that the information provided is helpful. If you have further questions, my phone number is (202) 564-9235 and e-mail address is hankin.norbert@epa.gov.

Sincerely,



Norbert Hankin
Center for Science and Risk Assessment
Radiation Protection Division

Enclosures:

1) letter to Thomas P. Stanley, Chief Engineer, Office of Engineering and Technology, Federal Communications Commission, November 9, 1993, in response to the FCC's request for comments on their Notice of Proposed Rulemaking (NPRM), Guidelines for Evaluating the Environmental Effects of Radiofrequency Radiation
2) June 1999 letter to Mr. Richard Tell, Chair, IEEE SCC28 (SC4) Risk Assessment Work Group from the Radiofrequency Radiation Interagency Work Group

US Agencies; EPA Letter to the FCC, Comments on FCC 93-142
Environmental Effects of RF; 1993

Thomas P. Stanley, Chief Engineer
Office of Engineering and Technology
Federal Communications Commission
Mail Stop 1300
1919 M Street, N.W.
Washington, D.C. 20554

Dear Dr. Stanley:

In accordance with its responsibilities under Section 309 of the Clean Air Act (CAA), the Environmental Protection Agency (EPA) is pleased to submit comments to the Federal Communications Commission (FCC) on the Notice of Proposed Rulemaking (NPRM), Guidelines for Evaluating the Environmental Effects of Radiofrequency Radiation, ET Docket No. 93-62. The CAA responsibilities have been delegated from the Office of Federal Activities to the Office of Radiation and Indoor Air for this specific review. This proposal, if adopted, would use the 1992 American National Standards Institute/Institute of Electrical and Electronics Engineers (ANSI/IEEE) standard to update and amend the FCC guidelines for evaluating the environmental effects of radiofrequency (RF) radiation emitted by FCC-regulated facilities on public health and safety.

The 1992 ANSI standard represents a significant revision of the earlier 1982 ANSI standard. Improvements with regard to protection are reflected in (1) the development of a 2-level exposure standard specifying maximum permissible exposure (MPE) limits for "controlled" and "uncontrolled" environments to replace the single-tier 1982 standard, and (2) the extension of the low frequency range from 300 kHz to 3 kHz to limit the possibility of low-frequency RF shock and burn. Other significant changes in the 1992 standard, however, are not improvements, in our view. Changes that allow for a two-fold increase in the MPE at high frequencies over the MPE permitted by the 1982 ANSI standard, and the application of the same MPE for both controlled and uncontrolled environments for frequencies from 15 GHz to 300 GHz are not improvements. Therefore, EPA recommends against adopting the 1992 ANSI/IEEE standard because it has serious flaws that call into question whether its proposed use is sufficiently protective of public health and safety.

To have a more protective public exposure standard, EPA recommends that the FCC instead adopt the exposure criteria

recommended earlier by the National Council on Radiation Protection and Measurements (NCRP) in their report entitled "Biological Effects and Exposure Criteria for Radiofrequency Electromagnetic Fields (NCRP 1986)." The bases for this recommendation are noted below:

a. NCRP's RF radiation exposure limits consider both workers and the public.

b. Their exposure criteria are more protective at higher frequencies.

c. There are no substantive differences in the literature base supporting both standards, except for the literature on RF shocks and burns.

d. NCRP is chartered by the U.S. Congress to develop radiation protection recommendations and is recognized as one of the leading authorities in this area.

In addition, EPA recommends that the FCC consider including limits for induced and contact RF currents for the frequency range of 300 kHz to 100 MHz to protect against shock and burn along with the FCC proposal for low-power device exclusions as modified in the attachment to this letter. The Agency believes these recommendations provide a more protective alternative to the 1992 ANSI/IEEE standard. The basis for EPA's recommendations are provided in the detailed comments in the enclosure to this letter.

Furthermore, the Agency recommends that the FCC consider requesting the NCRP to revise its 1986 report and provide an updated, comprehensive report on the biological effects of RF radiation and recommendations for exposure criteria. EPA endorses such a request as reasonable and appropriate.

In summary, EPA recommends the following:

1. The FCC should not adopt the 1992 ANSI/IEEE standard. There are serious flaws in the standard that call into question whether the proposed use of the 1992 ANSI/IEEE is sufficiently protective. The following four points address several key Agency concerns.

a. The 1992 ANSI/IEEE allows a two-fo;d increase in the MPE at high frequencies above that permitted by the current FCC guideline.

b. The two-level revised standard is not directly applicable to any population group but is applicable to exposure environments called "controlled" and "uncontrolled" environments

that are not well defined and are discretionary. The Agency disagrees with this approach.

c. The 1992 ANSI/IEEE conclusion that there is no scientific data indicating that certain subgroups of the population are more at risk than others is not supported by NCRP and EPA reports.

d. The thesis that the 1992 ANSI/IEEE recommendations are protective of all mechanisms of interaction is unwarranted because the adverse effects level in the 1992 ANSI/IEEE standard is based on a thermal effect.

2. The FCC should consider the exposure criteria recommended by the NCRP in NCRP Report No. 86, "Biological Effects and Exposure Criteria for Radiofrequency Electromagnetic Fields," with the addition of:

a. the 1992 ANSI/IEEE limits for induced and contact RF currents, for the frequency range of 300 kHz to 100 MHz, to protect against shock and burn, and

b. the FCC proposal for low power device exclusions (FCC 93-142, pp. 7-8) as the standard for the public, where the definition of "public" includes all persons using these devices unless the user is operating a device as a concomitant of employment.

3. The FCC should consider requesting the NCRP to revise its 1986 report to provide an updated, comprehensive review of the biological effects on RF radiation and recommendations for exposure criteria.

More specific comments are enclosed for your consideration. We appreciate the opportunity to comment on the the FCC proposal. If you have any questions concerning EPA's comments, please feel free to contact Norbert Hankin in the Radiation Studies Branch at (202) 233-9235.

Sincerely,

Margo T. Oge
Director, Office of Radiation
and Indoor Air

Enclosure

Environmental Protection Agency (EPA) Comments to the Federal Communications Commission (FCC) on FCC 93-142, April 1993, Notice of Proposed Rulemaking; Guidelines for Evaluating the Environmental Effects of Radiofrequency Radiation.

Introduction

The FCC currently uses the 1982 ANSI (American National Standards Institute, Inc.) radiofrequency (RF) radiation guidelines for evaluating the environmental effects, particularly on public health and safety, of RF radiation emitted by FCC regulated facilities. In November 1992, ANSI adopted a revised standard now known as ANSI/IEEE C95.1-1992 (IEEE Standard for Safety Levels with Respect to Human Exposure to Radio Frequency Electromagnetic Fields, 3 kHz to 300 GHz, IEEE C95.1-1991). The FCC now proposes to amend and update the guidelines and methods that it uses to evaluate the environmental effects of RF radiation by adopting the new ANSI/IEEE standard. The 1992 recommendations contain a number of significant changes when compared to the 1982 single-level guideline based on a 10-fold safety factor. The revised guideline is a two-level standard, i.e., it contains two sets of exposure limits, one for the controlled environment and one for the uncontrolled environment, incorporating safety factors of 10 and 50, respectively. Another change is the extension of the frequency range from 300 kHz - 100 GHz to 3 kHz - 300 GHz. In addition, 1992 ANSI/IEEE allows a two-fold increase in the MPE at high frequencies above that permitted by the 1982 ANSI standard.

EPA welcomes the opportunity to comment on the FCC proposal and to address the complexity and what we believe are the limitations of ANSI/IEEE C95.1-1992. EPA review of 1992 ANSI/IEEE leads us to believe that it is a standard with flaws that cast doubt about whether it is sufficiently protective of public health and safety, and its claim that "the recommended exposure levels should be safe for all."

EPA comments on the FCC proposed standard address: derivation of standards; the claim of protection for all persons from all interaction mechanisms; controlled and uncontrolled environments; database limitations; modulation; low-power devices; and, other contemporary exposure standards.

Discussion

Approach to Derivation of Standards

The rationale provided in ANSI/IEEE to explain fundamental characteristics of the 1992 ANSI/IEEE guidelines, in many cases, lacks explanation, consistency, and well-founded justifications. In addition, there is concern that the complexity of the 1992 ANSI/IEEE standard may make it difficult to comply with or effectively enforce.

No explanation is given for the decision to employ safety factors of 10 and 50; there is no discussion that supports the introduction of the standard for the "uncontrolled" environment. In fact, the stated conclusion that "the recommended exposure levels should be safe for all" (at the controlled environment working basis of 0.4 W/kg) and the support given for this conclusion in the standard's rationale constitute an argument for a single-tier, not a two-tier standard. The addition of the second level of protection for exposure in an

uncontrolled environment with the application of an additional safety factor is done without any justification.

When available, human data is preferable to laboratory animal data in standards development. Therefore we consider the 1992 ANSI/IEEE guidelines to be deficient in this area because reports published after 1986 that presented human data were not considered. We would expect that future efforts to develop or update RF radiation standards would include analysis of available human thermophysiological information and models.

Claim of Protection for All Persons from All Interaction Mechanisms

The new ANSI/IEEE standard states that the "intent was to protect human beings from harm by any mechanism, including those arising from excessive elevations of body temperature" (IEEE p.27), i.e., the 1992 ANSI/IEEE standard is purported to be protective of all persons and all interaction mechanisms. We believe that this position has not been supported, as shown by the following discussion.

In the 1992 ANSI/IEEE standard, as well as in the 1986 NCRP guidelines, the biological basis for maximum permissible exposure level varies with frequency. In the frequency range from 100 kHz to 6 GHz, maximum permissible exposure levels are based on whole-body averaged SAR (specific absorption rate expressed in watts per kilogram of body mass, W/kg). More specifically, the working threshold for unfavorable biological effects in human beings in the frequency range from 100 kHz to 6 GHz is defined as 4 W/kg. Safety factors of 10 and 50 were used to derive the maximum permissible exposures for controlled and uncontrolled environments, respectively.

This adverse effect level for human beings, 4 W/kg, is the threshold for a specific biological effect, i.e., behavioral disruption (work stoppage) in nonhuman primates that is associated with an increase in body temperature. Work stoppage, the failure of a food-deprived animal to perform a learned task to gain a food reward, is interpreted to result from thermal stress, caused by the absorption of RF energy, that is sufficiently severe to deter hungry animals from working for food.

Since the ANSI/IEEE hazard level is an SAR associated with an effect resulting from a known mechanism of interaction (RF heating) that is associated with an increase in body temperature (as is the NCRP hazard level), the ANSI/IEEE C95.1-1992 standard is based on a thermal effect of RF radiation and, by extension, is protective of effects arising from a thermal mechanism, but not from all possible mechanisms. Therefore, the generalization that 1992 ANSI/IEEE guidelines protect human beings from harm by any mechanism is not justified.

In contrast to the 1992 ANSI/IEEE standard, 1986 NCRP states that a response to RF radiation may have a "thermal basis, an athermal basis, or a combined basis," and that a "determination of which of these three classes of causation is operative in a given context rests upon appropriate experimentation and inference, not presumption." NCRP

also claims that there is "no intent to define exposure criteria solely in terms of SAR," and that "consideration is also given to other factors where appropriate." These factors include, among others, possible modulation- and carrier-frequency specific biological responses.

Exposure Environments - Controlled and Uncontrolled

EPA believes that the proper approach in defining exposure environments to which guidelines are applied should be in terms of the populations to be protected, i.e., the traditionally defined populations being workers and the public. However, the ANSI/IEEE standard takes a different approach.

The 1992 ANSI/IEEE standard recommends exposure limits for a controlled environment and an uncontrolled environment. Controlled environments are defined as locations where exposure may be incurred by persons who are aware of the potential for exposure or as the result of transient passage. Uncontrolled environments are locations where exposures may be incurred by persons who are unaware of the potential for exposure. In the uncontrolled environment, an additional safety factor is applied for exposure in the resonant frequency range and for low-frequency exposure to electric fields. As defined in the standard, controlled environments are discretionary, i.e., identification of controlled environments is at the discretion of the operator of a source (see IEEE, p. 9, footnote 1).

The 1992 ANSI/IEEE standard states clearly that the distinction between the two exposure environments is based on the nature of the exposure environment and not on the population type (see IEEE 1991, p. 23). ANSI/IEEE does not allow for any variation in sensitivity to RF radiation. It states that there is no reliable evidence that certain subgroups of the population [such as infants, aged, ill and disabled, persons dependent on medication, persons in adverse environmental conditions (excessive heat and/or humidity), voluntary vs. involuntary exposure] are more at risk than others (IEEE 1991, p. 23). This conclusion is not in agreement with conclusions in the EPA report "Biological Effects of Radiofrequency Radiation" (EPA 600/8-83-026F, 1984) or in the NCRP Report No. 86, "Biological Effects and Exposure Criteria for Radiofrequency Electromagnetic Fields" that the general population has groups of individuals particularly susceptible to heat.

Other contemporary guidelines agree with NCRP and EPA; the Food and Drug Administration (FDA) 1988, National Radiological Protection Board (NRPB) 1991, International Radiation Protection Association (IRPA) 1991, and the International Electrotechnical Commission (IEC) 1993, guidelines define groups of people who are less heat tolerant than others. These include the elderly, infants, pregnant women, and people who are obese, have hypertension, or take drugs such as diuretics, tranquilizers, sedatives, or vasodilators that decrease heat tolerance.

The basis for the ANSI/IEEE guideline in the frequency range of 0.1 MHz to 6.0 GHz, the frequency range in which most of FCC licensed transmitters operate, is an effect due to RF heating. Since, as mentioned above, the general population contains individuals

particularly susceptible to heat, we recommend against the use of controlled and uncontrolled environments and recommend consideration of 1986 NCRP as a means of avoiding this problem.

We strongly disagree with the use of the concepts of control and awareness in the discretionary manner presented in 1992 ANSI/IEEE. In the standard there are no firm rules given to differentiate between controlled and uncontrolled environments, and therefore the concept will be difficult to apply because people seldom agree on discretionary areas of exposure. The standard could be applied arbitrarily and inconsistently since ANSI/IEEE does not impose conditions to describe or create the state of awareness. An individual's degree of awareness could vary from complete understanding of RF sources to only a vague awareness that RF radiation exists in his controlled environment.

If awareness in a controlled environment can vary from complete knowledge to almost no knowledge, then the degree of control over safety is uncertain. Unspecified awareness in itself does not constitute a controlled situation. A controlled environment could be established with measures imposed to ensure strict adherence to the standard to prevent the possibility for exposure of any individual in the controlled environment to exposures greater than recommended by the standard. However, 1992 ANSI/IEEE does not recommend the actions that should be taken to establish a controlled environment, and if it would, it could not provide the authority for control. In our view, "awareness" is not equivalent to protection.

The FCC proposal (paragraph 13) presents a reasonable way to apply the guidelines to the public that is more consistent with traditional definitions of workers and the public. This is also the method used in the 1986 NCRP exposure criteria. NCRP recognizes that there is variability in human response, that there are categories of individuals with susceptibilities that place them at greater risk for potential harm, and that workers, who may be relatively well informed of potential hazards of RF radiation exposure, may have the opportunity to make personal decisions in regard to their exposure. Therefore it is appropriate for the FCC to adopt this approach to apply the more conservative guidelines where there is any question of possible exposure of the general public (which might also include nontechnical employees) to RF radiation, and to apply the more restrictive exposure limits to any transmitters and facilities that are located in residential areas or locations where the RF source may be accessible to the public. We suggest that the phrase "accessible to the public" replace the word "unrestricted" in the FCC proposal because the former phrase more accurately describes the locations.

Limitations of data

Availability of chronic exposure information

It is clear that the adverse effect threshold of 4 W/kg is based on acute exposures (measured in minutes or a few hours) that elevate temperature in laboratory animals including nonhuman primates, and not on long-term, low-level (non-thermal) exposure. Only a few chronic exposure studies of laboratory animals and epidemiological studies of human populations have been reported. The majority of these relatively

few studies indicate no significant health effects are associated with chronic, low-level exposure to RF radiation. This conclusion is tempered by the results of a small number of reports suggesting potentially adverse health effects (cancer) may exist (e.g., Szmigielski - Bioelectromagnetics 1982; Chou - Bioelectromagnetics 1992; Milham - NEJM 1982, Lancet 1985, Am. J Epid. 1988). A determination of the significance of such potential adverse effects awaits independent confirmation of the experimental results.

The limitations of the data used to define the adverse effect level in the 1992 ANSI/IEEE recommendations do not support the claim that the recommended MPEs in 1992 ANSI/IEEE are protective of all mechanisms and all people.

Publication Cut-off Date

The 1992 ANSI/IEEE standard is based on literature published before 1986, except for a few papers on RF shock and burn. The cut-off date for the literature review supporting the NCRP recommendations is 1982. Even though the 1992 ANSI/IEEE guidelines had more recent data for consideration than did 1986 NCRP, the recommendations are basically similar for the resonant frequency range in that both use work stoppage at 4 W/kg as the adverse effect basis for standard setting and also safety factors of 10 and 50 to establish two levels of MPE. Therefore it cannot be argued that the 1992 ANSI/IEEE standard is preferable because it is based on more recent information except for the recommendations on shock and burn. Although the Agency believes the ANSI/IEEE standard to be generally deficient, EPA concurs with the FCC proposal to adopt the 1992 ANSI/IEEE standard with respect to exposure limitations for shock and burn.

Extremely Low Frequency (ELF)-Modulated RF Radiation

As noted in the FCC proposal (paragraph 25), the NCRP guidelines include a special provision with respect to exposure of workers to RF carrier frequencies modulated at ELF frequencies. This recommendation is apparently based on experimental results showing neurophysiological effects of modulated fields. The modulation provision for workers in the NCRP guidelines is unique; no other RF exposure guideline contains such a provision. For certain modulation conditions, the exposure criteria for occupational exposures is the generally 10-fold more stringent general population exposure criteria.

While studies continue to be published describing biological responses to nonthermal ELF-modulated RF radiation, the effects information is not yet sufficient to be used as a basis for exposure criteria to protect the public against adverse human health effects.

Pulse-modulated vs. continuous-wave (CW) RF radiation

Many other studies provide evidence that nonthermal modulated-RF exposures produce effects that are not produced by CW (unmodulated) RF radiation. Meaningful studies of biological and health effects of nonthermal, pulse-modulated RF radiation exist including studies that show injury to the eye (Kues et al., Johns Hopkins Applied Physics Laboratory (JHAPL). The significance of these results, even at the early stages of this continuing research, was responsible for the

development and adoption of an RF radiation exposure standard by JHAPL (in 1984) for their personnel. The JHAPL MPE for frequencies from 30 MHz to 100 GHz is 0.1 mW/cm^2. This standard provided the basis for the 0.1 mW/cm^2 action level used to protect personnel from harm from RF radiation-generating equipment at the Hughes Aircraft Company. The JHAPL MPE is a factor of 100 times more stringent than the 1992 ANSI/IEEE MPE for controlled environments for the frequency range of 3.0 GHz and above.

Pulse-modulated RF radiation can produce a response that is called "microwave hearing". This effect seems well established and probably results from very rapid thermoelastic expansion of the brain, creating a sound wave in the head. Conditions under which the auditory effect can be invoked in people with normal hearing should be avoided according to the National Radiological Protection Board (NRPB) draft recommendations for workers and the public. In contrast to this recommendation, the 1992 ANSI/IEEE standard states that the human auditory effect is clearly not deleterious; it recommends a limit for pulsed radiation that is well above the threshold for the auditory effect.

Low-power Devices

We recommend that the two population groups, workers and the public, be used in the following suggested modifications to the FCC proposal regarding exposure to hand-held devices and amateur radio facilities (see FCC 1993, p.6, footnote 16). Non-users exposed to hand-held devices and amateur radio facilities should be considered as the public. Users of hand-held devices and amateur radio facilities should be considered as the public unless the user is operating a device as a concomitant of employment. This recommendation is based on the difficulty of differentiating between individuals who are cognizant or noncognizant of the potential for RF exposure and is consistent with the NCRP recognition of the two population groups, workers and the public. If NCRP is used, the problem of differentiating between cognizant workers and cognizant public would be avoided, and it would not be necessary to distinguish between users and non-users.

Other Contemporary Radiofrequency Radiation Guidelines

In addition to the differences identified and discussed between the 1992 ANSI/IEEE standard and the 1986 NCRP recommendations, there are significant differences between 1992 ANSI/IEEE and other contemporary RF radiation exposure guidelines, including those of the Food and Drug Administration (FDA), National Radiological Protection Board (NRPB), International Radiation Protection Association (IRPA), the International Electrotechnical Commission (IEC), and the Johns Hopkins Applied Physics Laboratory (JHAPL). The comments in this section address some of the differences.

The 1992 ANSI/IEEE guidelines are based on literature published before 1986 except for several papers on shock and burn. Other contemporary recommendations use more recent information and appear to be strongly influenced by clinical and modeling data describing thermoregulatory responses of patients and volunteers exposed in magnetic resonance imaging devices. As noted, the 1992 ANSI/IEEE adverse-effects level is based only on laboratory animal data.

The 1992 ANSI/IEEE standard claims that the recommendations protect against harm by any mechanism, that is, both thermal and nonthermal. It contends that chronic exposure data and information on nonthermal interactions are not meaningful for standards development. While there is general, although not unanimous, agreement that the data base on low-level, long-term exposure is insufficient to provide a basis for standards development, some contemporary guidelines state explicitly that their adverse-effect level is based on an increase in body temperature (NRPB 1993). Furthermore, they do not claim that the exposure limits protect against both thermal and nonthermal effects. EPA does not agree with the claim that the 1992 ANSI/IEEE guidelines protect against effects of any mechanism; we believe that the only claim that can be made is that the 1992 ANSI/IEEE standard applies only to thermal effects and electric shock.

Although several mechanisms of interaction of RF radiation with living systems have been proposed, the established and noncontroversial mechanism for acute exposures is heating. This is reflected in several guidelines for protection of patients from the physiological consequences of an increase in temperature due to exposure to RF radiation during magnetic resonance imaging procedures. These guidelines include: the 1988 FDA guidance, 1991 NRPB guidelines, the 1991 IRPA guidelines, and the 1993 draft IEC standard.

The 1993 NRPB draft recommendations for workers and the public state that restrictions on acute exposure to RF radiation of frequencies greater than 100 kHz are intended to avoid adverse effects resulting from whole-body and partial-body heating, and adverse effects resulting from pulsed RF radiation.

The 1992 ANSI/IEEE standard recommends limits for controlled and uncontrolled environments, using as its basis the position that the it is the nature of the exposure environment, not population type, that is important. This position is based partially on the conclusion that no reliable scientific data exists indicating that certain subgroups of the population are more at risk than others. However, other contemporary guidelines state the opposite conclusion. The FDA (1988), NRPB (1991), IRPA (1991), and the IEC (1993) guidelines define groups of people who are less heat tolerant than others. This information should be considered in development of an exposure standard.

Summary of EPA Recommendations

1. The FCC should not adopt the 1992 ANSI/IEEE standard. There are serious flaws in the standard that call into question whether the proposed use of 1992 ANSI/IEEE is sufficiently protective. The following four points address some of our concerns.

a) 1992 ANSI/IEEE allows a two-fold increase in the MPE at high frequencies above that permitted by the current FCC guideline.

b) The two-level revised standard is not directly applicable to any population group but is applicable to exposure environments called controlled and uncontrolled environments that are not well defined and are discretionary. We disagree with this approach.

c) The 1992 ANSI/IEEE conclusion that there is no scientific data indicating that certain subgroups of the population are more at risk than others is not supported by NCRP and EPA reports.

d) The thesis that the 1992 ANSI/IEEE recommendations are protective of all mechanisms of interaction is unwarranted because the adverse effects level in the 1992 ANSI/IEEE standard is based on a thermal effect.

2. The FCC should consider the exposure criteria recommended by the National Council on Radiation Protection and Measurements (NCRP) in NCRP Report No. 86, "Biological Effects and Exposure Criteria for Radiofrequency Electromagnetic Fields," with the addition of

(a) the 1992 ANSI/IEEE limits for induced and contact RF currents, for the frequency range of 300 kHz to 100 MHz, to protect against shock and burn, and

(b) the FCC proposal for low power device exclusions (FCC 93-142, pp. 7-8) as the standard for the public, where "public" includes all persons using these devices unless the user is operating a device as a concomitant of employment.

EPA recommends consideration of 1986 NCRP for the following reasons.

a) 1986 NCRP recommends RF radiation exposure limits specifically for both workers and the public.

b) 1986 NCRP is more protective than 1992 ANSI/IEEE at higher frequencies.

c) There are no substantive differences in the literature base supporting 1986 NCRP and 1992 ANSI/IEEE except for the literature on RF shocks and burns.

In addition, NCRP is chartered by the U.S. Congress to develop radiation protection recommendations.

3. The FCC should consider requesting that the NCRP revise its 1986 report to provide an updated, critical, and comprehensive review of the biological effects on RF radiation and recommendations for exposure criteria.

References

EPA 1984. EPA-600/8-83-026F, Biological Effects of Radiofrequency Radiation, U.S. Environmental Protection Agency, September 1984.

FCC 1993. Notice of Proposed Rulemaking; Guidelines for Evaluating the Environmental Effects of Radiofrequency Radiation, FCC 93-142, April 1993.

FDA 1992. Current FDA Guidance for MR Patient Exposure and Considerations for the Future, T.W. Athey, In Biological Effects and

Safety Aspects of Nuclear Magnetic Resonance Imaging and Spectroscopy, R.L. Magin, R.P. Liburdy and B. Persson, Editors, Annals of the New York Academy of Sciences 649: 242-257, 1992.

IEC 1993. Medical Electrical Equipment, Part 2: Particular Requirements for the Safety of Magnetic Resonance Equipment for Medical Diagnosis, International Electrotechnical Commission (IEC), Sub-Committee 62B Standard (Draft), March 1993, 61 pages.

IEEE 1991. IEEE Standard for Safety Levels with Respect to Human Exposure to Radio Frequency Electromagnetic Fields, 3 kHz to 300 GHz, IEEE C95.1-1991, Institute of Electrical and Electronics Engineers, Inc., 345 East 47th Street, New York, NY 10017, April 27, 1992.

IRPA 1991. Protection of the Patient Undergoing a Magnetic Resonance Examination, International Non-ionizing Radiation Committee of the International Radiation Protection Association (IRPA), Health Physics 61: 923-928, 1991.

JHAPL 1984. APL Standard for Exposure to Radio-Frequency Radiation, APL Safety Memo No. 15, Johns Hopkins Applied Physics Laboratory, October 19, 1984.

NCRP 1986. Biological Effects and Exposure Criteria for Radiofrequency Electromagnetic Fields, National Council on Radiation Protection and Measurements (NCRP), 7910 Woodmont Av, Bethesda, MD 20814, NCRP Report No. 86, April 2, 1986.

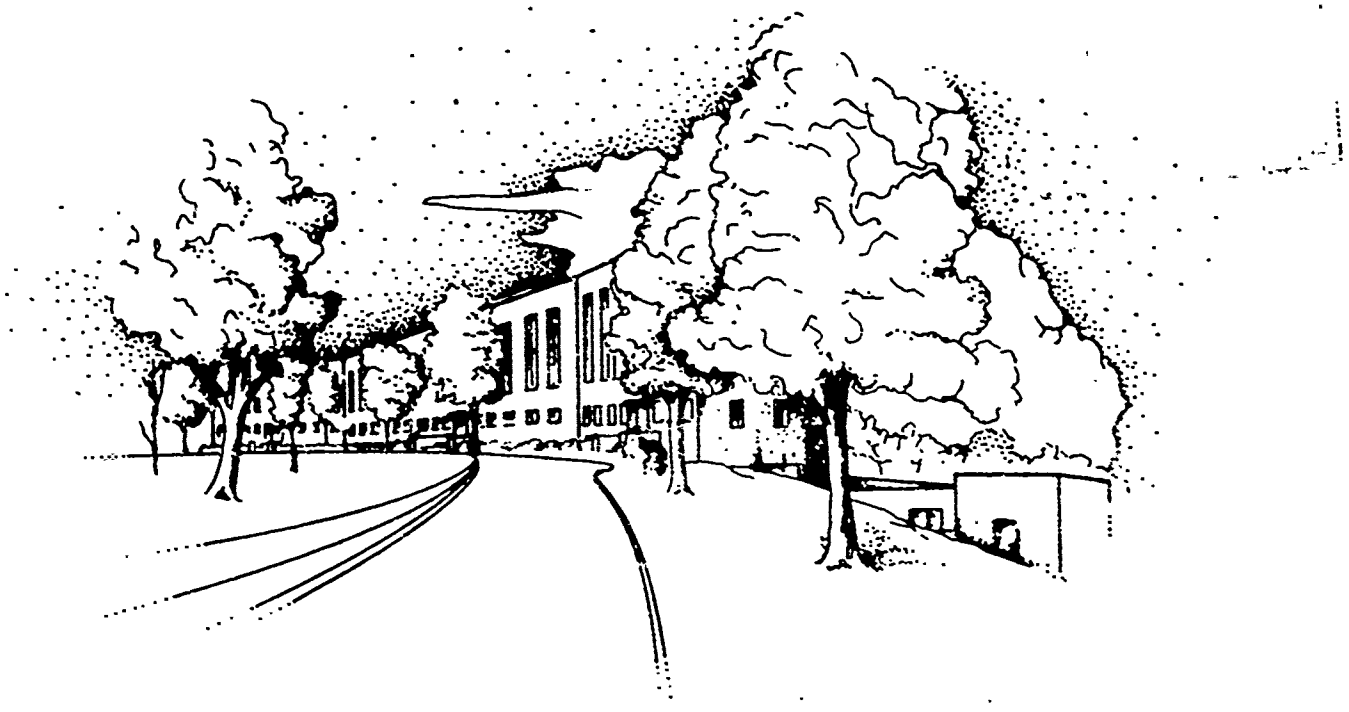
NRPB 1992. Limits on Patient and Volunteer Exposure During Clinical Magnetic Resonance Diagnostic Procedures, In Biological Effects and Safety Aspects of Nuclear Magnetic Resonance Imaging and Spectroscopy, R.L. Magin, R.P. Liburdy and B. Persson, Editors, Annals of the New York Academy of Sciences 649: 376-398, 1992.

NRPB 1993. Restrictions on Exposure to Static and Time-Varying Electromagnetic Fields and Radiation, National Radiological Protection Board (NRPB), Draft Proposal, March 1993, 14 pages.

US Agencies; US Naval Medical Research Institute. Bibliography of Reported Biological Phenomena ("Effects") and Clinical Manifestations Attributed to Microwave and Radio-frequency Radiation; 1971
(Tab 185 Part 1)

NMRI

NAVAL MEDICAL RESEARCH INSTITUTE



BIBLIOGRAPHY OF REPORTED BIOLOGICAL PHENOMENA ('EFFECTS') AND CLINICAL MANIFESTATIONS ATTRIBUTED TO MICROWAVE AND RADIO-FREQUENCY RADIATION

RESEARCH REPORT

MF12.524.015-0004B

REPORT NO. 2
REVISED

BIBLIOGRAPHY OF REPORTED BIOLOGICAL PHENOMENA ('EFFECTS') AND CLINICAL MANIFESTATIONS ATTRIBUTED TO MICROWAVE AND RADIO-FREQUENCY RADIATION

Zorach R. Glaser, Ph.D.
LT, MSC, USNR

Research Report

Project MF12.524.015-0004B, Report No. 2

Naval Medical Research Institute
National Naval Medical Center
Bethesda, Maryland 20014, U.S.A.

4 October 1971

Second Printing, with Revisions,
Corrections, and Additions: 20 April 1972
(Supersedes AD No. 734391)

ABSTRACT

More than 2000 references on the biological responses to radio frequency and microwave radiation, published up to June 1971, are included in the bibliography.* Particular attention has been paid to the effects on man of non-ionizing radiation at these frequencies. The citations are arranged alphabetically by author, and contain as much information as possible so as to assure effective retrieval of the original documents. An outline of the effects which have been attributed to radio frequency and microwave radiation is also part of the report.

*Three supplementary listings bring the number of citations to more than 2300.

Key Words

Biological Effects
Non-Ionizing Radiation
Radar Hazards
Radio Frequency Radiation
Microwave Radiation
Health Hazards
Bibliography
Electromagnetic Radiation Injury

The comments upon and criticisms of the literature made in this report, and the recommendations and inferences suggested, are those of the author, and do not necessarily reflect the views of the Navy Department or of the Naval Service.

Security Classification

DOCUMENT CONTROL DATA - R & D

(Security classification of title, body of abstract and indexing annotation must be entered when the overall report is classified)

ORIGINATING ACTIVITY (Corporate author)
NAVAL MEDICAL RESEARCH INSTITUTE
NATIONAL NAVAL MEDICAL CENTER
BETHESDA, MARYLAND 20014

2a. REPORT SECURITY CLASSIFICATION
UNCLASSIFIED

2b. GROUP

3. REPORT TITLE

BIBLIOGRAPHY OF REPORTED BIOLOGICAL PHENOMENA ('EFFECTS') AND CLINICAL MANIFESTATIONS ATTRIBUTED TO MICROWAVE AND RADIO-FREQUENCY RADIATION

4. DESCRIPTIVE NOTES (Type of report and inclusive dates)
Medical research interim report, bibliographic (Current to April 1972)

5. AUTHOR(S) (First name, middle initial, last name)

Zorach R. GLASER, Ph.D.
LT, MSC, USN

6. REPORT DATE	7a. TOTAL NO. OF PAGES	7b. NO. OF REFS
Revised 20 April 1972 (4 October 1971, Original)	~~163~~ 106	2,311

8a. CONTRACT OR GRANT NO.	9a. ORIGINATOR'S REPORT NUMBER(S)
b. PROJECT NO	MF12.524.015-0004B, Report No. 2, Revised
c.	9b. OTHER REPORT NO(S) (Any other numbers that may be assigned this report)
d.	

10. DISTRIBUTION STATEMENT
THIS DOCUMENT HAS BEEN APPROVED FOR PUBLIC RELEASE AND SALE; ITS DISTRIBUTION IS UNLIMITED.

11. SUPPLEMENTARY NOTES	12. SPONSORING MILITARY ACTIVITY
	BUREAU OF MEDICINE AND SURGERY (NAVY) WASHINGTON, D.C. 20390

13. ABSTRACT

More than 2300 references on the biological responses to radio frequency and microwave radiation, published up to April 1972, are included in this bibliography of the world literature. Particular attention has been paid to the effects on man of non-ionizing radiation at these frequencies. The citations are arranged alphabetically by author, and contain as much information as possible so as to assure effective retrieval of the original documents. Soviet and East European literature is included in detail. An outline of the effects which have been attributed to radio frequency and microwave radiation is included as Chapter 1. The revised report (which supersedes DDC report AD#734391) is updated with the inclusion of three supplementary listings, and has incorporated many corrections and additions to the original 2100 citations.

DD FORM 1 NOV 65 1473

UNCLASSIFIED
Security Classification

UNCLASSIFIED
Security Classification

14 KEY WORDS	LINK A		LINK B		LINK C	
	ROLE	WT	ROLE	WT	ROLE	WT
Biological effects						
Non-ionizing radiation						
Radar hazards						
Radio frequency radiation						
Microwave radiation						
Health hazards						
Bibliography						
Electromagnetic radiation injury						
Radiation adverse effects						

TABLE OF CONTENTS

Foreword

It is the hope of the author that this bibliography will provide guidance to the diffuse and conflicting literature on the biological responses to electromagnetic radiation at radio- and microwave-frequencies, with particular reference to the effects of concern to man. Such guidance is needed in the formulation and appraisal of criteria and limits of human exposure to "non-ionizing" radiation, and in the planning and conduct of future research.

The original plans were to categorize and key the literature citations to the "outline of biological and clinical effects" (Chapter 1). This proved to be a much more difficult and time-consuming task than anticipated, and was actually completed only for about 400 papers. Thus, the letter-number combinations given in square brackets for some of the "A" through "C" citations refer to the outline. [NV] indicates the citation was "not verified".

The standard format used throughout the bibliography is: author, (date), journal, volume, (issue): page, "title". The authors are alphabetized, and in chronological order. Multiple authors are also alphabetically ordered according to the second, third, etc., author. Inclusive pagination is given where possible, as is the original language of the citation. Report accession and translation numbers (some of which are cited in Appendix A), and alternate sources are listed when known. The title of books is underlined. When the title of the report was not available (or not given), a short (one line) description of the paper is listed whenever possible. Reports in which the name of the author was not given are listed chronologically using the format, "title", reference, source, (date). In many cases the citation was obtained from secondary (and tertiary) sources. For this reason it was impossible to put every citation into a consistent format.

In a few cases, papers have been cited which were presented at symposia or meetings devoted to the present topic, even when the report title suggests that it does not pertain directly to the topic. This has been done to show the wide range of items considered relevant (at least at the time of the meeting, and by the organizing chairman) in past years. An example is "electroanesthesia".

A few citations of marginal and/or peripheral relationship have also been included so that the reader may judge the applicability to his individual research needs. Examples are reports dealing with the biological effects of static and alternating magnetic fields, experimental techniques using radio frequency and microwave radiation (e.g., electron spin resonance, and nuclear magnetic resonance spectroscopy), and microwave exposure limits, regulations, and standards.

References for a few limited-distribution government reports are available upon request.

The author welcomes information which will correct errors and omissions (both of which no doubt exist). Copies of new papers would be greatly appreciated, and would encourage updating and revising the bibliography periodically.

ACKNOWLEDGMENTS

The assistance and support received during the preparation of this bibliography have been considerable, and I am happy to acknowledge my indebtedness and gratitude. Drs. John Keesey and Dennis Heffner, former and present Heads of the Biophysics Division, and Dr. Seymour Friess, Director of the Environmental Biosciences Department of the Naval Medical Research Institute, permitted me the opportunity to work on the bibliography, and offered frequent encouragement.

Acknowledgment is also due to many friends and associates for their helpful suggestions, comments, and loans and/or gifts of reports or other material, which have been invaluable in the course of the work. Mr. Glenn Heimer of the Naval Ship Engineering Center contributed an extensive collection of government reports and documents, many of which had not previously been cited in the open literature.

Special help in tracing and in the acquisition of relevant papers has been received from the librarians and staff members of the NMRI library: Mrs. Thelma Robinson, Mrs. Ernestine Gendleman, Mrs. Eleanor Capps, and Miss Deborah Grove. Their diligence and resourcefulness in tracing and obtaining copies of a large number of papers and reports, often in spite of incomplete and/or inaccurate citations given in other sources, enabled me to include many relevant items in the bibliography.

Mr. Christopher Dodge of the Scientific and Technical Center, Department of the Navy, provided much of the Soviet Bloc literature, linguistic and other technical assistance, and in addition offered valuable comments and encouragement throughout the preparation of this report. Especially noteworthy were the corrections and improvements suggested by Chris following his reading of the entire manuscript.

Helpful also in locating some of the Soviet literature was Mr. E. S. Serebrennikov, of the Science and Technology Division, The Library of Congress.

Credit is due Mrs. Anna Woke (of this Institute) for translating many of the German papers; to Dr. Emilio Weiss, who translated from the Italian, and to Mrs. Edith Pugh who typed many "first drafts"; also to Mrs. Rhoda Glaser for her help in many aspects of the work.

Mrs. Fannie Epstein deserves special mention for her outstanding editorial assistance, and especially for the heroic typing, organization, and checking of the entire report.

The Outline of Reported Biological Phenomena ('Effects') and Clinical Manifestations Attributed to Microwave and Radio-Frequency Radiation, is patterned after that given by R. Murray, et al., in an article entitled, "How safe are microwaves", which appeared in Non-Ionizing Radiation 1(1):7-8 (1969). Some of the "effects" were listed in the report by S. F. Cleary and W. T. Ham, Jr., entitled, "Considerations in the evaluation of the biological effects on exposure to microwave radiation", (Background document, Part I, 1969, for the Task Force on Research Planning in Environmental Health, Subtask Force on Physical Factors in the Environment). The discussion and suggestions offered by Byron McLees, Edward Finch, Lewis Gershman, and Christopher Dodge relating to the Outline are also gratefully acknowledged.

Preparation of the bibliography was supported by the Bureau of Medicine and Surgery, Department of the Navy, under work unit MF12.524.015-0004B.

CHAPTER 1

Reported Biological Phenomena ("Effects") and Some Clinical Manifestations Attributed to Microwave and Radio-Frequency Radiation (See Note)

A. Heating of Organs* (Applications: Diathermy, Electrosurgery, Electrocoagulation, Electrodesiccation, Electrotomy)

1. Whole Body (temperature regulation defects), Hyperpyrexia
2. Skin
3. Bone and Bone Marrow
4. (a) Lens of Eye (cataractous lesions - due to the avascular nature of the lens which prevents adequate heat dissipation.) (b) Corneal damage also possible at extremely high frequencies.
5. Genitalia (tubular degeneration of testicles)
6. Brain
7. Sinuses
8. Metal Implants (burns near hip pins, etc.)

The effects are generally reversible except for 4a.

B. Changes in Physiologic Function

1. Striated Muscle Contraction
2. Alteration of Diameter of Blood Vessels (increased vascular elasticity), Dilation
3. Changes in the Oxidative Processes in Tissues and Organs
4. Liver Enlargement
5. Altered Sensitivity to Drug Stimuli
6. Decreased Spermatogenesis (decreased fertility, to sterility)
7. Altered Sex Ratio of Births (more girls!)
8. Altered Menstrual Activity
9. Altered Fetal Development
10. Decreased Lactation in Nursing Mothers
11. Reduction in Diuresis (Na^+ excretion, via urine output)
12. Altered Renal Function (decreased filtration in tubules)
13. Changes in Conditioned Reflexes
14. Decreased Electrical Resistance of Skin
15. Changes in the Structure of Skin Receptors of the (a) Digestive, and (b) Blood-Carrying Systems
16. Altered Blood Flow Rate

---

* It is also reported that low levels of irradiation produce a cooling effect - "hypercompensation".

Note: These effects are listed without comment or endorsement since the literature abounds with conflicting reports. In some cases the basis for reporting an "effect" was a single or a non-statistical observation which may have been drawn from a poorly conceived (and poorly executed) experiment.

17. Alterations in the Biocurrents (EEG?) of the Cerebral Cortex (in animals)
18. Changes in the Rate of Clearance of Tagged Ions from Tissue
19. Reversible Structural Changes in the Cerebral Cortex and the Diencephalon
20. Electrocardiographic (EKG) Changes
21. Alterations in Sensitivity to Light, Sound, and Olfactory Stimuli
22. Functional (a) and Pathological (b) Changes in the Eyes: (a) decrease in size of blind spot, altered color recognition, changes in intraocular pressure, lacrimation, trembling of eyelids; (b) lens opacity and coagulation, altered tissue respiration, and altered reduction-oxidation processes
23. Myocardial Necrosis
24. Hemorrhage in Lungs, Liver, Gut, and Brain } At Fatal Levels
25. Generalized Degeneration of all Body Tissue } of Radiation
26. Loss of Anatomical Parts
27. Death
28. Dehydration
29. Altered Rate of Calcification of Certain Tissue

C. Central Nervous System Effects

1. Headaches
2. Insomnia
3. Restlessness (Awake and During Sleep)
4. Electroencephalographic (EEG) Changes
5. Cranial Nerve Disorders
6. Pyramidal Tract Lesions
7. Conditioned Reflex Disorders
8. Vagomimetic Action of the Heart; Sympaticomimetic Action
9. Seizures, Convulsions

D. Autonomic Nervous System Effects

1. Neuro-vegetative Disorders (e.g., alteration of heart rhythm)
2. Fatigue
3. Structural Alterations in the Synapses of the Vagus Nerve
4. Stimulation of Parasympathetic Nervous System (Bradycardia), and Inhibition of the Sympathetic Nervous System

E. Peripheral Nervous System Effects

Effects on Locomotor Nerves

F. Psychological Disorders ("Human Behavioral Studies") - the so-called "Psychophysiologic (and Psychosomatic) Responses"

1. Neurasthenia - (general "bad" feeling)
2. Depression
3. Impotence
4. Anxiety
5. Lack of Concentration
6. Hypochondria
7. Dizziness
8. Hallucinations
9. Sleepiness
10. Insomnia
11. Increased Irritability
12. Decreased Appetite
13. Loss of Memory
14. Scalp Sensations
15. Increased Fatigability
16. Chest Pain
17. Tremor of the Hands

G. Behavioral Changes (Animal Studies)

Reflexive, Operant, Avoidance, and Discrimination Behaviors

H. Blood Disorders

(V = in vivo)
(v = in vitro)

Changes in:

1. Blood and Bone Marrow
2. Phagocytic (polymorphs) and Bactericidal Functions of Blood (V,v)
3. Hemolysis Rate (increase), (a shortened lifespan of cells)
4. Sedimentation Rate (increase), (due to changes in serum protein levels or amount of fibrinogen (?))
5. Number of Erythrocytes (decrease), also number of Lymphocytes
6. Blood Glucose Concentration (increase)
7. Blood Histamine Content
8. Cholesterol and Lipids
9. Gamma (also α and β) Globulin, and Total Protein Concentration
10. Number of Eosinophils
11. Albumin/Globulin Ratio (decrease)
12. Hemopoiesis (rate of formation of blood corpuscles)
13. Leukopenia (increase in number of white cells), and Leukocytosis
14. Reticulocytosis

I. Vascular Disorders

1. Thrombosis
2. Hypertension

J. Enzyme and Other Biochemical Changes

Changes in activity of:
1. Cholinesterase (V,v)
2. Phosphatase (v)
3. Transaminase (v)
4. Amylase (v)
5. Carboxydismutase

6. Protein Denaturation
7. Toxin, Fungus, and Virus Inactivation (at high radiation dose levels), Bacteriostatic Effect
8. Tissue Cultures Killed
9. Alteration in Rate of Cell Division
10. Increased Concentration of RNA in Lymphocytes, and Decreased Concentration in Brain, Liver, and Spleen
11. Changes in Pyruvic Acid, Lactic Acid, and Creatinine Excretions
12. Change in Concentration of Glycogen in Liver (Hyperglycemia)
13. Alteration in Concentration of 17- Ketosteroids in Urine

K. Metabolic Disorders

1. Glycosuria (sugar in urine; related with blood sugar?)
2. Increase in Urinary Phenol (derivatives? DOPA?)
3. Alteration of Rate of Metabolic Enzymatic Processes
4. Altered Carbohydrate Metabolism

L. Gastro-Intestinal Disorders

1. Anorexia (loss of appetite)
2. Epigastric Pain
3. Constipation
4. Altered Secretion of Stomach "Digestive Juices"

M. Endocrine Gland Changes

1. Altered Pituitary Function
2. Hyperthyroidism
3. Thyroid Enlargement
4. Increased Uptake of Radioactive Iodine by Thyroid Gland
5. Altered Adrenal Cortex Activity
6. Decreased Corticosteroids in Blood
7. Decreased Glucocorticoidal Activity
8. Hypogonadism (usually decreased testosterone production)

N. Histological Changes

1. Changes in Tubular Epithelium of Testicles
2. Cross Changes

O. Genetic and Chromosomal Changes

1. Chromosome Aberrations (e.g., linear shortening, pseudochiasm, diploid structures, amitotic division, bridging, "sticky" chromosomes, irregularities in chromosomal envelope)
2. Mutations
3. Mongolism
4. Somatic Alterations (changes in cell not involving nucleus or chromosomes, cellular transformation)
5. Neoplastic Diseases (e.g., tumors)

P. Pearl Chain Effect (Intracellular orientation of subcellular particles, and orientation of cellular and other (non-biologic) particles)

Also, orientation of animals, birds, and fish in electromagnetic fields

Q. Miscellaneous Effects

1. Sparking between dental fillings
2. Peculiar metallic taste in mouth
3. Changes in Optical Activity of Colloidal Solutions
4. Treatment for Syphilis, Poliomyelitis, Skin Diseases
5. Loss of Hair
6. Brittleness of Hair
7. Sensations of Buzzing Vibrations, Pulsations, and Tickling About the Head and Ears
8. Copious Perspiration, Salivation, and Protrusion of Tongue
9. Changes in the Operation of Implanted Cardiac Pacemakers
10. Changes in Circadian Rhythms

CHAPTER 2

BIBLIOGRAPHY OF REPORTED BIOLOGICAL PHENOMENA ('EFFECTS') AND CLINICAL MANIFESTATIONS ATTRIBUTED TO MICROWAVE AND RADIO-FREQUENCY RADIATION

1. AARONSON, T. (1970) Environment 12(4):2-10, "Mystery" [A good review article]

2. ABRAMSON, E. I., BELL, Y., REJAL, H., TUCK, S., BURNETT, C., & FLEISCHER, C. J. (1960) Amer. J. of Physical Med. 39:87-95, "Change in blood flow, oxygen, uptake, and tissue temperatures produced by therapeutic physical agents, II. Effect of shortwave diathermy" [A2, B2, B3, B16]

3. ABRAMSON, D. I., HARRIS, A. J., BEACONSFIELD, P., & SCHROEDER, J. M. (1957) Arch. of Physical Med. 38:369-376, "Changes in peripheral blood flow produced by shortwave diathermy" (I) [B16, I2]

4. ABRIKOSOV, I. A. (1954) Dissertation, Moscow, "The Impulse UHF Field in Experimental and Clinical Practice" (NV)

5. ABRIKOSOV, I. A. (1955) Theses of Reports of the Scientific Session of the State Sci. Res. Inst. of Physiotherapy, Moscow, pp. 28-29, "The Action of a Pulsed Electric UHF Field on the Organism" (NV)

6. ADDINGTON, C. H., FISCHER, F. P., NEUBAUER, R. A., OSBORN, C., SARKEES, Y. T., & SWARTZ, G. (1958) Proc. 2nd Tri-service Conf. on Biological Effects of Microwave Energy (Pattishall, E. G., & Banghart, F. W., eds.) 2:189-201, "Review of the work at University of Buffalo - Studies of the biological effects of 200 megacycles: I. Electrical facilities and instrumentation; II. Ophthalmological studies"

7. ADDINGTON, C. H., NEUBAUER, R. A., OSBORN, C., SWARTZ, G., FISCHER, F. P., & SARKEES, Y. T. (1959) Proc. 3rd Tri-service Conf. on Biological Effects of Microwave Radiating Equipments (Susskind, C., ed.) 3:1-9, "Biological effects of microwave energy at 200 megacycles upon the eyes of selected mammals" [A4, B22]

8. ADDINGTON, C. H., OSBORN, C., SWARTZ, G., FISCHER, F. P., & SARKEES, Y. T. (1959) Proc. 3rd Tri-service Conf. on Biological Effects of Microwave Radiating Equipments (Susskind, C., ed.) 3:10-14, "Thermal effects of 200 megacycles (cw) irradiation as related to shape, location, and orientation in the field"

9. ADDINGTON, C. H., OSBORN, C., SWARTZ, G., FISCHER, F. P., NEUBAUER, R. A., & SARKEES, Y. T. (1961) Proc. 4th Tri-service Conf. on the Biological Effects of Microwave Radiation, Vol. 1 (Peyton, M. F., ed.) pp. 177-186, "Biological effects of microwave energy at 200 mc"

10. ADLER, E., & MAGORA, A. (1955) Amer. J. of Physical Med. 34:521-, "Experiments on the relation between shortwave irradiation and the pituitary cortical adrenal system" [M1]

11. AFANAS'YEV, B. G., (1968) Voyenno-Meditsinskiy Zh. (1):73-74, "The functional condition of the adrenal cortex in ship specialists who are subjected to the action of a super-high frequency EM field" [M5]

12. AKOYUNOGLOU, G. (1964) Nature (London) 202(4931):452-, "Effect of a magnetic field on carboxydismutase" [J]

13. ALBRECHT, W. (1935) Arch. of Physical Therapy 16:634 only, (Abstr. from: Zeitschrift fur Gesamte Experimentale Med. 93:816-, (Jun 1934)), "Development and form of shortwave thermal zones in an agar body" [A]

14. ALEKSEYENKO, N. YU. (1956) In: Materialy po evolyutsionnoy fiziologii. Simpozium (Materials on evolutionary physiology. Symposium), Moscow, Leningrad, 1:7-, [Title not given] [A UHF field evoked changes in muscle function of frogs]

15. ALEYEV, A. M., YELANTSEVA, V. R., & DZHUMAGALIYEV, M. (1961) Zdravookhraneniye Kazakhstana (Public Health of Kazakhstan) (4):75-78, (JPRS 9713), "Effect of a VHF-HF field on the course of experimental echinococcus" [B, J]

16. ALLAM, D. S. (1969) J. Microwave Power 4(2):108-114, "Conference Report: Radio and microwave radiations, applications, and potential hazards"

17. ALM, H. (1958) (In German) Berliner Medizinische Verlagsanstalt G.m.b.H, Berlin, 174 pages, Introduction to Microwave Therapy

18. ALTABASHEVA, V. P., & IL'YASHEVICH, M. I. (1934) Biulleten Gosudarstvennogo Tsentral'nogo Instituta Sechenova (Bull. of the State Central Institute of Sechenova) (4-5), "The effects of the action of short waves on the morphology and the physical and chemical behavior of the blood of the rabbit"

19. ALTMAN, C. (1969) Zoologischei Anzeiger, Germany, 32(Suppl):416-430, (In German) "The physiological effect of electric fields on animals"

20. AMER, N. (1956) Proc. Institute of Radio Engineers 44:2A-, "An observation on the detection by the ear of microwave signals" [Q7]

21. ANDRIYASHEVA, N. M. (1937) In: The Biological Action of VHF-HF-Ultrashort Waves (Kupalov, P. S., & Frenkel, G. L., eds.), All Union Institute of Experimental Medicine, Moscow, pp. 373-379, "Occupational hazard of VHF-HF and the preventive measures"

22. ANIKIN, M. M., & RUMYANTSOVA-RUSSKIKH, M. V. (1961) J. of Neuropathology and Psychiatry imeni S.S. Korsakov 61(8):1122-1128, "High frequency currents in the treatment of poliomyelitis in adults" [Q4]

23. ANNE, A., SAITO, M., SALATI, O. M., & SCHWAN, H. P. (1961) Proc. 4th Tri-service Conf. on the Biological Effects of Microwave Radiation, Vol. 1 (Peyton, M. F., ed.) pp. 153-176, "Relative microwave absorption cross sections of biological significance"

24. ANNE, A., SAITO, M., SALATI, O. M., & SCHWAN, H. P. (1962), Univ. of Penna. Rpt. No. 62-13, 125 pages, RADC-TDR-62-244, (AD 284981), "Penetration and thermal dissipation of microwaves in tissues" [A]

25. ANNE, A., SALATI, O. M., & SCHWAN, H. P. (1961) Digest of the 4th Internat. Conf. on Medical Electronics, Biological Effects of Microwaves I (Athermal Aspects), (Frommer, P. L., ed.) Plenum Press, New York, p. 153, "Relative microwave absorption cross section of mankind"

26. ANNE, A., & SCHWAN, H. P. (1963) (From: Ph.D. Dissertation of A. Anne, Univ. of Penna., "Scattering and absorption of microwaves by dissipative dielectric objects: The biological significance and hazards to mankind"

27. ANTONOV, G. S. (1964) Voprosy Kurortologii, Fizioterapii, i Lechebnoy Fizicheskoy Kul'tury (Problems in Health Resort Science, Physiotherapy and Medical Physical Culture) Moscow, __(6):513-518, (JPRS 29384), "Combined treatment of pustulous skin diseases with ultra-high frequency electric field and staphylococcal anti-phagin electrophoresis" [B2, B16, B28, H2, H10, H13, H14, J6, Q4]

28. ARONOVA, S. B. (1955) Theses of Reports, Sci. Session of the State Sci. Res. Inst. of Physiotherapy, Moscow, "Comparative action of a pulse and continuous UHF field on the arterial pressure" [B16, I2] (NV)

29. ASANOVA, T. P., et al. (1963) Materials of the Sci. Session Concerned with the Work of the Institute of Industrial Hygiene and Occupational Diseases for 1962-1962, Leningrad, pp. 52-54, "The problem of the effect of high voltage industrial frequency electric frequency field on the organism of workers" (NV)

30. ASANOVA, T. P., & RAKOV, A. N. (1966) Gigiena Truda i Professional'nye Zabolevaniya, USSR, __(5):50-53, "The health of workers exposed to high voltage (400 to 500 KV) electric fields" (NV)

31. ASCHOFF, J. (1969) Aerospace Med. 40(8):844-849, "Desynchronization and resynchronization of human circadian rhythms" [Q10]

32. ASTANIN, P. P. (1937) In: The Biological Action of VHF-HF-Ultrashort Waves, (Kupalov, P. S., & Frenkel, G. L., eds.), All Union Institute of Experimental Medicine, Moscow, [Title not given] (NV)

33. ATANELISHVILLI, E. V. (1965) Soobshcheniya Akademia nauk Gruzinskoi SSR 37(2):453-458, "Changes in the functional state of the CNS in patients with resected stomachs during various physiotherapeutical procedures" [B, C] (NV)

34. AUSTIN, G. N., & HORVATH, S. M. (1949) Amer. J. Medical Sci. 218:115-, "Production of convulsions in rats by exposure to ultrahigh frequency electrical currents (radar)" [C9]

35. AUSTIN, G. N., & HORVATH, S. M. (1954) Amer. J. of Physical Med. 33:141-149, "Production of convulsions in rats by high frequency electrical currents" [A6, C9]

36. BABAKHANOV, P. V. (1948) Sbornik Voprosy Eksperimental'noy Fisioterapii (Tashkent) 10:95-, "Influence of various dosages of electrical fields of UHF on the isolated rabbit's heart" [B20, D1] (NV)

37. BABITSKII, E. L. (1966) Vrachebnoe Delo 1:143-, "Ultra high frequency therapy of patients with peptic ulcer" (NV)

38. BACH, S. A. (1965) Federation Proceedings, Supp. #14, S22-, "Biological sensitivity to radio-frequency and microwave energy" [H9, J4, J6]

39. BACH, S. A. (1961) Digest of the 4th Internat. Conf. on Medical Electronics, Biological Effects of Microwaves I (Athermal Aspects), (Frommer, P. L., ed.) "Changes in macromolecules produced by alternating electrical fields" [J4, J6]

40. BACH, S. A., BALDWIN, M., & LEWIS, S. A. (1959) Proc. 3rd Tri-service Conf. on Biological Effects of Microwave Radiating Equipments (Susskind, C., ed.) 3:82-93, "Some effects of ultrahigh frequency energy on primate cerebral activity" [C]

41. BACH, S. A., BROWNELL, A. S., LUZZIO, A. J., & SPOERL, E. S. (1960) U. S. Army Medical Res. Lab., Ft. Knox, Ky., Progress Rpt. CSCRD, 16 July 1959 to June 1960, pp. 12-16, (AD 239186), "Biomedical effects of microwave radiation" [H9, J6]

42. BACH, S. A., LUZZIO, A. J., & BROWNELL, A. S. (1961) Proc. 4th Tri-service Conf. on the Biological Effects of Microwave Radiation, Vol. 1 (Peyton, M. F., ed.) pp. 117-133, "Effects of radio frequency energy on human gamma globulin" [H9]

43. BACH, S. A. LUZZIO, A. J., & BROWNELL, A. S. (1961) J. of Medical Electronics 1(1):9-14, "Effects of RF energy on human gamma globulin" [H9]

44. BACH, S. A., & ROSENBAUM, J. C. (1965) In: U. S. Army Medical Res. Lab. Progress Rpt, (AD 470368), pp. 31-32, "Radio frequency effects on enzyme systems" [J5]

45. BACHEM, A. (1935) Arch. of Physical Therapy 16:645-650, "A selective heat production by ultrashort (Hertzian) waves" [A1, A2, A3]

46. BADENOCH, A. W. (1945) British Medical J. 2:601-603, "Descent of the testes in relation to temperature" [A]

47. BAGBY, R. B. (1960) Prepared by Bell Telephone Labs., N. Y., N. Y., Case #27675-2, (AD 244137), "Improved NIKE-HERCULES - personnel safety - microwave radiation", Memorandum for File

48. BAILEY, P. (1959) Aviation Week _:29-30 (May 4), (Quoted) "High intensity radiation produces convulsions, death in monkey" [A1, B27, C3, C9]

49. BAILLIE, H. D. (1970) In: Proc. of the "Biological Effects and Health Implications of Microwave Radiation" Symposium, (Cleary, S. F., ed.), Bur. of Rad. Health, Div. of Bio. Effects, Rept. No. 70-2, pp. 59-65, "Thermal and nonthermal cataractogenesis by microwaves" (Also: Non-Ionizing Rad. 1(4):159-163 (1970))

50. BAILLIE, H. D., HEATON, A. G., & PAL, D. K. (1970) In: Proc. of the "Biological Effects and Health Implications of Microwave Radiation" Symposium, (Cleary, S. F., ed.), Bur. of Rad. Health, Div. of Bio. Effects, Rept. No. 70-2, pp. 85-89, "The dissipation of microwaves as heat in the eye" (Also: Non-Ionizing Rad. 1(4):164-168 (1970))

51. BAKER, V. H., WIANT, D. E., & TABOADA, O. (1956) J. of Economic Entomology 49(1):33-37, "Some effects of microwaves on certain insects which infect wheat and flour"

52. BALDWIN, B. R., CONSTANT, P. C., Jr., JONES, B. L., RINGE, L., & WAIDELICH, D. L. (1961) U. S. Navy, Bureau of Ships Contract with Midwest Res. Inst., Kansas City, Mo., Interim Rpt #1, Oct. 1960; Rpt. #2 (AD #427612), 20 June 1961, Survey of radio frequency radiation hazards" [Rpt #2, P.]

53. BALDWIN, M. S., BACH, S. A., & LEWIS, S. A. (1960) Neurology 10(2):178-187, "Effects of radio-frequency energy on primate cerebral activity" [C3, C4, C9, P9]

54. BALUTINA, A. P. (1965) Bulletin of Experimental Biology and Med. 60(12):1385-1386, " Experimental injury to the eye with UHF electromagnetic fields" [A4, B22]

55. BALUTINA, A. P., & KOROBKOVA, T. L. (1969) Gigiena Truda i Professional'nye Zabolevaniya USSR 13(4):57-58, "Pathohistological alterations in the eyes of rabbits exposed to SHF-UHF radiation" [A4, B22]

56. BARANSKI, S. (1964) Military Inst. of Aviation Med. (5):pp.-, "Histochemical investigations on the microwave effect on the central nervous system" [C, N] (NV)

57. BARANSKI, S., CZEKALINSKI, L., CZERSKI, P., & HADUCH, S. (1963) Revue de medecine aeronautique (Paris) 2:108-111, "Experimental research on the fatal effect of microwetric wave electromagnetic radiation"

58. BARANSKI, S., & CZERSKI, P. (1966) Lekarz Wojskowy (Poland) (10):903-909, (In Polish) "Investigation of the behavior of corpuscular blood constituents in persons exposed to microwaves" [H1]

59. BARANSKI, S., & EDELWEJN, Z. (1968) Acta Physiologica Polonica 19(1):31-41, "Studies on the combined effect of microwaves and some drugs on bioelectric activity of the rabbit CNS" [B5, B19, C4]

60. BARANSKI, S., & EDELWEJN, Z. (1967) ACTA Physiologia Polonica 18(4):517-532 (423-436 Eng. Transl.), "Electroencephalographical and morphological investigation upon the influence of microwaves on the central nervous system"

61. BARBER, D. E. (1962) Institute of Radio Engineers Trans. on Biomedical Electronics 9(2):77-80, "The reaction of luminous bacteria to microwave radiation exposures in the frequency range of 2608.7 to 3082.3 Mc" [J6]

62. BARLOW, H. M. (1962) Institute of Radio Engineers Trans. on Instrumentation 1-2:257-, "Microwave power measurements"

63. BARNOTHY, M. F. (ed.) (1964, Vol. 1) (1969, Vol. 2) Plenum Press, New York, Biological Effects of Magnetic Fields

64. BARONENKO, V. A., & TIMOFEEVA, K. F. (1958) Zashchita ot deystviya elektrom, poley i elektr. toka v prom, Leningrad, pp. 48-59, "The effect of high and ultrahigh frequency EMF on the organism of man and animal" (NV)

65. BARONENKO, V. A., & TIMOFEEVA, K. F. (1959) Fiziologicheskiy Zh. SSSR Sechenov 45:184-188, "Effects of high frequency electromagnetic fields on the conditioned reflex activity and certain unconditioned functions of animals and men" [B13, C7] (NV)

66. BARRON, C. I., & BARAFF, A. A. (1958) J. of the Amer. Medical Assoc. 168(9):1194-1199 (Also U. S. Navy Medical News Letter 34(7):35-40, 1959), "Medical considerations of exposure to microwaves (radar)" [A, B, C, F, H, J, K]

67. BARRON, C. I., & BARAFF, A. A. (1958) Proc. 2nd Tri-service Conf. on Biological Effects of Microwave Energy (Pattishall, E. G., & Banghart, P. W., eds.) 2:112-117, "Medical considerations of exposure to microwaves (radar)" [A, B, C, F, H, J, K]

68. BARRON, C. I., LOVE, A. A., & BARAFF, A. A. (1955) J. of Aviation Med. 26:442-452, (Also Institute of Radio Engineers Trans. on Medical Electronics, PGME-4:44 only, Feb. 1956) (AD #63851), "Physical evaluation of personnel exposed to microwave emanations" [A4, C, F, H, I, J, K, L]

69. BARTONICEK, V., & KLIMKOVA-DEUTCHOVA, E. (1964) Casopis Lekaru Ceskych CZ 103(1):26-30, (ATD Transl. U-64-95, AD #460106), (Also in: Biological Effects of Microwaves, ATD P-65-68, Sept. 1965, pp. 13-14, "Effect of centimeter waves on human biochemistry"), "Some biochemical changes in workers exposed to centimeter waves"

70. BASS, D. E., KLEEMAN, C. R., QUINN, M., HENSCHEL, A., & HEGNAUER, A. H. (1955) Medicine (Analytical Reviews of Gen. Med., Neurology, and Pediatrics) 34:323-380, "Mechanisms of acclimatization to heat in man"

71. BASSETT, H. L., ECKER, H. A., JOHNSON, R. C., & SHEPPARD, A. P. (1971) IEEE Trans. on Microwave Theory and Techniques (Special Issue on Biological Effects of Microwaves) MTT-19(2)197-204, "New techniques for implementing microwave biological-exposure systems"

72. BAUER, J., & GUTMAN, G. (1940) Urologic and Cutaneous Review 44(1):64-66, "The effect of diathermy on testicular function"

73. BAUS, R., & FLEMING, J. D. (1959) Proc. 3rd Tri-service Conf. on Biological Effects of Microwave Radiating Equipments (Sussking, C., ed.) 3:291-313, "Biologic effect of microwave radiation with limited body heating"

74. BAVRO, G. V., & KHOLODOV, YU. A. (1962) In: Summaries of reports, Questions of the Biological Effect of a SHF-UHF Electromagnetic Field. Kirov Order of Lenin Military Medical Academy, Leningrad, pp. 3-4, "The character of bioelectric reactions of the rabbit cerebral cortex during the influence of a SHF-UHF field"

75. BAVRO, G. V., & KHOLODOV, YU. A. (1963) Gigiena Truda i Biol. Deyst. Electrom. Poley Radiochastot (Trudy, Inst. of Industrial Hygiene & Occupational Diseases, Acad. Medical Sci., Moscow), Occupational hygiene & biological effects of RF fields, p. 108-, [Title not given]

76. BAZETT, H. C. (1949) In: Physiology of Heat Regulation and the Science of Clothing, (Newburgh, ed.), W. B. Saunders, Philadelphia, Pa., pp. 109-192, "The regulation of body temperatures"

77. BEISCHER, D. E. (1962) Naval School of Aviation Med., and NASA Rpt, "Survival of animals in magnetic fields of 120,000 Gauss"

78. BEISCHER, D. E. (1964) In: Biological Effects of Magnetic Fields, Vol. 1, (Barnothy, M. F., ed.), Plenum Press, New York, Chapt. 11, pp. 201-, "Survival of animals in magnetic fields of 140,000 Oe"

79. BEISCHER, D. E., & COWART, G. S. (1970) Naval Aerospace Medical Institute Rpt NAMI-1105, "Growth of Staphylococcus aureus in a null magnetic field environment"

80. BEISCHER, D. E., & KNEPTON, J. C., JR. (1964) Naval School of Aviation Med. and NASA Rpt, "Influence of strong magnetic fields on the electrocardiogram of squirrel monkeys (Saimiri sciureus)"

81. BEISCHER, D. E., & KNEPTON, J. C., JR. (1966) Naval Aerospace Medical Institute (and NASA) Rpt NAMI-972, "The electroencephalogram of the squirrel monkey (Saimiri sciureus) in a very high magnetic field"

82. BEISCHER, D. E., & MILLER, E. F. II (1962) Research Rpt, Bureau of Med. & Surg. (Navy), "Exposure of man to low intensity magnetic fields"

83. BEISCHER, D. E., MILLER, E. F., II, & KNEPTON, J. C., JR. (1967) Naval Aerospace Medical Institute (and NASA) Rpt No. 1018, AD #662672, "Exposure of man to low intensity magnetic fields in a coil system"

84. BEKAURI, N. V. (1941) Fiziologicheskiy Zh. SSSR 30(2):173-, "The effect of ultrashort waves on the reflex excitability of frogs"

85. BEKKER, D. B., & MOGENDOVICH, M. R. (1948) In: Biological and Therapeutic Effect of a Magnetic Field and Strictly Periodic Vibrations, pp. 93-, "The effect of a magnetic field on osmotic processes in mice"

86. BELDING, H. S., & HATCH, T. F. (1955) Heating, Piping and Air Conditioning 27(8):129-136, "Index for evaluating heat stress in terms of resulting physiological strains"

87. BELITSKII, B. M., & KNORRE, K. G. (1959) In: Summaries of reports, Labor Hygiene and the Biological Effect of Radio Frequency Electromagnetic Waves, Moscow, [Title not given]

88. BELITSKII, B. M., & KNORRE, K. G. (1960) Trudy Nii Gigyena Truda i Profzabolevaniya USSR, __(1):107-117, (Also in: The Biological Action of Ultrahigh Frequencies, (Letavet, A. A., & Gordon, Z. V., eds.), Acad. of Med. Sci., USSR, Moscow, (JPRS 12471, 1962, pp. 110-122), "Protection from radiation in work with SHF-UHF Generators"

89. BELL, R. L., BLOCK, A. F., HERVIN, R. L., & GRAY, L. B. (1969) Goddard Space Flight Center, Greenbelt, Maryland, Rpt -205-69-405, "Microwave radiation - its potential health hazards and their control"

90. BELL, W. H., & FERGUSON, D. (1931) U. S. Navy Medical Bulletin 29:525-551, "Effects of super-high frequency radio current on health of men exposed under service conditions" (Also Arch. of Physical Therapy _(12):pp.-, (1932))

91. BELOVA, S. F. (1957) In: Summaries of Reports, Part 2, Moscow, Jubilee Sci. Session of the Institute of Labor Hygiene & Occupational Diseases, dedicated to the 40th Anniv. of the Great October Socialistic Revolution, pp. 66-, "State of the organ of sight in persons subjected to the influence of ultrahigh frequency fields"

92. BELOVA, S. F. (1960) In: Physical Factors of the External Environment, Moscow, pp. 184-, "The state of the visual organ in persons exposed to superhigh frequency fields"

93. BELOVA, S. F. (1960) Trudy Nii Gigyena Truda i Profzabolevaniya, __(1):86-89, (Abstr. in: The Biological Action of Ultrahigh Frequencies, (Letavet, A. A., & Gordon, Z. V., eds.), Acad. of Med. Sci., USSR, Moscow, (JPRS 12471, pp. 89-93, 1962)), "Change in the elastotonometric curve in rabbits under the influence of SHF-UHF"

94. BELOVA, S. F. (1962) In: The Biological Action of Ultrahigh Frequencies, (Letavet, A. A. & Gordon, Z. V., eds.), Moscow, (JPRS 12471, pp. 36-38, 1962), "Influence of UHF on the organ of sight"

95. BELOVA, S. F. (1964) Trudy Nii Gigyena Truda i Profzabolevaniya USSR, __(2):119-121, "Results of sight organ examination in workers associated with MF-LF generators (150-600KC)"

96. BELOVA, S. F. (1964) Trudy Nii Gigyena Truda i Profzabolevaniya USSR, __(2):140-143, "Functional state of the visual analyzer under the action of microwaves"

97. BELOVA, S. F. (1960) In: Nauchnoissledovatel'skiy Institut Gigiena Truda i Provzabolevaniya. Trudy __(1):36-38, (Abstr. in: The Biological Action of Ultrahigh Frequencies, (Letavet, A. A., & Gordon, Z. V., eds.), Acad. of Med. Sci., USSR, Moscow, (JPRS 12471, 1962)), (AID Rpt. P-65-17 (1965)), "The effect of UHF on the eye"

98. BELOVA, S. F., & GORDON, Z. V. (1956) Bulletin Experimental Biology & Med. 41:327-330, "The effect of centimeter waves on the eye"

99. BENEDICT, W. L., DAILY, L., HERRICK, J. F., & WAKIM, H. J. (1951) Amer. J. of Ophthalmology, Series 3, 34:1301-, "The effects of microwave diathermy on the eye of a rabbit"

100. BENYO, I., FUSY, F., & IHASZ, M. (1965) Kiserletes Orvostudomany 7(5):454-458, "Effect of shortwave irradiation of the liver on the elimination of bromsulphalein from the blood"

101. BEREZNITSKAYA, A. N. (1968) Gigiena Truda i Professional'nye Zabolevaniya, Moscow, USSR, 12(9):33-37, "Some indicators of the fecundity in female mice irradiated with 10 cm waves"

102. BERG, A. I. (ed.) (1960) Gosenergoizdat, Moscow, Proc. Moscow Conf. Jan. 1959, 392 pages (see especially pages 69, 77, 92, & 123) (In Russian), (Abstr. in: The Biological Effects of Electromagnetic Fields - Annotated Bibliography, AID Rept. P-65-17, Apr. 1965), Electronics in Medicine

103. BERGMAN, W. (1965) Transl. (from German) by Tech. Lib. Res. Serv., Ford Motor Co., Copyright by author, The Effect of Microwaves on the Central Nervous System

104. BERLIN, L. B., & ZHUPEN, V. F. (1952) (AD #400015), "Histological changes in skin following homoplasty to burns of irradiated rabbits.

105. BERLINER, M. L. (1951) AMA Arch. of Ophthalmology, Annual Reviews, 45(2):196-213, "Cornea and sclera"

106. BERNAL, E., & KEPLINGER, M. (1959) Industrial Med. & Surgery 28:535-538, "Effects of environmental temperature and air volume exchange on survival of rats exposed to microwave radiation of 24,000 megacycles"

107. BICKFORD, R. G., & FREMMING, B. D. (1965) Digest of 6th Internat. Conf. on Medical Electronics and Biological Engineering, (Iwai, Y., Chm.) p. 112 only, "Neuronal stimulation by pulsed magnetic fields in animals and man"

108. BIERMAN, W. (1934) Amer. J. of Medical Science 187:545-552, "The effect of hyperpyrexia induced by radiation upon the leukocyte count"

109. BIERMAN, W. (1948) Arch. of Physical Med. 29:408-415, "Present status of fever therapy"

110. BIERMAN, W., HOROWITZ, W. A., & LEVENSON, C. L. (1935) Arch. of Physical Therapy 16:520-522, "Fever therapy in pelvic conditions: Results of experimental and clinical studies"

111. BILOKRYNYTS'KYY, V. S. (1966) Fiziologichnyy Zh. 12(1):70-78, (ATD Rpt 67-3, Jan. 1967), "Changes in the tigroid substance of neurons under the effect of radio waves"

112. BILOKRYNYTS'KYY, V. S. (1968) Fiziologichnyy Zh. 14(3):376-381, (Ukr. with English summary), "Morphological changes in the sciatic nerve of dogs affected with SHF electromagnetic fields"

113. BIRENBAUM, L., GROSOF, G. M., HAMMOND, A. H., ROSENTHAL, S. W., SCHMIDT, H., & ZARET, M. M. (1965, 1966) In Progress Rpt. No. 28, AD 476288, Apr. 1965 - Sept. 1965; Progress Rpt. No. 29, AD 483303, Oct 1965 - Mar. 1966. Summary of Current Research in the Microwave Research Institute Programs, Polytech. Inst., Brooklyn, N. Y., "Effects of microwave radiation on the eye"

114. BIRENBAUM, L., GROSOF, G. M., ROSENTHAL, S. W., & ZARET, M. (1969) IEEE Trans. on Biomedical Engineering BME-16(1): 7-14, "Effect of microwaves on the eye"

115. BIRENBAUM, L., KAPLAN, I., ROSENTHAL, S. W., SCHMIDT, H., & ZARET, M. M. (1967) In: Progress Rpt No. 32, AD 662885 (N68-16938), Mar. 1966 - Sept. 1967. A Summary of Current Research in the Microwave Research Institute Programs, Polytech. Inst., Brooklyn, N. Y., pp. 50-51, "Effects of microwave radiation on the eye" [of the rabbit]

116. BIRENBAUM, L., ROSENTHAL, S., KAPLAN, I., METLAY, W., SCHMIDT, H., & ZARET, M. (1968) Paper presented at meeting of . . ? p. 68-, "Effect of microwaves on the rabbit eye"

117. BIRNBAUM, G., & FRANEAU, J. (1949) J. of Applied Physics 20:817-, "Measurement of the Dielectric constant and loss of solids and liquids by a cavity perturbation method"

118. BLACKSMITH, P., & MACK, R. B. (1965) Air Force Cambridge Res. Labs., Hanscom Field, Mass., AD 625163, "On measuring the radar cross sections of ducks and chickens"

119. BLAGOVIDOVA, L. A., BELEKHOVA, M. G., & ZAGORULKO, T. M. (1962) Biulleten Eksperimental'noi Biologii i Meditsiny, Moscow, 55:8-13, (AD 294524, FTD-TT-62-1482/1+2) "Changes in electrical activity of the diencephalic area and cortex of the rabbit's cerebral hemispheres under the effect of bitemporal diathermy"

120. BLUMEN, L., YERUSHALMI, S., FREI, E. H., BARR, I. M., & NEUFELD, H. N. (1968) J. of Cardiovascular Surgery (Torino) 9:49-53, "Environmental hazards associated with a radio frequency pacemaker"

121. BLINKOVA, T. P., BOGDANOV, O. V., & YAKOVLEVA, M. I. (1967) Zh. Evolyutsionnoy Biokhimii i Fiziol. 3(2):178-181, "Effect of superhigh frequency electromagnetic field on the pulse rate of chick embryos"

122. BLOIS, S. (1956) Institute of Radio Engineers Trans. on Medical Electronics PGME-4:35-37 (from Symposium on Physiologic and Pathologic Effects of Microwaves, Krusen, F. H., Chm., Sept. 1955), "Paramagnetic resonance methods in biological research"

123. BLUDOVA, P. A., KURILOVA, L. N., & TIKHONOVA, M. A. (1953) Zh. Nevropat. i Psikhiat. im. Korsakov 53(10):790-, "The effect of shortwave diathermy on the function of the visual analyzer"

124. BODEN, C., & POMPE, H. J. (1962) Elektronische Rundschau 16(11):517-518, (In German) "The effect of HF-radiation on living organisms"

125. BODROVA, N. V., & KRAYUKHIN, B. V. (1965) In: Bionics, Nauka, Moscow, pp. 264-, "The lateral line of fish as an apparatus for the perception of an electric field"

126. BOITEAU, H. (1960) Revue des Corpes de Sante des Armees 1:637-652, (In French) "Biological effects of radar waves"

127. BOITEAU, H. (1963) Le Medecin de Reserve 1:1-9, (In French) "Biological action of radar waves"

128. BOLSHUKLIN, I. D. (1959) In: Summaries of reports, Labor Hygiene and Biological Effect of Radio Frequency Electromagnetic Waves, Moscow, "Results of shielding of certain kinds of MF-LF generators"

129. BORDIER, H. (1935) Arch. of Physical Therapy 16:263-267, "Radiotherapy combined with diathermy and galvanization in infantile paralysis: Bordier method"

130. BOURGEOIS, A. E., JR. (1967) Ph.D. Thesis (in Experimental Psychology), Baylor Univ., 117 pages, "The effect of microwave exposure upon the auditory threshold of humans"

131. BOVILL, C. B. (1960) British Communications and Electronics 7:363-365, "Are radar radiations dangerous? A survey of possible hazards"

132. BOWMAN, R. R. (1970) In: Proc. of the "Biological Effects and Health Implications of Microwave Radiation" Symposium, (Cleary, S. F., ed.) Bur. of Rad. Health, Div. of Bio. Effects, Rept. No. 70-2, pp. 204-209, "Quantifying hazardous microwave fields: practical considerations"

133. BOYD, G. A. (1947) Biophysics Seminar, School of Med. & Dentistry, Univ. of Rochester, (unpublished report), (Dec.), "Athermal biological effects of microwaves"

134. BOYKO, I. D. (1963) In: Interoceptors and the Neural Control of System Functions Under Normal and Pathological Conditions, Tezisy dokladov. Ivano-Frankovsk, "Some general features of the effect of energy of electromagnetic oscillations of varied frequency and intensity on the quality of interoceptive reflexes"

135. BOYENKO, I. D. (1964) In: Some Problems of Physiological Biophysics, Voronezh, Izd-vo Voronezh. Univ., pp. 7-21, "Electromagnetic field as a stimulus"

136. BOYENKO, I. D., & SHAKHGELDYAN, F. G. (1968) Fiziologicheskiy Zh., Sechenova, USSR 54(8):937-941, "The role of reflexogenic-vascular zones in blood coagulation changes during the action of electromagnetic oscillations on the organism"

137. BOYLE, A., COOK, H. F., & BUCHANAN, T. J. (1950) British J. of Physical Med. 13:1-9, "Effects of microwaves, preliminary investigations"

138. BOYLE, A., COOK, H. F., & WOOLF, D. L. (1952) Annals of Physical Med. 1:3-16, "Further investigation into the effects of microwaves"

139. BOYSEN, J. (1953) AMA Arch. of Industrial Hygiene & Occupational Med. 7(6):516-525, "Hyperthermic and pathologic effects of electromagnetic radiation (350 mc)"

140. BOYSEN, J. E. (1961) Proc. 4th Tri-service Conf. on the Biological Effects of Microwave Radiation, Vol. 1 (Peyton, M. F., ed.) pp. 309-317, "A review of unanswered biological hazard operational problems"

141. BOYSEN, J. E. (1962) J. of Occupational Med. 4(4):192-194, "U. S. Air Force experience with microwave exposure"

142. BOZIK, L., & GRUBEROVA, J. (1967) Pracovni Lekarstvi, Prague, 19(6):249-251, "The influence of electromagnetic waves upon the nervous system"

143. BRADLEY, F. J. (1969) Conf. on Federal-State Implementation of P.L. 90-602, (Mar. 1969), Montgomery, Ala., (Miller, J. W., & Gerusky, T. M., Co-chm.) U.S. Dept. of HEW, P.H.S., B.R.H. Rpt. #ORO 69-4, "Review of current standards for electronic products"

144. BRANDT, A. A. (1963) Gosudarstvennoe Izdatel'stvo Fiziko-Matematicheskov Literatury, Moscow, Research on Dielectrics at Superhigh Frequencies

145. BRATKOVSKIY, R. YE. (1937) In: The Biological Action of VHF-HF-Ultrashort Waves, (Kupalov, P. S., & Frenkel, G. L., eds.) All Union Institute of Experimental Medicine, Moscow, pp. 227-251, "The influence of an ultrahigh frequency electric field on oxidation processes and nitrogen metabolism"

146. BREITWIESER, E. F. (1935) Arch. of Physical Therapy 16:594-598, "Analysis of selective effects of shortwave therapy"

147. BREITWIESER, C. J., & HIRSEN, J. S. (1935) Arch. of Physical Therapy 16:228-234, "Comparative analysis of heat production: Physical analysis of high frequency, radio frequency, and conductive heat"

148. BRENGS, R., JR., & BRIGNOLI, F., (1969) U. S. Navy, (July), (unpublished report), "Preliminary notes on the Navy's RF hazards (RADHAZ) program"

149. BRODY, S. I. (1953) Aviation Med. 24:328-333, "The operational hazard of microwave radiation"

150. BRODY, S. I. (1956) Institute of Radio Engineers Trans. on Medical Electronics PGME-4:8-9 (from Symposium on Physiologic and Pathologic Effects of Microwaves, Krusen, F. H., Chm., Sept. 1955), "Military aspects of the biological effects of microwave radiation"

151. BROWN, F. A., JR. (1971) In: Conf. on "Orientation: Sensory Basis" (Adler, H. E.,(ed.)& Conf. Chairman), Ann. N. Y. Acad. of Sciences 188:224-241, "Some orientational influences of non-visual, terrestrial electromagnetic fields"

152. BROWN, C. H., HOYLER, C. N., & BIERWIRTH, R. A. (1947) D. Van Nostrand Co., Inc., New York, 384 pages, Theory and Application of Radio Frequency Heating

153. BROWN, G. H., & MORRISON, W. C. (1954) Food Technology 8:361-366 (Also IRE Trans. on Medical Electronics PGME-4:16 only, (1955), (Abstr. from Symposium on Physiologic and Pathologic Effects of Microwaves, Krusen, F. H., Chm., Sept. 1955), "An exploration of the effects of strong RF fields on micro-organisms in aqueous solutions"

154. BROWN, W. S., JR. (1952) Lockheed Aircraft Corp., Burbank, Calif., (Rpt SDR-1072, AD 39901), "Physiological hazard of non-ionizing radiation"

155. BRUNNER, G. D., LEHMANN, J. F., McMILLAN, J. A., JOHNSTON, V. C., & GUY, A. W. (1963) Annals of Physical Med. 7(4):121-132 & p. 139, "Temperature distributions as produced by microwaves in specimens under therapeutic conditions"

156. BRYAN, R. N. (1966) Science 163(3738):897-899, "Retrograde amnesia: effects of handling and microwave radiation"

157. BUBAK, K. (1959) Biological Abstracts 36, pt. 67081, 2(1/3):358-363, "Biological effects of electromagnetic radiation within the scope of cm waves"

158. BUCHANAN, A. R., HEIM, H. C., & KRAUSHAAR, J. J. (1961) Air Force Systems Command (AD 265279), 166 pages, (see especially p. 95), "Biomedical effects of exposure to electromagnetic radiation. Part II. Biomedical effects on the eye from exposure to microwaves and ionizing radiations"

159. BUDKO, L. N. (1964) In: Some Questions of Physiology and Biophysics, Trudy Otdeleniya, Voronezh, Izd-vo Voronezh Univ., pp. 31-, "Dynamics of carbohydrate metabolism in isolated liver of white rats on exposure to electromagnetic fields of different frequencies"; and pp. 73-, "Change in blood carbohydrate content due to the action of electromagnetic radiation of audio- and radio-frequency ranges on organisms"

160. BUDKO, L. N., & KOSTYUK, A. YU. (1964) In: Some Problems of Physiology and Biophysics, Trudy Otdeleniya, Voronezh, Izd-vo Voronezh. Univ., pp. 21-25, "The effect of certain portions of the electromagnetic spectrum on the sorption of alkaline stain by the organs of white rats"

161. BUKSA, L. G. (1950) Tr.Permskogo Gosudarstvennogo Med. Inst. __(24-25):pp.? "The effects of magnetic fields, electric fields, HF-VHF fields, and ultraviolet radiation on the reproduction of y eat"

162. BURGESS, J. S. (1957) Proc. 1st Tri-service Conf. on Biological Hazards of Microwave Radiation (Pattishall, E. G., ed.), 1:32-34, "High power microwave facilities"

163. BURHAN, A. S. (1959) Proc. 3rd Tri-service Conf. on Biological Effects of Microwave Radiating Equipments (Susskind, C., ed.) 3:124-135, "Some recent developments in pulsed energy sleep"

164. BURNER, A. M. (Chairman) (1968) Symposium on Microwave Power, Internat. Microwave Power Institute, Boston, Mass., (Transcript & Supplementary Material) San Francisco Press, Inc., Biological Effects of Microwaves: Future Research Directions

165. BURNER, A. M. (Moderator), TELLES, N., MICHAELSON, S. J., FREY, A., ALPEN, E., CARPENTER, R. L., SUSSKIND, C., & HELLER, J. H. (1970) In: Proc. of the "Biological Effects and Health Implications of Microwave Radiation" Symposium, (Cleary, S. F., ed.), Bur. of Rad. Health, Div. of Bio. Effects, Rept. No. 70-2, pp. 248-262, "Panel discussion II: Future needs in research on the biological effects of microwave and RF radiation"

166. BURR, H., & MAURO, A. (1949) Yale J. of Biology and Med. 21:455-, "Electrostatic fields and the sciatic nerve in the frog"

167. BUSCO, R., & COMIGNANI, L. (1967) Rivista di Medicina Aeronautica e Spaziale (Rome) 30:469-528, "Current knowledge regarding the effects of radar waves on living organisms and the protective equipment involved. Part I. General principles of the physiological effects"; pp. 718-757, "Part II"

168. BUTKINA, T. K. (1959) In: Summaries of reports, Labor Hygiene and the Biological Effect of Radio Frequency Electromagnetic Waves, Moscow, "Sanitary hygienic working conditions and the health of individuals exposed simultaneously to x-rays and centimeter waves"

169. BUTKINA, T. K., VOROMTSOVA, A. S., GIRSKAYA, E. N., DUBROVSKAYA, L. R., & KLYACHINA, I. E. (1959) In: Summaries of reports, Labor Hygiene and the Biological Effect of Radio Frequency Electromagnetic Waves; pages?; title ?

170. BYALKO, N. K., & SADCHIKOVA, M. A. (1964) Trudy Nii Gigiyena Truda i Profzabolevaniya, USSR, _(2):137-139, "Some biochemical blood indices under the action of centimeter waves"

171. BYCHKOV, M. S. (1957) Trudy Voyen. Meditsink Akad. i Kirov, USSR, 73:58-77, "Changes of electric activity of the cortex of the large hemispheres in animals exposed to SHF-UHF electromagnetic fields"

172. BYCHKOV, M. S. (1959) In: Summaries of reports, Labor Hygiene and the Biological Effect of Radio Frequency Electromagnetic Waves, Moscow, pp. 49 only, "Electrophysiological characteristic of the biological effect of microwave electromagnetic fields of various parameters"

173. BYCHKOV, M. S. (1962) In: Summaries of reports, Questions of the Biological Effect of a SHF-UHF Electromagnetic Field. Kirov Order of Lenin Military Medical Academy, Leningrad; pp. 6-8 & 8-9, "On the mechanism of action of a SHF-UHF electromagnetic field"

174. BYCHKOV, M. S. (1967) In: Abstracts of reports of the All Union Conference on Neurocybernetics, Rostov-on-Don, pp. 17-18, "Neurophysiological characteristics of the specific effects of radiowaves in the SHF-UHF range"

175. BYCHKOV, M. S., & MOREVA, Z. E. (1960) Trans. Leningrad Obshchest. Isp'tatel. Prirod. 71:178-, "The effect of radiowaves in the SHF range on a frog nerve-muscle preparation"

176. BYCHKOV, M. S., & SYMGAYEVSKAYA, V. A. (1962) In: Summaries of reports, Questions of the Biological Effect of a SHF-UHF Electromagnetic Field. Kirov Order of Lenin Military Medical Academy, Leningrad. pp. 9-11, "Data on the non-thermal effect of SHF-UHF fields on the cholinergic systems of an organism"

177. BYNUM, J. A. (1966) Ph.D. Dissertation, Baylor Univ., 103 pages, "The effects of UHF fields on retention in a verbal learning task"

178. CAFFARATTO, T. M. (1946) La Ginecologia 12(9):237-249, "Leukocytis vagistrices following shortwave therapy"

179. CALDERON, A. P. (1953) Ohio State Univ. Research Foundation, Rpt 478-18, (AD 19536), "The computation of radiation and scattered electromagnetic fields"

180. CAPPELLI, L. (Editor) (1935) Book (in 2 volumes) Bologna (Papers in English, French, German, or Italian), 1330 pages, Proc. of First International Congress of Electro-Radio-Biology, Sept. 1934, Venice

181. CARD, R. H. (1957) Trans. of the National Safety Congress 8:8-12, "The hazard of radio transmitters and their correction"

182. CARLETON, R. A., SESSIONS, R. W., & GRAETTINGER, J. S. (1964) J. of the Amer. Medical Assoc. 190(10):938-940, "Environmental influence on implantable cardiac pacemakers"

183. CARLEY, W. S., & STURGILL, L. G. (1961) Unpublished (Report to Bureau of Ships, USN, from Jansky & Bailey, Division of Atlantic Research, Washington, D. C.), "Calculations of hazardous zones of electromagnetic radiation"

184. CARNEY, S. A., LAWRENCE, J. C., & RICKETTS, C. R. (1968) British J. of Industrial Med. (Part I) 25:223-228; (Part II) 229-234; (Part III) ibid. 27:72-76 (1970), "Effect of microwaves at X-band on guinea pig skin in tissue culture. Part I. Microwave apparatus for exposing tissue and the effect of the radiation on skin respiration. Part II. Effect of the radiation on skin biochemistry. Part III. Effect of pulsed microwaves on skin respiration and biochemistry"

185. CARPENTER, C. M., & BOAK, R. A. (1930) Amer. J. of Syphilis 14:346-365, "The effect of heat produced by an ultrahigh frequency oscillator on experimental syphilis in rabbits"

186. CARPENTER, C. M., & PAGE, A. B. (1930) Science 71(1844):450-452, "Production of fever in man by short radio waves"

187. CARPENTER, R. L. (1957) Tufts Univ., Medford, Mass., Informal Progress Report to U. S. Air Force on the "Cumulative effects of 12.3 cm radiation on the eyes of rabbits"

188. CARPENTER, R. L. (1958) Proc. 2nd Tri-service Conf. on Biological Effects of Microwave Energy (Pattishall, E. G., & Hanghart, F. W., eds.) 2:146-168, "Review of the work conducted at Tufts Univ. (USAF sponsored); experimental radiation cataracts induced by microwave radiation"

189. CARPENTER, R. L. (1959) Digest of Tech. Papers, Proc. of the 12th Annual Conf. on Electrical Techniques in Medicine and Biology (Schwan, H. P., Chm.), Pub. Lewis Winner, New York, p. 52 only, "Opacities in the lens of the eye experimentally induced by exposure to microwave radiation"

190. CARPENTER, R. L. (1959) Proc. 3rd Tri-service Conf. on the Biological Effects of Microwave Radiating Equipments (Susskind, C., ed.) 3:279-290 (RADC-TR-59140, AD 234788), "Studies on the effects of 2450 megacycle radiation on the eye of the rabbit"

191. CARPENTER, R. L. (1962) Rept. RADC-TDR-62-131 (AD 275840), (Also in Senate Hearings, pp. 991-1049), "An experimental study of the biological effects of microwave radiation in relation to the eye"

192. CARPENTER, R. L. (1965) Digest of 6th Internat. Conf. on Medical Electronics and Biological Engineering, pp. 573-574, "Suppression of differentiation in living tissues exposed to microwave radiation"

193. CARPENTER, R. L. (1970) In: Proc. of the "Biological Effects and Health Implications of Microwave Radiation" Symposium, (Cleary, S. F., ed.) Bur. of Rad. Health, Div. of Bio. Effects, Rept. No. 70-2, pp. 76-81, "Experimental microwave cataract: a review"

194. CARPENTER, R. L. (Chm.) (1971) "Microwave" Session of the Internat. Conf. on Non-Ionizing Radiation Safety, 29-31 Mar., Cincinnati, Ohio, sponsored by Medical Center of U. of Cincinnati

195. CARPENTER, R. L., BIDDLE, D. K., & VAN UMMERSEN, C. A. (1959) In Investigators' Conf. on Biological Effects of Electronic Radiating Equipments (Knauf, G. M., Chm.) RADC-TR-59-67, pp. 12-15, (AD 214693), "Report on work in progress at Tufts University"

196. CARPENTER, R. L., BIDDLE, D. K., & VAN UMMERSEN, C. A. (1960) Institute of Radio Engineers Trans. on Medical Electronics, ME-7(3):152-157, "Opacities in the lens of the eye experimentally induced by exposure to microwave radiation"

197. CARPENTER, R. L., BIDDLE, D. K., & VAN UMMERSEN, C. A. (1960) From Proc. of 3rd Internat. Conf. on Medical Electronics, Part 3, London, pp. 401-408, (Also in Senate Hearings, pp. 982-990), "Biological effects of microwave radiation with particular reference to the eye"

198. CARPENTER, R. L., BIDDLE, D. K., & VAN UMMERSEN, C. A. (1961) Digest of Internat. Conf. on Medical Electronics, Biological Effects of Microwaves I (Athermal Aspects), (Frommer, P. L., ed.) Plenum Press, New York, pp. 196-, "Comparison of absorption by normal and phantom eyes exposed to cataractogenic doses of microwave radiation at 2450 mc and 10,050 mc"

199. CARPENTER, R. L., et al. (1961) Digest of Internat. Conf. on Medical Electronics, Biological Effects of Microwaves I (Athermal Aspects), (Frommer, P. L., ed.), Plenum Press, New York, New York, 26:5-, "The effect on the rabbit eye of microwave radiation at x-band regions"

200. CARPENTER, R. L., BIDDLE, D. K., VAN UMMERSEN, C., MANGANAS, C. P., & FREEMAN, H. M. (1959) Amer. J. of Ophthalmology 47:94 only, (Abstract of paper presented at meeting of Eastern Section of Assoc. for Research in Ophthalmology, Inc., Nov. 1958, at New York Univ.), "Experimental radiation cataracts induced by microwave radiation"

201. CARPENTER, R. L., & CLARK, V. A. (1966) In: Environmental Biology, Altman, P. L., & Dittmer, D. C. (eds.), Federation of Amer. Soc. for Experimental Biology, Bethesda, Md., (AD 646890), pp. 131-139, "Responses to radio frequency radiation"

202. CARPENTER, R. L., & LIVSTONE, E. M. (1971) IEEE Trans. on Microwave Theory and Techniques (Special Issue on Biological Effects of Microwaves) MTT-19(2):173-178, "Evidence for nonthermal effects of microwave radiation: abnormal development of irradiated insect pupae"

203. CARPENTER, R. L., & VAN UMMERSEN, C. A. (1968) J. of Microwave Power 3(1):3-19, (AD 668619), "The action of microwave radiation on the eye"

204. CARPENTER, R. L., & VAN UMMERSEN, C. A. (1968) Proc. of Hearings before Committee of Congress, U. S. Senate, 90th Congress, on Radiation Control for Health and Safety Act of 1967, Part 2, Serial No. 90-49, pp. 955-971, "The action of microwave radiation on the eye"

205. CARSTENSEN, E. L. (1962) Army Report, Ft. Detrick Tech. Rept. MS-23, (AD 293693), 9 pages, "Internal conductivity of Escherichia coli"

206. CASSIANO, O., & AUDISIO, B. (1966) Minerva Anestesiologica (Torino), 32:261-264, (In Italian) "Some neurovegetative responses to the action of electromagnetic fields in man"

207. CASSIANO, O., CARTA, Q., & TRONCONE, S. (1967) Minerva Anestesiologica (Torino), 33:326-329, (In Italian) "Action of electromagnetic fields on the glycaemic level of normal and diabetic subjects"

208. CASTALDI, L. (1934) Abstracts of the 1st Internat. Congress of Electro-radio-biology (Cappelli, L., ed., Bologna, Italy), pp. 277-335, (In Italian with English summary), "Biological effect of high-frequency waves"

209. CAVALLARO, L. (1934) Abstracts of the 1st Internat. Congress of Electro-radio-biology (Cappelli, L., ed., Bologna, Italy), pp. 341-350, (In Italian with English summary) "Dispersion of radio frequency waves in protein systems"

210. CAZZAMALLI, F. (1925) Neurologica 6:193-, (AD #273787), "The effects of radar on the human body"

211. CAZZAMALLI, F. (1960) In: Il Cervello Radiante, (In Italian), (U. S. Army Engr. Res. & Dev. Lab. Transl. T-1695), (AD 422217, 42 page translated report), pp. 125-152, "On a cerebro-psychic radiation phenomenon (cerebro-psychic radiation reflex) as a means of psychophysical exploration"

212. CAZZAMALLI, F. (1960) In: Il Cervello Radiante, (In Italian), (U. S. Army Engr. Res. & Dev. Lab. Transl. T-1696), (AD 422218, 40 page translated report), pp. 153-194, "Electromagnetic phenomena which radiates from the human brain during intense psychosensorial activity from dreamy, hallucinatory and telepsychic states"

213. CHALOV, V. G. (1968) Voenno-Meditsinskii Zh. _(5):24-26, "The effect of a SHF-UHF field on the functional condition of the otorhinolaryngological organs"

214. CHIRKOV, M. M. (1964) In: Some Questions of Physiology and Biophysics, Trudy Otdeleniya, Voronezh, Izd-vo Voronezh, Univ., pp. 25-31, (In Russian), "The effect of the energy of electromagnetic radiation of the acoustic spectrum on catalase activity in blood"

215. CHIZHENKOVA, R. A. (1966) Biulleten Eksperimental'noi Biologii i Meditsiny, Moscow 61(6):11-15, "Changes in the EEG of rabbits during the action of a constant magnetic field"

216. CHIZHENKOVA, R. A. (1967) Zh. Vysshei Nervnoi Deiatel'nosti imeni I. P. Pavlova, Moscow 17(2):313-321, (In Russian, English abstract), (ATD Rpt 68-105-108-9, Abstract, (June 1968), p. 69 only, Soviet Radiobiology, AD 671436), "The role of various brain formations in EEG responses of rabbits to a constant magnetic field and to VHF-HF and SHF-UHF electromagnetic fields"

217. CHIZHENKOVA, R. A. (1967) Fiziologicheskii Zh. SSSR, Moscow 53(5):514-519, (In Russian) (ATD Rpt 68-105-108-9, Abstract (June 1968), pp. 70-72, Soviet Radiobiology), "Brain biopotentials in the rabbit during exposure to electromagnetic fields"

218. CHIZHENKOVA, R. A. (1967) Zh. Vysshei Nervnoi Deiatel'nosti, Moscow 17(6):1083-1090 (In Russian, English abstract), "Electrical reaction of a rabbit's cerebral cortex to various electromagnetic fields"

219. CHIZHENKOVA, R. A. (1969) Zh. Vysshei Nervnoi Deiatel'nosti Pavlov USSR 19(3):495-501, (In Russian, English summary), "Background and evoked neuron activity in the visual cortex of rabbits following exposure to the action of a SHF-UHF field"

220. CHRISTIANSON, C. (1963) Presentation: Naval Material Lab. Program Summary, "Radiation hazards body protection devices"

221. CHRISTIANSON, C., & RUTKOWSKI, A. (1966) Naval Applied Sci. Lab. Tech. Memo No. 3 (Jan 1967), Brooklyn; (AD 645496); (Also presented at 4th Annual Navy-wide Workshop in the Biological Sciences, Nav. Med. Res. Unit #4, Great Lakes, Ill., Oct. 1966), "Electromagnetic radiation hazards in the Navy"

222. CHRISTIE, R. V., & LOOMIS, A. L. (1929) J. Experimental Med. 49:303-321, "The relation of frequency to the physiological effects of ultra-high frequency currents"

223. CHUKHLOVIN, B. A. (1965) Voenno-Meditsinskii Zh., Moscow (Military Medical Journal), _(7):25-29, "The effect of SHF-UHF electromagnetic radiation on the immunobiological properties of the organism"

224. CHUKHLOVIN, B., A., GRACHEV, B. N., & LIKINA, I. V. (1966) Biulleten Eksperimental'noi Biologii i Meditsiny, Moscow 61(6):53-55, "The detection of C- and C_x- reactive protein in the blood serum during exposure of the organism to SHF-UHF electromagnetic waves"

225. CIECIURA, L., KARASEK, M., PAWLIKOWSKI, M., & MINECKI, L. (1969) Folia Morphologica (Warszawa) 28(3):343-351, (In Polish with English summary) "The influence of microwaves radiation on the ultrastructure of the pineal gland of white rats"

226. CIECIURA, L., & MINECKI, L. (1962) Lekarz Wojskowy, Poland 38(6):519-530, (In Polish, French summary), "Pathological changes in the testes of rats subjected to single or repeated doses of microwaves (S band)"

227. CIECIURA, L., & MINECKI, I. L. (1966) Medycyna Pracy 17:507-514, "Histopathological changes in the testes of rats exposed to the action of microwave radiation in hyperthermal condition"

228. CIGNOLINI, P. (1947) Minerva Medicine 38:284-285, (In Italian) "Dosimetry in shortwave therapy"

229. CIGNOLINI, P., & OLIVIERI, _.(1936) Rev. de Physiotherap. _(3):212-, "The action of high frequency electromagnetic waves on the circulatory system"

230. CIMITAN, O. (1951) Giornaledi Science Mediche (Venezia) 6:138-140, "Effect of shortwave irradiation on bacteria"

231. CLARK, J. W. (1950) Proc. of the Institute of Radio Engineers 38(9):1028-1032, "Effects of intense microwave radiation on living organisms"

232. CLARK, J. W., HINES, H. M., & SALISBURY, W. W. (1949) Electronics 22:66-, "Exposure to microwaves: recent experiments on animals with high intensity 12 cm radiation"

233. CLARK, L. A. (1959) Proc. 3rd Tri-service Conf. on Biological Effects of Microwave Radiating Equipments (Surskind, C., ed.) 3:239-243, "Eye study survey"

234. CLARK, W. B. (1952) Trans. of the Amer. Acad. of Ophthalmology 56:600-607, "Microwave diathermy in ophthalmology: clinical evaluation"

235. CLEARY, S. F. (Ed.) (1970) Symposium held at Medical College of Virginia, Richmond, 17-19 Sept. 1969, U. S. Dept. of Health, Education, and Welfare, Public Health Service, Bureau of Radiological Health, Division of Biological Effects, Rept. No. 70-2, (PB 193-898), Proceedings, Biological Effects and Health Implications of Microwave Radiation; Also: "Chairman's Remarks" and "Introductory Comments"

236. CLEARY, S. F. (1970) Amer. Industrial Hygiene Assoc. J. 31:52-59, "Considerations in the evaluation of the biological effects of exposure to microwave radiation"

237. CLEARY, S. F., & HAM, W. T., JR. (1969) Task Force on Research Planning in Environmental Health Science, Subtask Force on Physical Factors in the Environment (background document), (unpublished), Part I. "Considerations in the evaluation of the biological effects of exposure to microwave radiation"

238. CLEARY, S. F., & PASTERNACK, B. S. (1966) Arch. of Environmental Health 12:23-29, "Lenticular changes in microwave workers"
(A65-82038)

239. CLEARY, S. F., PASTERNACK, B. S., & BEEBE, G. W. (1965) Arch. of Environmental Health 11:179-182, "Cataract incidence in radar workers"

240. CLEARY, S. F., PASTERNACK, B., & EISENBUD, M., Institute of Environmental Medicine, N. Y. Univ. Med. Center, Report, "Relationship of environmental factors to lenticular changes in microwave workers"

241. CLOSE, P. & BEISCHER, D. E. (1962) Naval School of Aviation Medicine, BUMED and NASA Report, "Experiments with Drosophila melanogaster in magnetic fields"

242. COGAN, D. G. (1950) J. Amer. Medical Assoc. 142(3):145-151, "Lesions of the eye from radiation energy"

243. COGAN, D. G. (1959) AMA Arch. of Industrial Health 20:293-, "Ocular effects of radiation"

244. COGAN, D. G., FRICKER, S. J., LUBIN, M., DONALDSON, D. D., & HARDY, H. (1958) AMA Arch. of Industrial Health 18(4):299-302, "Cataracts and ultra-high-frequency radiation"

245. COLSON, C., et al. (1970) Bulletin de la Classe des Sciences, Academie Royale de Belgique 56(9):960-, & 983-, "Action of electromagnetic radiations on proteins, Parts I & II"

246. CONSTANT, P. C., JR. (1963) Institute of Electrical and Electronics Engineers Student J. 1(1):36-, "Biological aspects of RF radiation"

247. CONSTANT, P. C., JR. (1967) Digest of the 7th Internat. Conf. on Medical and Biological Engineering, (Jacobson, B., ed.), Stockholm, 7:349 only, "Hearing EM waves"

248. CONSTANT, P. C., JR., ASHLEY, W. H., BALDWIN, B. R., MARTIN, E. J. JR., & RICE, R. F. (1960) Midwest Research Institute, Kansas City, Mo., Report to Navy (June 1960), "Survey of radio frequency radiation hazards"

249. CONSTANT, P. C., JR., & MARTIN, E. J. (1963) IEEE Trans. on Radio Frequency Interference 5(1):56-76 (also Report to Navy from Midwest Research Institute, Kansas City, Mo.), "The Navy's radiation hazards (RADHAZ) program on the formulation of standards"

250. COOK, H. F. (1951) British J. of Applied Physics 2:295-300, "The dielectric behavior of some types of human tissues at microwave frequencies"

251. COOK, H. F. (1952) J. of Physiology 118:1-11, "The pain threshold for microwave and infrared radiation"

252. COOK, H. F. (1952) British J. of Applied Physics 3:33-40, "Microwaves in medical and biological research"

253. COOK, H. F. (1952) British J. of Applied Physics 3:245-248, "A physical investigation of heat production in human tissue when exposed to microwaves"

254. COOK, H. F. (1952) British J. of Applied Physics 3:249-255, "A comparison of dielectric behavior of pure water and human blood at microwave frequencies"

255. COOK, H. F., & BOYLE, A. (1952) British J. of Applied Physics 3:1-6, "Clinical picture of the chronic effect of electromagnetic microwave radiation"

256. COOPER, R. (1946) J. of the Institute of Electronic Engineers 93(3):69-, "The electrical properties of salt-water solutions over the frequency range 1-4000 Mc"

257. COOPER, T., JELLINEK, M., PINAKATT, T., & RICHARDSON, A. W. (1965) Experientia 21:28-29, "The effect of pyridoxine and pyridoxal on the circulatory responses of rats to microwave irradiation"

258. COOPER, T., PINAKATT, T., JELLINEK, M. & RICHARDSON, A. W. (196-) Aerospace Med. 33(7):794-798, "Effects of adrenalectomy, vagotomy, and ganglionic blockade on the circulatory system response to microwave hyperthermia"

259. COPSON, D. A. (1967) Digest of the 7th Internat. Conf. on Medical and Biological Engineering, (Jacobson, B., ed.), Stockholm, p. 404 only, "Athermic and thermic absorption processes with microwaves from 1 mm to 30 cm"

260. COPSON, D. A. (1956) Institute of Radio Engineers Trans. on Medical Electronics, PGME-4:27-35 (from Symposium on Physiologic and Pathologic Effects of Microwaves, Krusen, F. H., Chm., Sept. 1955), "Microwave energy in food procedures"

261. COPSON, D. A. (1961) Digest of the 1961 Internat. Conf. on Medical Electronics, Biological Effects of Microwaves, I (Athermal Aspects), (Frommer, P. L., ed.), Plenum Press, New York, pp. 228-, "Theory of thermal dissipation of microwave energy, and microwave engineering"

262. COPSON, D. A. (1962) Microwave Heating, Avi Pub. Co., Inc., Westport, Conn., Esp. Chapt. 19, "The radiation biology of microwaves"

263. COPSON, D. A., NEUMAN, B. R., & BRADY, A. L. (1955) J. of Agricultural/Food Chemistry 3(5):424-427, "Browning methods in microwave cooking"

264. COSIC, V., KRAMER, M., & GALA, A. (1963) Vojnosanit Pregl 20(3):119-126, "Effects of radar installations on the human body"

265. COULTER, J. S., & CARTER, N. A. (1936) J. of the Amer. Medical Assoc. 106:2063-2066, "Heating of human tissues by short wave diathermy"

266. COULTER, J. S., & OSBORNE, S. L. (1936) Arch. of Physical Therapy 17:135-139, "Shortwave diathermy: a comparative study in pelvic heating"

267. CRAPUCHETTES, P. W. (1970) In: Proc. of the "Biological Effects and Health Implications of Microwave Radiation" Symposium, (Cleary, S. F., ed.), Bur. of Rad. Health, Div. of Bio. Effects, Rept. No. 70-2, pp. 210-216, "Microwave leakage instrumentation"

268. CUSTIN, T. G. (1961) Proc. of the Institute of Radio Engineers 49:1574 only, "Microwave radiation hazards"

269. CUTTER, R. S. (1958) (compiler) National Library of Medicine, Washington, D. C., (unpublished report), "Biological effects of non-ionizing radiation on humans and higher animals; selected references in English 1916-1957"

270. DADIRRIAN, A. N. (1959) Proc. 3rd Tri-service Conf. on Biological Effects of Microwave Radiating Equipments (Susskind, C., ed.) 3:271-278, "A microwave medical safety program in an industrial electronics facility"

271. DAHLEN, R. W. (1960) Dissertation Abstracts 21(6):1612-, "Effects of irradiation of the head region of dogs with 2450 Mc microwaves"

272. DAILY, L. E., (1943) U. S. Navy Medical Bulletin 41:1052-1056, "A clinical study of the results of exposure of laboratory personnel to radar and high frequency radio"

273. DAILY, L., JR., WAKIM, K. G., HERRICK, J. F., PARKHILL, E. M., & BENEDICT, W. L. (1950) Amer. J. of Ophthalmology 33: 1241-1254, "The effects of microwave diathermy on the eye: an experimental study"

274. DAILY, L., JR., WAKIM, K. G., HERRICK, J. F., PARKHILL, E., & BENEDICT, W. L. (1952) Amer. J. of Ophthalmology 35: 1001-1017, "The effects of microwave diathermy on the eye of the rabbit"

275. DAILY, L., JR., ZELLER, E. A., WAKIM, K. G., HERRICK, J. F., & BENEDICT, W. L. (1951) Amer. J. of Ophthalmology 34: 1301-1306, "Influence of microwaves on certain enzyme systems in the lens of the eye"

276. DAILY, L., JR., WAKIM, K. G., HERRICK, J. F., & PARKHILL, F. M. (1948) Amer. J. of Physiology 155:432 only, (Also Institute of Radio Engineers Trans. on Medical Electronics, PGME-4:25-26 (1956); (from Symposium on Physiologic and Pathologic Effects of Microwaves, Krusen, F. H., Chm., Sept. 1955), "The effects of microwave diathermy on the eye"

277. DANIELS, R. G., & GOLDSTEIN, B. (1965) Federation Proceedings Supplement 24, S-27-, "Lasers and masers - health hazards and their control"

278. D'ARSONVAL, A. (1932) Arch. of Physical Therapy 13:715-717, "Therapeutic applications of high frequency currents"

279. D'ARSONVAL, A. (1934) Abstracts of the 1st Internat. Congress of Electro-Radio-Biology, (Cappelli, L., ed.), Bologna, Italy, pp. 111-114, "Biological effects of high frequency fields"

280. D'ARSONVAL, A., & CHARBIN, A. (1896) Comptes Rendus Societe de Biologie 48:121-123, (In French) "The action of electricity on bacterial toxins"

281. DAVIS, H. (1958) Proc. 2nd Tri-service Conf. on Biological Effects of Microwave Energy (Pattishall, E. G., & Banghart, F. W., eds.) 2:19-32, "Discussion of long range research and development plans in the Air Force"

282. DAVIS, R. T., ELAM, C. B., & McDOWELL, A. (19) Report, School of Aviation Med., Randolph Air Force Base, (AD 204696), "Latent effects of chronic whole body irradiation of monkeys with mixed source radiation"

283. DAVIS, T. P. (1959) Digest of Tech. Papers, Proc. of the 12th Annual Conf. on Electrical Techniques in Medicine and Biology (Schwan, H. P., Chm.), pp. 90-91, "The temperature response of skin exposed to penetrating and non-penetrating radiation"

284. DAVIS, T. R. A., & MAYER, J. (1954) Amer. J. of Physiology 178:283-287, "Uses of high frequency electromagnetic waves in the study of thermogenesis"

285. DAY, G. C. (1955) British J. of Physical Med. 18:14-16, "The subjective effects of general irradiation"

286. DAYTON, W. P. (1961) Ground Electronics Engineering Installation Agency, Griffiss Air Force Base, Rpt. GEEIA TR-61-1, (AD 253671), "Microwave radiation effects program"

287. DEBRONS, A. (1958) Proc. 2nd Tri-service Conf. on Biological Effects of Microwave Energy (Pattishall, E. G., & Banghart, F. W., eds.) 2:105-111, "Human engineering applications as related to personnel protection"

288. DeCHOLNOKY, T. (1935) Arch. of Physical Therapy 16:587-594, "Shortwave therapy in pyogenic skin infection"

289. DEICHMANN, W. B. (1959) Proc. 3rd Tri-service Conf. on Biological Effects of Microwave Radiating Equipments (Susskind, C., ed.) 3:72-74, "Results of (pathological) studies of microwave radiation"

290. DEICHMANN, W. B. (1961) Biochemical Pharmacology 8(1):/ pp.? "Introducing the irradiation cycle rate in microwave radiation exposures"

291. DEICHMANN, W. B. (1966) Arch. of Toxicology 22:24-35, "Biological effects of microwave radiation of 24,000 megacycles"

292. DEICHMANN, W. B., & BERNAL, E. (1963) Univ. of Miami, (AD 400345), "Chronic exposure of dogs to microwave radiation of 24,000 megacycles and a power density of 20 mw/sq cm "

293. DEICHMANN, W. B., BERNAL, E., STEPHENS, F., & LANDEEN, K. (1963) J. of Occupational Medicine 5(9):418-425, "Effects on dogs of chronic exposure to microwave radiation"

294. DEICHMANN, W. B., KEPLINGER, M., & BERNAL, E. (1959) Proc. 3rd Tri-service Conf. on Biological Effects of Microwave Radiating Equipments (Susskind, C., ed.) 3:77-81, (Alsc, Industrial Med. & Surgery 28(5):212-213 (1959), and RADC-TN-59-302, AD 228987), "Relation of interrupted pulsed microwaves to biological hazards"

295. DEICHMANN, W. B., KEPLINGER, M., & BERNAL, E. (1959) Proc. 3rd Tri-service Conf. on Biological Effects of Microwave Radiating Equipments (Susskind, C., ed.) 1:62-70, (Also, Industrial Med. & Surgery 28(12):535-,), (Rome Air Development Center, RADC-TN-59-303, AD 228993), "Effects of environmental temperature and air volume exchange on survival of rats exposed to microwave radiation of 2,400 megacycles"

296. DEICHMANN, W. B., MIALE, J., & LANDEEN, K. (1962) Report, Univ. of Miami, RADC-TDR-62-192, (AD 278022), 16 pages, "Effects of microwave radiation of 10 and 20 mw/cm^2 (24,000 megacycles)"

297. DEICHMANN, W. B., MIALE, J., & LANDEEN, K. (1964) Toxic Applied Pharmacology 6(1):71-77, "Effect of microwave on the hemopoietic system of the rat"

298. DEICHMANN, W. B., & STEPHENS, F. H., JR. (1961) Digest of the 1961 Internat. Conf. of Medical Electronics, Biological Effects of Microwaves, I (Athermal Aspects), (Frommer, P. L., ed.) Plenum Press, New York, pp. 191-, (Also, Industrial Medicine and Surgery 30:264-(1961)), "Factors that influence the biological effects of microwave radiation"

299. DEICHMANN, W. B., & STEVENS, F. H., JR. (1961) Industrial Med. & Surgery 30:221 only, "Microwave radiation of 10 mw/cm^2 and factors that influence biological effects at various power densities"

300. DEICHMANN, W. B., STEPHENS, E. H., JR., KEPLINGER, M., & LAMPE, K. E. (1959) J. of Occupational Med. 1(7):369-381, "Acute effects of microwave radiation on experimental animals (24,000 megacycles)"
(PAFF, G.H., BRAUZER, B., & FINNERTY, D. E.)

301. DEICHMANN, W. B., et al./(1959) Section in: Microwave Radiation Research, Univ. of Miami Annual Report, RADC-TN-59-228, (AD 232925), pp. 11-14, "Hyperpyrexia - microwave versus infrared"; pp. 14-15, "Comparative sensitivity of head, lumbar, and abdominal region to microwave radiation"; pp. 15-18, "Comparative rises of temperature in various organs"; pp. 19-25, "The effect of single and repeated microwave exposures on the formed elements in the blood of rats"; p. 25 only, "Skin cancer study"; pp. 26-28, "Chronic microwave studies"; pp. 29-32, "Observations on the effects of radar upon the embryonic heart"

302. DEICHMANN, W. B., et al. (1960) Section in: Microwave Radiation Research, Univ. of Miami Annual Report, RADC-TR-61-42, (AD 256500), pp. 4-10, "Organ temperature studies"; pp. 11-24, "The effect of microwave radiation of 10 mw/sq. cm. in the treatment of acute leukemia of the rat"; pp. 25-46, "Chronic, intermittent, exposure of experimental animals to microwave radiation"; pp. 36-41, "Chronic exposure of Beagle dogs to microwave radiation of 20 mw/sq. cm."

303. DELGADO, J. M. R. (1969) Presented at the Hazards and Utility of Microwaves and Radiowaves Seminar, (Heller, J., Chm.), 11-12 Dec., Boston, "Effects of radio-frequency on the central nervous system"

304. DeLHERY, G. P., DERKSEN, W. L., & MONAHAN, T. I. (1959) Naval Material Lab., Brooklyn, AFSWP-114, (AD 220576), "Research on the thermal conductivity and diathermancy of Albino rat skin"

305. DELHERY, G. P., DERKSEN, W. L., & MONAHAN, T. I. (1959) Digest of Technical Papers, Proc. of the 12th Annual Conf. on Electrical Techniques in Medicine and Biology (Schwan, H. P., Chm.), p. 92 only, "Some thermal and optical properties of rat skin"

306. De LOOR, G. P. (1968) J. of Microwave Power 3(2):67-73, "Dielectric properties of heterogeneous mixtures containing water"

307. De LOZ, A. (1951) Le Scalpel 104(21):591-598, (In French) "Influence of high frequency radiowaves on 'hypercholesterinemia'"

308. DeMINCO, A. P., (1961) Proc. 4th Tri-service Conf. on Biological Effects of Microwave Radiation, Vol. 1 (Peyton, M. F., ed.) pp. 33-46, (Also, RADC-TR-60-185, Nov. 1960), "Generation and detection of pulsed x-rays from microwave sources"

309. DEMIRGHOGLYAN, G. G. (1953) Problemy Fiziologicheskoi Optiki (Akademiia nauk SSR), Moscow, _(8):203-, "Photopotential of the retina and its variation under the action of SHF-UHF fields"

310. DENIER, _. (1933) Arch. of Electron. in Medicine 41:273-276, (In French)"Biological action of high frequency ultrashort radio waves of 80 cm"

311. DESSAUER. F. (1934) Abstracts of the 1st Internat. Congress of Electro-Radio-Biology, (Cappelli, L., ed.), Bologna, Italy, pp. 336-340 (In German, English summary), "Reference concerning electrical waves and biological phenomena"

312. DIAS, J. F. (1965) J. of the Internat. College of Surgeons 43:505-, "Eye disease from natural and man-made radiation"

313. DINKLOH, H. (1966) Wehrmedizin 4(6/7):123-131, "Health damage caused by microwaves, especially radar waves"

314. DODGE, C. H. (1965) ATD Bulletin (Library of Congress) 1(2):33-38, "The influence of microwaves on the functional condition of the nerve" (Transl. of Kamenskiy (1964), citation #703, this Bibliography)

315. DODGE, C. H. (1965) Foreign Science Bulletin (Library of Congress) 1(2):7-19, "Biological and medical aspects of microwaves"
[See also citation numbers 1931 and 1932, this Bibliography]

316. DODGE, C. H. (1966) Unpublished report, Biosciences Div., U. S. Naval Observatory, Washington, D. C., "Clinical and hygienic aspects of exposure to electromagnetic fields (a review of the Soviet and Eastern European literature)" [Expanded in citation #317]

317. DODGE, C. H. (1970) In: Proc. of the "Biological Effects and Health Implications of Microwave Radiation" Symposium. (Cleary, S. F., ed.), Bur. of Rad. Health, Div. of Bio. Effects, Rept. No. 70-2, pp. 140-149, "Clinical and hygienic aspects of exposure to electromagnetic fields"

318. DODGE, C. H., & KASSEL, S. (1966) ATD Report (Library of Congress) #66-133, "Soviet research on the neural effects of microwaves"

319. DOLATKOWSKI, A., LENKO, J., MROZ-WASILEWSKA, _. & Wochna, Z. (1964) Polish Medical J. 138(3):1156-1163, "Studies on the effect of microwaves emitted by radar devices on the testicles and epididymides of the rabbit"

320. DOLINA, L. A. (1959) In Book, Summaries of reports, Labor Hygiene and the Biological Effect of Radio Frequency Electromagnetic Waves, Moscow, pp. 44-45 [Title not given]

321. DOLINA, A. (1961) Arkhiv fur pathologii 23(1):51-57, "Morphological changes in the central nervous system following the action of centimeter waves on the organism. (An experimental investigation)"

322. DONDERO, R. L. (1958) Medical News Letter 31(2):22-, (Abstracted from Proc. 1st Tri-service Conf. on Biological Hazards of Microwave Radiation (Pattishall, E. G., ed.) 1:115-118, (1957)), "Determination of power density at microwave frequencies"

323. DOOLEY, E. S., GILLENWATER, J. Y., & FROHLICH, E. D. (1963) U. S. Army Medical Research Lab., Fort Knox, Rpt. 565, (AD 411221), 23 pages, "Altered renopressor response-pattern to endotoxin radiated with radio-frequency energy"

324. DOUGHERTY, J. D., CALDWELL, J. C., HOWE, W. M., & CLARK, W. B. (1965) Aerospace Med. 36:466-471, "Evaluation of an alleged case of radiation induced cataract at a radar site"

325. DROGICHINA, E. A. (1960) In: The Biological Action of Ultrahigh Frequencies, (Letavet, A. A., & Gordon, Z. V., eds.), Moscow, (JPRS #12471, pp. 22-24, (1962)), (Translation of O Biologicheskom Vozdeistvii Sverkhvysokikh Chastot, Moscow, Acad. of Med. Sci., USSR, 1960, pp. 29-31); (Also in Biological Effects of Microwaves, "Effect of chronic exposure to UHF on the human organism", pp. 7-8, ATD P-65-68, Sept. 1965), "The clinical aspects of chronic influence of SHF/UHF on the human organism"

326. DROGICHINA, E. A., & SADCHIKOVA, M. A., (1963) Abstracts of Conf. on Industrial Hygiene and the Biological Action of Radio Frequency Electromagnetic Fields. Institute of Industrial Hygiene and Occupational Diseases, Acad. Med. Sci., Moscow; 29 pages

327. DROGICHINA, E. A., & SADCHIKOVA, M. A. (1964) Trudy Nii Gigiena Truda i Profzabolevaniya,USSR, (2):105-109, "Clinical syndromes during the action of various radio frequency ranges"

328. DROGICHINA, E. A., & SADCHIKOVA, M. N. (1965) Gigiyena Truda i Professional'nyye Zabolevaniya (Labor Hygiene and Occupational Diseases) 9(1):17-21 (JPRS #29694, TT:65-30791), "Clinical syndromes arising under the effect of various radio frequency bands"

329. DROGICHINA, E. A., SADCHIKOVA, M. A., & GINZBURG, D. A. (1962) In: Summaries of reports, Questions of the Biological Effect of a SHF-UHF Electromagnetic Field. Kirov Order of Lenin Military Medical Academy, Leningrad, p. 22 only, "Clinical symptoms of acute phases of continuous action of centimeter waves"

330. DROGICHINA, E. A., SADCHIKOVA, M. A., GINZBURG, D. A., & CHULINA, N. A. (1962) Gigiena Truda i Professional'nye Zabolevaniya, USSR, 6(1):28-34, (JPRS 13157), "Certain clinical manifestations from chronic exposure to centimeter waves"

331. DROGICHINA, E. A., SADCHIKOVA, M. N., SMEGOVA, G. V., KONCHALOVSKAYA, N. M., & GLOTOVA, K. V. (1966) Gigiena Truda i Professional'nye Zabolevaniya 10(7):13-17, (JPRS 38663, LC-ATD-66-124, AD 644360), "The problem of autonomic (vegetative) and cardiovascular disorders during the chronic action of SHF electromagnetic fields"

332. DRUZ, V. A., & MADIYEVSKII, V. M. (1956) Biophysics 11:724-731 (In English), (Biofizika 11(4):631-637), "Effect of constant magnetic and low-frequency electromagnetic fields on the hydration capacity of surviving tissues"

333. DUHAMEL, J. (1959) Presse Med. 67(4):151-, (In French) "Biological effects of ultrahigh frequency radio waves"

334. DUMANSKIY, YU. D. (1966) (Ref.?) ATD-66-92, "Hygienic evaluation of radio frequency electromagnetic waves"

335. DUMANSKIY, YU. D. (1967) Vestnik Akademii Meditsinskikh Nauk USSR, 22(8):47-52, (ATD 68-105-108-9, Soviet Radiobiology (June 1968)), (AD 671436), "Hygienic evaluation of radio frequency electromagnetic fields in populated areas"

336. DYAKOV, YU, P. (1957) Trudy Voy Med. Akad. i Kirov, USSR, 73:20 only, [Title not given]

337. DZYAMIDAVA, S. I., & KULIN, YA. T. (1967) Akademiia Navuk BSSR, Minsk, Vesti Seryya Biyalahichnykh Navuk (2):84-86, (Abstr. in ATD Rpt 68-105-108-9, Soviet Radiobiology, p. 73 only, (June 1968), AD 671436), "Effects of ultrahigh frequency exposure on the amount of glycolysis-intermediate products in yeast cells"

338. EAKIN, S. K. (1964) Doctoral Dissertation, Baylor Univ., "Behavioral effects of stimulation by UHF radio fields"

339. EAKIN, S. K., & THOMPSON, W. D. (1962) Psychological Reports 11:192 only, "Effects of microwave radiation on the activity level of rats"

340. ECKER, H. A., ZIMMER, R. P., & CAMP, R. W. (1969) Georgia Institute of Technology, Tech. Note #1, "Preliminary investigation of the use of electromagnetic radiation in differential hypothermia"

341. EDELWEJN, Z. (1968) Acta Physiologica Polonica 19(6):897-906, (In Polish with English summary) "An attempt to assess the functional state of the cerebral synapses in rabbits exposed to chronic irradiation with microwaves"

342. EDELWEJN, Z., & BARANSKI, S. (1966) Lekarz Wojskowy, Poland, (9):781-786, (In Polish), (NASA TT-F-10-612, Jan. 1967), "Investigation of the effects of irradiation on the nervous system of personnel working with microwave fields"

343. EDELWEJN, Z., & HADUCH, S. (1962) Acta Physiologica Polonica 13(3):431-435, (In Polish), (Physiological Polonica 13(3): 371-374, (1963), English transl.), "Electroencephalographic studies in persons exposed to microwaves"

344. EDEN, W. M. (1970) Paper presented at 4th Annual Midyear Topical Symposium, Health Physics Soc., Electronic Product Radiation and the Health Physicist, Louisville, Ky., 28-30 Jan.; Bur. of Radiation Health, Div. of Electronic Product Rept. No. 70-26, pp. 159-172, "Microwave oven repair: hazard evaluation"

345. EDMUNDS, F. E. (1961) Proc. 4th Tri-service Conf. on the Biological Effects of Microwave Radiation, Vol. 1 (Peyton, M. F., ed.) p. 327-, "Naval exposure environment"

346. EGAN, W. G. (1957) Electrical Engineering 76:126-, "Eye protection in radar fields"

347. EISENBUD, M. (1954) Annual Progress Report to the Commission on Environmental Hygiene of the Armed Forces Epidemiological Board, (AD 431047L), "Exposure of radar workers to microwaves"

348. EL'DAROV, A. L., & KHOLODOV, YU. A. (1964) Zh. Obshchei Biologii 25(3):224-229, "The effect of a permanent magnetic field on the motor activity of birds"

349. ELDER, R. L. (1971) In: Proc. "Biological Effects of Non-Ionizing Radiation" Symposium, (Rosenthal, S. W., Chm.), New York, 22-25 Mar., "Introduction-development of regulatory programs under the Radiation Control for Health and Safety Act of 1968"

350. ELEAZAROVA, M. P. (1940) Moskovskaia oblastnaia klinika fizicheskikh metodov lecheniia. Trudy (Moscow) 4:177-, "Changes in protein metabolism under the influence of UHF fields"

351. ELISEEV, V. V. (1964) In: The Biological Action of Radio-Frequency Electromagnetic Waves, Moscow, p. 94-, "Method of irradiating animals in experimental investigations of the action of radio-frequency electromagnetic waves"

352. ELISEEVA, M. I. (1937) Sbornik Biol. deistvii UHF, (Compilation of Biological Effects of UHF Radiation), (In Russian), 261 pages, "Glycaemic reaction in rabbits to the action of electrical fields of UHF"

353. ELY, T. S. (1958) Proc. 2nd Tri-service Conf. on Biological Effects of Microwave Energy (Pattishall, E. G., & Benghart, F. W., eds.) 2:97-104 (AD #131477), "Field trial of Richardson microwave dosimeter"

354. ELY, T. S. (1959) Digest of Technical papers, Proc. of 12th Annual Conf. on Electrical Techniques in Medicine and Biology (Schwan, H. P., Chm.), Lewis Winner, pub., New York, "Review of some recent research on the whole body effects of microwaves"

355. ELY, T. S., & GOLDMAN, D. E. (1957) Proc. of 1st Tri-service Conf. on Biological Hazards of Microwave Radiation (Pattishall, E. G., ed.) 1:64-75, (Also Naval Medical Research Institute Research Rpt 15, 77-138, (1957); (with Hearon, J. Z.), IEEE Trans. on Bio-Medical Engineering, BME-11(4):123-137, (1964); and Inst. of Radio Engineers Trans. on Med. Electronics, PGME-4, 38-43 (1956)), "Heating characteristics of laboratory animals exposed to ten centimeter microwaves - summary"

356. ENGELBRECHT, R. W., & MUMFORD, W. W. (1961) Proc. 4th Tri-service Conf. on the Biological Effects of Microwave Radiation, Vol. 1 (Peyton, M. F., ed.) pp. 55-70, "Some engineering aspects of microwave radiation hazards"

481

357. ENGLAND, T. S. (1950) Nature 166(4220):480-4, "Dielectric properties of the human body for wave-lengths in the 1-10 cm range"

358. ENGLAND, T. S., & SHARPLES, N. A. (1949) Nature 163(4143):487-488, "Dielectric properties of the human body in the microwave region of the spectrum"

359. ENGLE, J. P., HERRICK, J. F., WAKIM, K. G., GRINDLAY, J. H., & KRUSEN, F. H. (1950) Arch. of Physical Med. 31:453-461, "The effects of microwaves on bone and bone marrow, and on adjacent tissues"

360. EPSTEIN, N., & COOK, H. (1951) British J. of Cancer 5:244-, "The effects of microwaves on the 'Rous N-1' fowl sarcoma virus"

361. ERICKSON, E. E., & KINNEY, R. A. (1969) Louisiana State Univ., Baton Rouge, Tech. Rpt #2, (AD 685644), "A study of the feasibility of stimulating neurons by electromagnetic waves"

362. ERRERA, J. (1939) ACTA Unio Internationalis contra cancrum (Paris) 4:195-203, (In French) "Colloidal solutions and high frequency radio waves"

363. ERSHOVA, L. K., & DUMANSKII, YU. D. (1969) Fiziologichnyy Zh. (Kiev) 15(6):777-780, (In Ukr. with English summary), "Cortical biopotentials in rabbits under the effect of low intensity electromagnetic fields with radio frequency waves"

364. ESAY, A., et al. (1936) Naturwissenschaften 24:520-, "Temperature measurements of biological tissue layers at frequencies of 2.7 x 10^7 Hz to 1.2 x 10^9 Hz"

365. ESSMAN, L., & WISE, C. (1950) Arch. of Physical Med. 31:502-507, "Local effects of microwave radiation on tissues in the Albino rat"

366. ETTER, H. S., PUDENZ, R. H., & GERSH, I. (1947) Arch. of Physical Med. 28:333-344, "Injurious effects of tissues contiguous to implanted surgical methods"

367. ETTINGER, H. J. (1963) Los Alamos Sci. Lab., USAEC Health and Safety Information, Issue 171 (Sept.), "Microwave hazards"

EVERDINGEN (See Van Everdingen)

368. FAGO, E. T. (1966) Midwest Research Institute, Kansas City, Mo., Final Rpt. (March 1965 to August 1966) to the Naval Ship Systems Command, "Evaluation of radio-frequency protective clothing and measuring instruments"

369. FAITEL'BERG-BLANK, V. P. (1962) Fiziologicheskiy Zh. SSSR 48(6):735-741, (In Russian) "Absorptive, gastric, and intestinal activity under the influence of the microwave electric field"; (Also, Federation Proc. 22, Trans. Supp. pp. T301-T305 (1963), (in English), "Absorptive activity of stomach and intestine under the influence of a UHF electric field")

370. FAITEL'BERG-BLANK, V. R. (1962) Akademiia nauk SSSR, Kiev Dopovidi (10):1367-1370, (In Russian), "The effect of centimeter-band radio waves on the absorption of amino acids, chlorides, and water in the stomach and intestine"

371. FAITEL'BERG-BLANK, V. R. (1963) Biulleten Eksperimental'noi Biologii i Meditsiny (Moskva) 56(8):70-74, (In Russian); (Also, Chemical Abstracts 59:14387-g), "Effect of long-wave diathermy on the absorption by the stomach and intestine"

372. FAITEL'BERG-BLANK, V. R. (1964) Biulleten Eksperimental'noi Biologii i Meditsiny (Moskva) 57(1):45-48, (In Russian); (Abstr. in The Biological Effects of Electromagnetic Fields - Annotated Bibliography, ATD Rept. P-65-17, Apr. 1965), "Effect of high frequency waves of centimeter wavelength on the absorptive activity of the stomach and intestine"

373. FAITEL'BERG-BLANK, V. R. (1965) Patologicheskaia Fiziologiia i Eksperimental'naia Terapiia (Moskva) 9(4):90 only, (In Russian) "Changes in absorptive and secretory functions of the stomach affected by experimental ulcers from exposure of the organism to high frequency physical agents"

374. FAITEL'BERG-BLANK, V. R. (1965) Fiziologicheskii Zh. SSSR Sechenova 51(3):372-377, (In Russian) "Variation in mechanism of gastric and intestinal absorptive activity upon exposure to SHF-UHF radiowaves (in the centimeter range)"

375. FAITEL'BERG-BLANK, V. R. (1965) AN UKR RSR Dopovida Akad. Sci. _(1):113-116, (In Russian); (Abstr. in Biological Effects of Microwaves, ATP-P-65-68, pp. 56-58), "Role of the CNS and autonomic nervous system in the mechanism of the action of SHF-UHF on gastrointestinal absorption"

376. FELORENKO, N. YE., & SPASSNIY, A. A. (1966) Elektroanaya Obrabotka Materiolov 5:55-62, (Abst. in ATD Rpt 68-105-108-9, Soviet Radiobiology, p. 74 only (June 1968), AD 671436), "Method of exposing the active electrical field of living organisms"

377. FELLOWS, O. N., GRAY, O. S., & SANDERS, M. (1970) Presented before the New York Academy of Sciences, Nov. 1970 at the Symposium on "Effect of Controlled Electromagnetic Energy on Biological Systems", 7 pages, "Selective effect of electromagnetic energy on viruses"

378. FENN, J. E. (1969) Canadian Medical Assoc. 100:251-254, "Effect of pulsed electromagnetic energy (Diapulse) on experimental hematomas"

379. FERREIRA, J., & CARDANELLI, J. (1957) Case Practice Medicine 34:262-, "Lipophegin granuloma of abdominal wall due to diathermy"

380. FERRIS, B. G., JR. (1966) New England J. of Med. 275:1100-1105, "Environmental hazards: electromagnetic radiation"

381. FELCHT, B. L., RICHARDSON, A. W., & HINES, H. M. (1949) Arch. of Physical Med. 30:164-169, "Effects of implanted metals on tissue hyperthermia produced by microwaves"

382. FIDEL'MAN, F. M., & RASINA, G. YA. (1967) Gigiena Truda i Professional'nye Zabolevaniia (Moskva) _(8):56-57, (ATD Rept. 68-105-108-9 Soviet Radiobiology, pp. 74-75 (June 1968); AD 671436), "Hygienic evaluation of intensity levels for HF electromagnetic fields at Chelyabinsk Industrial plants, and the means of protection against the fields"

383. FIGAR, S. (1963) Ceskoslovenska Fysiologie (Praha) 12(5):316 only, (In Czech), (ATD Rept. U-64-110 (English abst.), 7 pages, AD 623253), "Effect of a strong electromagnetic field on vasomotor activity"

384. FINCH, H. (1955) General Electric Lab., BA102 Data Folder DF55CL-278, "Bibliographical abstract of biological effects of electromagnetic radiation"

385. FINKELSTEIN, S., & ROTH, E. M. (1968) In: Compendium of Human Responses to the Aerospace Environment, 1, (5), pp. 1-22, "Electrical current"

386. FISCHER, F. P., NEUBAUER, R. A., & SARKEES, Y. T. (1959) In: Investigators' Conf. on Biological Effects of Electronic Radiating Equipments, (Kauf, G. M., Chm.), pp. 19-25 (for Parts I, II, & III), Part I. "Studies on the biological effects of 200 megacycles"; Part II, Osborn, C. M., (title not given), and Part III, Addington, C., "Ophthalmological studies"

387. FISCHER, F. P., NEUBAUER, R. A., SARKEES, Y. T., ADDINGTON, C. H., OSBORN, C., & SWARTZ, G. (1959) Proc. 3rd Tri-service Conf. on Biological Effects of Microwave Radiating Equipments (Swaskind, C., ed.) 3:15-21, "Electrical instrumentation of bio-electric hazards at 200 mc, and the development of a miniature hazard meter"

388. FISHER, L. I. (1964) Voprosy Kurortologii Fizioterapii, i Lechebnoy Fizicheskoy Kultury (Problems of Health-Resort Science, Physiotherapy, and Therapeutic Physical Culture), 29(2):149-154, (OTS-64-31500; JPRS 25121, pp. 9-16), "Use of SHF-UHF therapy in acute nephritis"

389. FIXOTT, R. S., & ROSE, _. (1956) Rpt, School of Aviation Medicine, U. S. Air Force (March), "Ocular findings on electronics personnel"

390. FLAX, H. J., MILLER, R. N., & HORVATH, S. M. (1949) Arch. of Physical Med. 30:630-637, "Alterations in peripheral circulation and tissue temperature following local application of short wave diathermy"

391. FLEMING, H. (1944) Electrical Engineering 63(1):18-21, "Effect of high frequency fields on micro-organisms (bacteria)"

392. FLEMING, J., JR., PINNEO, L., BAUS, R., JR., & McAFEE, R. (1961) Proc. 4th Tri-service Conf. on the Biological Effects of Microwave Radiation, Vol. 1 (Peyton, M. F., ed.), pp. 229-249, "Microwave radiation in relation to biological systems and neural activity"

393. FOFANOV, P. N. (1966) Klinicheskaya Meditsina 44(4):18-22, (JPRS 36301; TT-66-32733), "Features peculiar to hemodynamics in persons working in conditions of protracted electromagnetic high frequency radiation"

394. FOFANOV, P. N. (1966) Probl. Endokrinologii i Gormonoterapii, Moscow 12(5):16-17, (In Russian), (JPRS-39265), "On functional changes of the thyroid gland in persons exposed to the effect of microwave irradiation (preliminary report)"

395. FOFANOV, P. N. (1968) Sovetskaya Meditsina 31(9):107-110, (In Russian), "Clinical picture of continuous action of SHF-UHF electromagnetic radiation on man"

396. FOFANOV, P. N. (1969) Kardiologiya 9(4):124-126, (JPRS 48481, July 1969), "Hemodynamic changes in individuals working under microwave irradiation"

397. FOLLIS, R. H., JR. (1946) Amer. J. of Physiology 147:281-283, (Also, Proc. 4th Tri-service Conf. on the Biological Effects of Microwave Radiation, Vol. 1 (Peyton, M. F., ed.) pp. 229-249, 1961), "Studies on the biological effects of high frequency radio waves (radar)"

398. FORTUNATOW, E. (1968) Report, ATD 68-105-108-9; N68-33037; AD 671436, "Soviet Radiobiology"

399. FRAENKEL, G. (1937) Archives Des Sciences Biologique 47(3):115-132, (Arkh. Biol. Nauk), (In Russian) "A summary of our studies in the electric field of ultra-high frequency"

400. FRANKE, V. A. (1957) In: Proc. of Jubilee Scientific Session of Institute of Labor Hygiene and Occupational Diseases of Academy of Medical sciences of the USSR, Moscow, pp. 71-, "Measurement of electric and magnetic components of a high-frequency field in the immediate vicinity of radiation sources (in the induction zone) in the range 100 kHz - 300 MHz"

401. FRANKE, V. A. (1958) In: Protection from the Action of Electromagnetic Fields and Electric Current in Industry, Leningrad, p. 64-, "Measurement of electric and magnetic components of a high-frequency field in the frequency range 100 kHz to 3 MHz, and the design of equipment"

402. FRANKE, V. A. (1959) In: Summaries of reports, Labor Hygiene and the Biological Effect of Radio Frequency Electromagnetic Waves, Moscow, "Dependence on the frequency of the absorption of energy by a human in an electromagnetic field"

403. FRANKE, V. A., et al. (1962) Circulation Research 10:870-, "Study of high-frequency components in electrocardiograms by power spectrum analysis"

404. FRANKE, V. A., & USHINSKAYA, O. (1962) Arbeitsoekonomik und Arbeitsschutz (Labor Economy and Occupational Safety) 6(1): 65-71, (In German) "Personnel safety problems confronting operators of (HF and VHF) radio frequency equipment"

405. FRANK-KAMENETSKIY, D. A. (1961) Nauka i Zhizn' (7):88-90, (Abstr. in: The Biological Effects of Electromagnetic Fields - Annotated Bibliography, ATD Rept. P-65-17 (Apr. 1965)), "Observations by physics (electromagnetics)" [Use of electromagnetic fields in biological studies]

406. FRANK-KAMENETSKIY, D. A. (1961) Doklady Akad. Sci. USSR 136(2):476-478, (In Russian), (Also Transl. in Soviet Physics Doklady (in English) 6:91-92 (1961)), "Plasma effects in semiconductors, and the biological effect of radiowaves"

407. FRANKLIN, P. (ed.) (1969) Microwaves 8(9):13-14, "Microwave safe exposure level scrutinized"; p. 14, "Low level microwaves stop frogs' hearts"; (1969) p. 16, "Monkey deaths denied in RF bio-tests at Sanders"

408. FRASER, A., & FREY, A. H. (1968) Biophysical J. 8(6):731-734, "Electromagnetic emission at micron wavelengths from active nerves"

409. FRENCKEL, G. L. (1941) Arkh. Biologii Nauk, Archives Des Sciences Biologiques 61(1):147-156, "Urgent problems of high frequency therapy and their experimental accomplishment"

410. FRENKEL', G. L. (1937) In: All Union Institute for Experimental Medicine, Moscow, pp. 115-137, also p. 410, "Some characteristics of the biological effect of VHF-HF"

411. FRENKEL', G. L. (1939) The Electrical (UHF-VHF-HF) Field (Ultrashort Waves) in Biology and Experimental Medicine, Vols. I and II; Vols. III and IV (1940) (Elektricheskaye pole ul'travysokoy chastoty (ul'trakorotkiye volny) v biologii i eksperimental'noy meditsine, Medgiz, Moscow, Leningrad)

412. FRENKEL', G. L., & KUPALOV, P. S. (1937), See Kupalov and Frenkel' (1937)

413. FREY, A. H. (1961) Aerospace Med. 32(12):1140-1142, "Auditory system response to radio frequency energy: technical note"

414. FREY, A. H. (1961) Presented at Aerospace Medical Assoc. Meeting, April, (Also at 4th Internat. Conf. on Medical Electronics, 20 July, Cornell Univ., Ithaca, N.Y.), "Auditory system response to modulated radio frequency energy"

415. FREY, A. H. (1961) In: Digest of the 1961 Internat. Conf. on Medical Electronics, 4th, (Frommer, P. L., ed.), p. 158 only, "Human auditory system response to modulated radio frequency energy"

416. FREY, A. H. (1962) J. of Applied Physiology 17(4):689-692, "Human auditory system response to modulated electromagnetic energy"

417. FREY, A. H. (1963) Amer. J. of Medical Electronics 2(1):28-31, "Some effects on human subjects of ultra-high frequency radiation"

418. FREY, A. H. (1963) Naval Research Reviews 16:1-, "Human response to very-low-frequency (VLF) electromagnetic energy"

419. FREY, A. H. (1965) Psychological Bulletin 63(5):322-337 (Also Rpt. #64-01, Institute for Research, State College, Pa., (47 pages), AD #606961), "Behavioral biophysics"

420. FREY, A. H. (1967) J. of Applied Physiology 23(6):984-988, (AD 678943), "Brain stem evoked responses associated with low-intensity pulsed UHF energy"

421. FREY, A. H. (1970) In: Proc. of the "Biological Effects and Health Implications of Microwave Radiation" Symposium, (Cleary, S. F., ed.), Bur. of Rad. Health, Div. of Bio. Effects, Rept. No. 70-2, pp. 134-139, (AD 698195; N70-20352), "Effects of microwave and radio frequency energy on the central nervous system"

422. FREY, A. H., & SEIFERT, E. (1968) Life Sciences 7 (part II):505-512, (AD 678942), "Pulse modulated UHF energy illumination of the heart associated with change in heart rate"

423. FRICKER, S. J. (1957) Proc. 1st Tri-service Conf. on Biological Hazards of Microwave Radiation (Pattishall, E. G., ed.) 1:77-78, "Biologically meaningful units of RF measurement and dosimetry development"

424. FRICKER, S. J. (1957) Proc. 1st Tri-service Conf. on Biological Hazards of Microwave Radiation (Pattishall, E. G., ed.) 1(Appendix C):104-108, "Summary of results of UHF radiation hazard experiments at Lincoln Laboratory, MIT"

425. FRICKER, S. J. (Moderator) (1957) Proc. 1st Tri-service Conf. on Biological Hazards of Microwave Radiation (Pattishall, E. G., ed.) 1:79-88, "Microwave exposure discussion"

426. FRIEND, A. W., JR. (1970) Report, Moore School of Electrical Engineering, Univ. of Pennsylvania, "Some research results concerning the effects of AC electric fields and pulses on the Giant Amoeba, Chaos chaos"

427. FRIEND, A. W., JR. (1970) (A Report proposal for a course at Univ. of Pennsylvania, May), "An investigation of motion of living cells and related electrical, mechanical, and optical phenomena, using giant amoebae and the techniques of microcircuitry"

428. FROLOVA, L. T. (1963) Gigiena Truda i Professional'nye Zabolevaniya (Moskva) (Labor Hygiene and Occupational Disease) (2):27-29, (JPRS 19068, pp. 6-9, OTS 63-21756, N64-11858), "Hygienic evaluation of the working conditions in work with high-frequency currents"

429. FROMMER, P. L., (ed.) (1961) Digest of the 1961 Internat. Conf. on Medical Electronics. Plenum Press, New York, Biological Effects of Microwaves, I (Athermal Aspects)

430. FUCHS, G. (1952) Wiener Medizinische Wochenschrift 102:583-588, (In German) "The combined shortwave and x-ray therapy of malignant tumors"

431. FUKALOVA, P. P. (1964) Trudy Nii Gigiena Truda i Profzabolevaniya,USSR, (2):78-79, (JPRS 34,963) "The effect of short and ultrashort waves on body temperature, and the survival rate of experimental animals"

In:

432. FUKALOVA, P. P. (1964)/Biological Effects of Radio Frequency Electromagnetic Fields, Inst. of Industrial Hygiene and Occupational Diseases, Academy of Med. Sci., USSR. (Trudy Nii Gigiyena Truda i Profzabolevaniy, Moscow, USSR, (2):144-148) (In Russian) "Sensitivity of olfactory and visual analyzers in individuals exposed to continuously generated short and ultrashort waves"

433. FUKALOVA, P. P. (1964) In: Biological Effects of Radio Frequency Electromagnetic Fields, Inst. of Industrial Hygiene and Occupational Diseases, Academy of Med. Sci., USSR, Moscow (Trudy Nii Gigyena Truda i Profzabolevaniy (2):158-163) (Transl. in: The Biological Action of Radio Frequency Electromagnetic Fields), "Hygiene characteristics of working conditions with sources of shortwave and ultrashort waves at radio and television stations"

434. FUKALOVA, P. P. (1966) Gigiena i Sanitariya, USSR, 31(2):306-308, (TT 66-51160/4-6, in English), "Effectiveness of protection against shortwave and ultrashortwave electromagnetic fields at radio and TV stations"

435. FUKALOVA, P. P., & SMUROVA, YE. I. (1962) In: Summaries of reports, Questions of the Biological Effect of a SHF-UHF Electromagnetic Field. Kirov Order of Lenin Military Medical Academy, Leningrad, pp. 57-58, "Changes in the functional condition of some analyzers (sense receptors?) in persons exposed to SHF-UHF fields"

436. FUKALOVA, P. P., TOLGSKAYA, M. S., NIKOGOSYAN, S. V., KITSOVSKAYA, I. A., & ZENINA, I. N. (1966) Gigiena Truda i Professional'nye Zabolevaniia (Moskva) USSR, 10(7):5-9, (ATD Rpt 66-126, JPRS 38,663 (16 Nov. 1966), AD 644537), "Research data on the standardization of electromagnetic fields in the short and ultrashort wave ranges"

437. FUREDI, A. A., & OHAD, I. (1964) Biochimica et Biophysica Acta 79:1-8, "Effects of high-frequency electric fields on the living cell: I. Behavior of human erythrocytes in high-frequency electric fields and its relation to their age"

438. FUREDI, A. A., & VALENTINE, R. C. (1962) Biochimica et Biophysica Acta 56:33-42, "Factors involved in the orientation of microscopic particles in suspensions influenced by radio-frequency fields"

439. FURMAN, S., PARKER, B., KRAUTHAMER, M., & ESCHER, D. J. W. (1968) Annals of Thoracic Surgery 6(1):90-95, "The influence of an electromagnetic environment on the performance of artificial cardiac pacemakers"

440. GALE, C. K. (1935) Arch. of Physical Therapy 16:271-277, "Penetrative and selective heat effects of short and ultrashort waves. (An experimental study with unicellular organisms and with electrolytes)"

441. GAPEYEV, P. I. (1957) Trudy Voenno-meditsinskoi akademii Krasnoi Armii imeni S. M. Kirova 73:152-, "The effect of SHF-UHF fields on sight organs"

442. GATEV, S. (1965) Voenno Meditsinski delo 20(3):30-35, (In Russian) "Treatment of tenovaginitis with microwave (radar) and hydrocortisone phonophoresis"

443. GEL'FON, I.A. (1964) In: Biological Effects of Radio Frequency Electromagnetic Fie Inst. of Industrial Hygiene and Occupational Diseases, Academy of Med. Sci., USSR, Moscow, pp. 68-69, "The effect of 10 low-intensit electromagnetic waves on the histamine content in the blood of animals"

444. GEL'FON, I. A., FEDOKOVA, V. I., & PATUSHINSKII, G. I. (1965) Gigiena Truda i Professional'nye Zabolevaniia (Moskva) USSR, 9(5):28-33, (In Russian),((JPRS 31877, English summary), "Effect of VHF-HF therapy on connective tissue proteins of the lungs in experimental silicosis"

445. GEL'FON (1960) Trudy Nii Gigyena Truda i Profzabolevaniy, USSR (1):46-49, (In Russian),(Also an article with similar title: ibid. (2):133-136 , (1964); (Also in Biological Action of UHF, Letavet, A. A., & Gordon, Z. V., (eds.), Academy of Medical Sciences USSR, Moscow, (OTS 62-19175), (JPRS 12471, pp. 42-46), "Protein fractions and histamine of the blood under the influence of SHF-UHF and HF radio waves"

446. GEMBITSKIY, YE. V. (1962) In: Summaries of reports, Questions of the Biological Effect of a SHF-UHF Electromagnetic Field. Kirov Order of Lenin Military Medical Academy, Leningrad, pp. 14-15, "Material on the clinical aspects of chronic microwave effects"

447. GEMBITSKIY, S. V. (1968) Honvedorvos (2)(Apr-Jun):114-115, "Some problems in the area of the biological effects of high-frequency electromagnetic fields"

448. GEMBITSKIY, YE. V., KOLESNIK,, F. A., & MALYSHEV, V. N. (1969) Voyenno-Meditsinskiy Zh. (Military Medical J.) (5):21-23, "Changes in the blood system during chronic exposure to a superhigh-frequency field"

449. GENTILE, N. (1934) (In Italian with English summary) Abstracts of the 1st Internat. Congress of Electro-radio-biology, Cappelli, L., (ed.), Bologna, Italy, pp. 356-359, "Induced human radiation"

450. GERNSBACH, H. (1959) Radio Electronics (?):29-, "Lethal radio waves"

451. GERSTEN, J. W., WAKIM, K. G., HERRICK, J. F., & KRUSEN, F. H. (1949) Arch. of Physical Med. 30:7-25, "The effect of microwave diathermy on the peripheral circulation and on tissue temperature in man"

452. GERSTEN, J. W., WAKIM, K. G., & KRUSEN, F. H. (1950) Arch. of Physical Med. 31:281-286, "A method for decreasing reflection of microwaves by tissue"

453. GHETTI, B. (1934) (In Italian with English summary) Abstracts of the 1st Internat. Congress of Electro-radio-biology, Cappelli, L., (ed.), Bologna, Italy, pp. 360-366, "Report on tests to determine the possible influence of very short electromagnetic waves (2-3 m) on seed germination and plant development"

454. GIESE, A. C. (1947) Quarterly Review of Biology 22(4):253-283, "Radiations and cell division"

455. GILL, S. J. (1959) Univ. of Colorado, Progress Rpt. to Office of Naval Research (Nov.), (AD 229625), "Magnetic susceptibility of single biological cells"

456. GILLES, E. (1944) Comptes Rendus 123:546-547, (In French) "Lethal effects of ultrasnort waves on microorganisms"

457. GILLES, E. (1944 Comptes Rendus 123:565-567, (In French) "Fungicidal and bactericidal effects of ultrashort waves are a consequence of selective thermal action under certain conditions"

458. GINZBURG, D. A., & SADCHIKOVA, M. A. (1964) Trudy nii Gigyena Truda i Profzaboleaniy, USSR, (2):126-132, (Abstr. in: The Biological Action of Radio Frequency Electromagnetic Fields, Moscow), "Changes of the electroencephalogram under continuous action of radio waves"

459. GIORI, F. A., & WINTERGERBER, A. B. (1967) Biomedical Sciences Instrumentation 3:291-308, "Remote physiological monitoring using a microwave interferometer"

460. GLASER, Z. R., & HEIMER, G. H. (1971) Institute of Electrical and Electronics Engineers, Trans. on Microwave Theory and Techniques, (Special Issue on the Biological Effects of Microwaves), MTT-19(2):232-238, "Determination and elimination of hazardous microwave fields aboard Naval ships"

461. GLEZER, D. YA. (1936) Fiziologicheskiy Zh., SSSR 20:5-, (Abstr. in: "The Biological Effects of Electromagnetic Fields - Annotated Bibliography, ATD Rpt P-65-17 (Apr. 1965)) [Title not given]

462. GLEZER, D. YA. (1937) In: Materials of the Leningrad Conference on VHF-HF Waves, Leningrad, pp. 5-18, [Title not given]

463. GLEZER, D. YA. (1940) Referaty rabot uchrezhdeniy otdeleniya biologicheskikh nauk za, (Abstracts of Studies by the Department of Biological Sciences for 1940), Moscow - Leningrad, pp. 318-, (Abstr. in: The Biological Effects of Electromagnetic Fields - Annotated Bibliography, ATD Rpt P-65-17, Apr. 1965) [Irradiation of the heads of dogs with 7.7 m electromagnetic waves]

464. GLEZER, D. YA. (1940) Nauchnyi Institut imeni P. F. Lesgaft, Leningrad Izvestiia, 22:5-146, (In Russian with German summary pp. 142-146) (Abstr. in: The Biological Effects of Electromagnetic Fields - Annotated Bibliography, ATD Rpt P-65-17, 1965), "Ultra short waves and their effect on the organs of the circulatory system"

465. GLEZER, D. YA. (1940) Referaty nauchno-issledovatel'skogo uchrezhd, OBNAN SSSR, Leningrad, "The effect of ultra short waves on the higher nervous activity"

466. GLOTZ, H. C. (1951) Archiv fur Physikalische Therapie 3:45-50, "The increase in fluid production during ultrashort wave irradiation of the head"

467. GOFF, L. G. (1957) Proc. Tri-service Conf. on Biological Hazards of Microwave Radiation (Pattishall, E. G., ed.) 1: p. 76 only, "Remarks at microwave conference" (Pertinent to Navy's program of microwave research)

468. GOGIBEDASHVILI, V. G. (1954) Gosudarstvennyy nauchno-issledovatel'skiy Institut Kurortologii i Fizioterapii, Referativnyy Sbornik Trudov, Tbilisis, 22:151-178, (Abstr. in: The Biological Effects of Electromagnetic Fields - Annotated Bibliography, ATD Rpt P-65-17, Apr. 1965), "Concerning the participation of the nervous system in the mechanism of UHF action on the secretory function of the stomach"

469. GOGIBEDASHVILI, V. G. (1954) Gosudarstvennyy nauchno-issledovatel'skiy Institut Kurortologii i Fizioterapii, Referativnyy Sbornik Trudov, Tvilisii, 21:176-, (Abstr. in: The Biological Effects of Electromagnetic Fields - Annotated Bibliography, ATD Rpt P-65-17, Apr. 1965), "Influence of UHF fields on the secretory function of the stomach"

470. GOLDBLITH, S. A. & WANG, D. I. (1967) Applied Microbiology 15:1371-1375, "Effect of microwave on Escherichia coli and Bacillus subtilis"

471. GOLDMAN, D. E. (1960) NMRI Lecture & Review Series, No. 60-6, 1959-1964, (Sept.) pp. 247-255, (Also AD 252582) "Short wave electromagnetic radiation as a hazard to personnel"

472. GOLENDBERG, A. D., YEVSTIFEYEVA, M. I., GLAZUNOVA, YE. I., LYZHKOVA, A. YA., & OSTRYAKOVA, A. N. (1965) Voprosy Kurortologii, Fizioterapii, i Lechebnoy Fizicheskoy Kul'tury (Problems in Health Resort Science, Physiotherapy and Medical Physical Culture) Moscow, 30(1):45-47 (JPRS #29914, pp. 9-13, TT 65-30903), "Experience with microwave therapy"

473. GOLISCHEVA, K. P. (1937) In: Problems of Metrics and Dosimetry of Ultrahigh Frequency in Biology and Medicine, Moscow, pp. 63-74

474. GOLISCHEVA, K. P. (1937) Archiv Des Sciences Biologiques (Arkh. Biol. Nauk), 47(3):133-140, (In Russian with English Summary),(Abstr. in: The Biological Effects of Electromagnetic Fields - Annotated Bibliography, ATD Report P-65-17) "Experimental study on the thermal effect of the electrical ultrahigh frequency field, II"; and pp.141-145, "Experimental study on the thermal effect of the electrical ultrahigh frequency field, III"

475. GOLISCHEVA, K. P. (1939) Arkhiv patologicheskoy anatomii i patologicheskoy fiziologii 5:5-, (Abstr. in: The Biological Effects of Electromagnetic Fields - Annotated Bibliography, ATD Rpt P-65-17, Apr.) [Title not given] [Irradiation of rabbits at UHF fields]

476. GOLISCHEVA, K. P. (1941) Arkhiv Patologicheskoi Anatomii, Moscow, 7(2):119-122, (In Russian) (Abstr. in: The Biological Effects of Electromagnetic Fields - Annotated Bibliography, ATD Rpt P-65-17, Apr.), "The effect of the electric field of ultrahigh frequency upon the temperature reaction and glycogen contents in denervated liver in cats"

477. GOLISCHEVA, K. P., & ANDRIYASHEVA, N. M. (1937) In: The Biological Action of Ultrahigh Frequency Waves, Frenkel', G. L., & Kupalov, P. S., (eds.), All Union Institute for Experimental Medicine, Moscow, pp. 309-324, "The effect of ultrahigh frequency on embryonic development of white mice"

478. GOLISCHEVA, K. P., & GAL'PERIN, S. I. (1941) Biulleten' Eksperimental'noy Biologii i Meditsiny 12(5-6): (Abstr. in: The Biological Effects of Electromagnetic Fields - Annotated Bibliography, ATD Rpt P-65-17) [Title not given]

479. GONCHAROVA, N. N., KARAMYSHEV, V. B., & MAKSIMENKO, B. V. (1966) Gigiena Truda i Professional'nye Zabolevaniia (Moskva) USSR, 10(7):10-13 (JPRS #38663, ATD Rpt 66-125), "Occupational hygiene problems in working with ultrashort-wave transmitters used in TV and radio broadcasting"

480. GONCHARUK, E. N., & PIVOVAROV, N. A. (1964) 3rd All Union Conf. on Radio Electronics, Tezisy Dokladov, Moscow, "The effect of UHF-VHF electromagnetic field on the motor reactions of man"

481. GORDON, D. A. (1948) Science 108(2817):710-, "Sensitivity of the homing pigeon to the magnetic field of the earth"

482. GORDON, Z. V. (195?) Zh. Gigiyena Epidemiologii Mikrobiologii i Immunologii, Prague _(1):399-404, "Problems of labor hygiene during work with centimeter wave generators"

483. GORDON, Z. V. (1955) Gigiyena i Sanitariya _(12):16-19, (Abstr. in Biological Effects of Microwaves, ATD P-65-68, Sept., 1965, pp. 24a-26, entitled "Effects of centimeter waves on the development of rats"), "Certain data on the action of centimeter waves"

484. GORDON, Z. V. (1957) Gigiyena Truda i Professional'nye Zabolevaniia (Moskva) _(6):14-18, "Certain problems of labor hygiene related to the influence of a UHF field"

485. GORDON, Z. V. (1957) In: Summaries of reports, Part 2, Jubilee Scientific Session of Inst. of Labor Hygiene & Occupational Diseases Dedicated to 40th Anniv. of the Great October Socialistic Revolution, Moscow, [Title not given]

486. GORDON, Z. V. (1960) Nauchno-issledovatel'skiy institut gigiena i profzabolevaniya (1):22-25 (Abstr. in: Biological Effects of Microwaves, ATD P-65-68, Sept. 1965, pp. 21-22,; also in: Letavet, A. A., & Gordon, Z. V., (eds.) (1960), pp. 18-21 (JPRS 12471) The Biological Action of Ultrahigh Frequencies), "Hygienic evaluation of the working conditions in the vicinity of UHF generators"

487. GORDON, Z. V. (1960) Trudy Nii Gigiena Truda i Profzabolevaniya,USSR, _(1):65-68 (also in: The Biological Action of Ultrahigh Frequencies, Letavet, A. A., & Gordon, Z. V., (eds.), Moscow, JPRS 12471, pp. 64-67), "Investigation of the blood pressure in rats (bloodless method) under the influence of SHF-UHF"

488. GORDON, Z. V. (1960) Trudy Nii Gigiena Truda i Profzabolevaniya, USSR, _(1):5-7, (Abstr. in Biological Effects of Microwaves, ATD-P-65-68, pp. 71-72; also, abstr. in: The Biological Action of Ultrahigh Frequencies, Letavet, A. A., & Gordon, Z. V., (eds.), Academy of Medical Sciences, USSR, Moscow, p. 2-, (JPRS 12471, OTS 62-19175), "The problem of the biological action of UHF"

489. GORDON, Z. V. (1960) In: Physical Factors of the Environment, Letavet, A. A., (ed.), p. 135-

490. GORDON, Z. V. (1960) Vestnik Akademii Meditsinskikh nauk SSSR, Moskva, 15(4):82-86, All Union Scientific Conf. on Problems of Industrial Hygiene and the Biological Action of Electromagnetic Waves

491. GORDON, Z. V. (1962) In: Summaries of reports, Questions of the Biological Effect of a SHF-UHF Electromagnetic Field. Kirov Order of Lenin Military Medical Academy, Leningrad, pp. 15-16, "Certain features of the biological effect of microwaves of various ranges"

492. GORDON, Z. V. (1964) In: Biological Action of Radio Frequency Electromagnetic Fields, Institute of Industrial Hygiene and Occupational Diseases, Academy of Medical Science, USSR, Moscow, (Trudy Nii Gigiyena Truda i Profzabolevaniy, USSR, _(2): pp. 57-60),"The effect of microwaves on blood pressure level in test animals"

493. GORDON, Z. V. (1964) In: Akademiya meditsinskikh nauk, Vestnik, 19(7):42-49, (Abstr. in: The Biological Effects of Microwaves, ATD-P-65-68, pp. 90-92; also, Herald of the Academy of Medical Sciences USSR, JPRS 27037; TT 64-51288, Oct. 1964, pp. 61-71), "Problems of industrial hygiene and the biological effect produced by radio waves of various bands"

494. GORDON, Z. V. (1964) In: Biological Action of Radio Frequency Electromagnetic Fields, Institute of Industrial Hygiene and Occupational Diseases, Academy of Medical Science, USSR, Moscow, (Trudy Nii Gigiyena Truda i Profzabolevaniy, USSR, _(2):3-9) "Results of a comprehensive study of the biological effects of radio frequency electromagnetic waves and the outlook for further research"

495. GORDON, Z. V. (1966) Gigiena Truda i Professional'nye Zabolevaniya (Moskva), 10(10):3-6, (JPRS 39820), "Electromagnetic radio frequency fields as a health factor"

496. GORDON, Z. V. (1966) (Book Review, in Foreign Science Bulletin 3(1):46-50, Jan. 1967), Biological Effects of Microwaves: Problems of industrial hygiene and the biological effects of ultrahigh-frequency electromagnetic waves, Izdatel'stvo "Meditsina", Leningrad Otdelenie, 164 pages, [Transl. by Israel Program for Scientific Translations, Ltd., Pub. by Nat. Aeronautics & Space Admin., and Nat. Sci. Foundation (TT-70-50087; NASA TT-F-633), (1970), Biological Effects of Microwaves in Occupational Hygiene]

497. GORDON, Z. V., & BELITSKIY, B. M. (1959) In: Summaries of reports, Labor Hygiene and the Biological Effect of Radio Frequency Electromagnetic Waves, Moscow, pp. 7-8

498. GORDON, Z. V., & ELISEEV, V. V. (1964) In: The Biological Action of Radio-Frequency Electromagnetic Fields, Moscow, pp. 151-, "Means of protection from SHF radiation and their effectiveness"

499. GORDON, Z. V., KITSOVSKAYA, I. A., TOLGSKAYA, M. S., & LETAVET, A. A. (1961) Digest of Internat. Conf. on Medical Electronics, in: Biological Effects of Microwaves (Athermal Aspects) I, (Frommer, P. L., ed.) Plenum Press, New York, pp. 153-

500. GORDON, Z. V., LOBANOVA, YE. A., KITSOVSKAYA, I. A., & TOLGSKAYA, M. S. (1963) Medical Electronics and Biological Engineering 1(1):67-69 (Presented at 4th Internat. Conf. on Medical Electronics, New York, July 1961), "Biological effect of microwaves of low intensity"

501. GORDON, Z. V., LOBANOVA, YE. A., KITSOVSKAIA, I. A., & TOLGSKAIA, M. S. (1969) Biulleten Eksperimental'noy Biologii Meticsiny 68(7):37-39, (In Russian with English summary), "Experimental studies of the biological effect of electromagnetic waves with wavelengths of about a millimeter"

502. GORDON, Z. V., LOBANOVA, YE. A., & TOLGSKAYA, M. S. (1955) Gigiena i Sanitariya USSR, _(12):16-18, "Some data on the (bio) effects of microwaves"

503. GORDON, Z. V., LOBANOVA, YE. A., KITSOVSKAYA, I. A., NIKOGOSYAN, S. V., & TOMASKAYA, M. S. (1962) In: Summaries of reports, Second All Union Conf. on the Application of Electronics in Biology and Medicine, (Moscow, Niiteir), p. 20-, "Data on the biological effect of microwaves of various frequencies"

504. GORDON, Z. V., & LOBANOVA, YE. A. (1960) Trudy Nii Gigiena Truda i Profzabolevaniya USSR, _(1):59-60, (Abstr. in: The Biological Action of Ultrahigh Frequencies, Letavet, A. A., & Gordon, Z. V., (eds.), JPRS 12471, pp. 57-59), "Temperature reaction of animals under the influence of SHF-UHF"

505. GORDON, Z. V., & PRESMAN, A. S. (1955) Gigiena i Sanitariya USSR, _(12):16-18, "Certain data on the action of centimeter waves (experimental investigation)"

506. GORDON, Z. V., & PRESMAN, A. S. (1956) Bureau of Technical Information, Ministry of the Radio Engineering Industry, Moscow, 14-, Preventative and Protective Measures in Work with Generators of Centimeter-Waves

507. GORDON, Z. V., TOLGSKAYA, M. S., & ALEKSANDROVA, L. S. (1963) Abstr. of the Conf. on Industrial Hygiene and the Biological Action of Radio Frequency Electromagnetic Fields, Institute of Industrial Hygiene and Occupational Diseases, Academy of Medical Sciences, Moscow, p. 23-, (Abstr. in: The Biological Effects of Electromagnetic Fields - Annotated Bibliography, ATD Rpt. P-65-17, Apr. 1965)

508. GORDON, Z. V., & YELISEYEV, V. V. (1964) Trudy Nii Gigiena Truda i Profzabolevaniya USSR _(2):151-157 (ATD abstr., JPRS 34,963), "Devices for protection against SHF-UHF radiation and their effectiveness"

509. GORDON, Z. V., et al. (1957) In: Summaries of reports, Part 2: Jubilee Scientific Session of the Institute of Labor Hygiene and Occupational Diseases Dedicated to the 40th Anniv. of the Great October Socialistic Revolution, Moscow, "Morphological changes in animals under the action of ultrahigh frequencies"

510. GORDON, Z. V., et al. (1963) Biol. i Medits. Elektronika _(6):72-, "On the biological action of microwaves of various frequencies"

511. GORE, I., & ISAACSON, N. H. (1949) Amer. J. of Pathology 25:1029-1046, "The pathology of hyperpyrexia: observations at autopsy in 17 cases of fever therapy"

512. GORODETSKAYA, S. F. (1960) Fiziologicheskiy Zh. Akad. nauk UKR SSSR, 6(5):622-628, "The effect of centimeter-band radio waves on hematogenic organs, reproduction, and the higher nervous activity"

513. GORODETSKAYA, S. F. (1961) Fiziologicheskiy Zh. Akad. nauk UKR SSSR, 7(5):672-674, "The effect of 3 cm radiowaves on the functional condition of the adrenal cortex"

514. GORODETSKAYA, S. F. (1962) Fiziologicheskiy Zh. Akad. nauk UKR SSSR, 8(3):390-396, (Also, FTD-TT-62-1361/1+2, AD #292205), "Morphological changes in internal organs when the organism is exposed to the effect of centimeter waves"

515. GORODETSKAYA, S. F. (1962) In: Summaries of reports, Questions of the Biological Effect of a SHF-UHF Electromagnetic Field. Kirov Order of Lenin Military Medical Academy, Leningrad, "The effect of SHF-UHF on reproductive organs"

516. GORODETSKAYA, S. F. (1963) Fiziologicheskiy Zh. Akad. nauk UKR SSSR, 9(3):394-395, (Also, JPRS 21200, OTS 63-31815, and N63-22588), "The effect of centimeter radio waves on mouse fertility"

517. GORODETSKAYA, S. F. (1964) Fiziologicheskiy Zh. Akad. nauk UKR SSSR, 10(4):494-500 (Abstr. in: The Biological Effects of Electromagnetic Fields - Annotated Bibliography, ATD Rept. P-65-17, Apr. 1965), (Also, JPRS 26990, N64-33486), "Effect of a SHF-UHF field and convectional heat on the estrual cycles of mice"

518. GORODETSKAYA, S. F. (1964) In: Problems of the Biophysics and Mode of Action of Radiation, (Also, JPRS 34963), pp. 70-74, "Characteristics of the biological effect of 200 cm radio waves on animals"

519. GORODETSKAYA, S. F. (1964) In: Biological Action of Ultrasound and SHF-UHF Electromagnetic Oscillations, Gorodetskiy, A.A., (ed.), Academy of Sciences, Institute of Physiology, imeni A. A. Bogomoletz, Kiev, UKR SSR, (JPRS 30860, Abstr. in: Biological Effects of Microwaves, ATD-P-65-68, (1965), pp. 53-54, and N65-28706), pp. 80-91, "Effect of a SHF-UHF electromagnetic field on the reproduction, peripheral blood composition, conditioned reflex activity, and the morphology of the internal organs of white mice"

520. GORODETSKAYA, S. F., & KEROVA, N. (1964) Fiziologicheskiy Zh. Akad. nauk UKR SSSR, 12(2):246-253, "Changes in some functional and biochemical indices in the testicles of animals exposed to 3 cm radiowaves"

521. GORODETSKIY, A. A. (ed.) (1964) Academy of sciences, Institute of Physiol. imeni, A. A. Bogomoletz, Kiev, UKR SSR, 120 pages, (JPRS 30860, TT-65-31380, and N65-28700), Biological Action of Ultrasound and Super gh Frequency Electromagnetic Oscillations

522. GORODETSKIY, A. A., YEVDOKIMOV, I. R., KOLESNI, V. M., & SHEVKO, G. N. (1967) Fiziologicheskiy Zh. 13(2):230-233, [Title?]

523. GORSHENINA, T. I. (1963) Materially Teoreticheskoy i klinicheskoy meditsiny (Tomak), _(2):pp.? "Early morphological changes after exposure to experimental electromagnetic fields"

524. GORSHENINA, T. I. (1964) Materials of the 1st Scientific Conf. of the Central Scientific Research Lab. (Tomsk), "Changes in the lungs induced by alternating electromagnetic fields"

525. GORSKI, S., KWASNIEWSKA-BLASZCZYK, M., & MACKIEWICZ, S. (1967), Polski tygodnik lekarski, Warsaw, 22:940-943, "Isotope evaluation of the effect of microwaves on capillary circulation in muscles of the extremities"

526. GRAHAM, G. D. (1935) Arch. of Physical Therapy 16:741-742, "Desiccation of hemorrhoids"

527. GRANBERRY, W. M., & JANES, J. M. (1963) J. of Bone and Joint Surgery 45A:773-777, "The lack of effect of microwave diathermy on bone of the growing dog"

528. GRANOVSKAYA, R. M. (1961) Leningrad Obshchestva Yestestvoispytateley 72(1):pp.? "The problem of electromagnetic brain fields"

529. GRANT, E. H. (1969) Non-Ionizing Radiation 1(2):77-79, "Fundamental physical concepts underlying absorption of microwave energy by biological material"

530. GRANT, E. H., KEEPE, S. E., & TAKASHIMA, S. (1968) J. of Physical Chemistry 72:4373-, "The dielectric behavior of aqueous solutions of bovine serum albumin from radiowave to microwave frequencies"

531. GRAY, O. S. (1970) Feb. 10, U. S. Patent Office, Pat. #3,494,722, "Method and apparatus for sterilizing [using microwave radiation & heat & pressure]"; Pats. #3,494,723, and #3,494,724, "Method and apparatus for controlling microorganisms and enzymes"

532. GRAY, O. S., & SANDERS, H. (1970) Paper presented to Section of Environmental Sciences of the New York Academy of Sciences, (4 Nov.), 7 pages, "Effect of controlled electromagnetic energy [microwave] on biological systems"

533. GREBESHECHNIKOVA, A. (1962) In: Summaries of reports, Questions of the Biological Effect of a SHF-UHF Electromagnetic Field. Kirov Order of Lenin Military Medical Academy, Leningrad, p. 17-, "The effect of SHF-UHF fields in the decimeter and meter wave ranges on the motor evacuator function of the gastrointestinal tract in dogs and guinea pigs"

534. GRIFFIN, D. R., McCUE, J. J. G., & GRINNELL, A. D. (1962) Rept., Harvard Univ. Cambridge, Mass. (AD 296493), "The resistance of bats to jamming"

535. GRIGOR'IAN, D. G. (1969) Voprosy Kurortologii Fizioterapii i Lechebnoi Fizicheskoi Kultury (Problems in Health Resort Sci., Physiotherapy, & Medical Physical Culture), Moscow, 34(6):510-513, (In Russian) "Examination of proteins in the brain and blood serum of animals which have been exposed to microwave radiation"

536. GRIGOR'YEVA, T. A. (1937) Biologicheskoye deystviye UVCh. Simpozium. (Biological effect of ultrahigh frequencies. Symposium), Moscow, pp. 137-, (Abstr. in: The Biological Effects of Electromagnetic Fields - Annotated Bibliography, ATD Rept P-65-17, Apr. 1965), [Title not given], [Irradiation of sciatic nerve of cat]

537. GRINBARG, A. G. (1959) Kazanskiy Med. Zh. Navy USSR, 40(4):59-61 and/or 63-65 (JPRS 2802), "VHF-HF therapy in certain affections of the peripheral nervous system"

538. GRISHINA, K. F. (1958) Biofizika 33(3):358-362 (Pergamon Press Transl.), "The importance of certain procedures in the local response of tissues to centimeter waves"

539. GRISHINA, K. F., & KOMAROVA, A. A. (1963) Leningrad (Transl. of some sections are in JPRS 21725, OTS 63-41061), 320 pages, Techniques and Methods of Conducting Physiotherapeutic Procedures

540. GRISHKO, F. I. (1959) Fiziologicheskiy Zh. Akad. nauk UKR SSR, 5(1):31-38, (Abstr. in Biological Abstracts, No. 33058, 1964), "The effect of an ultrahigh electromagnetic field on the reflex activity of the spinal cord with differing Ca and K concentration"

541. GROAG, P. (1937) ACTA of 1st Internat. Congress of Shortwaves, Vienna, "Shortwave therapy; a specific heat therapy"

542. GROAG, P., & TOMBERG, V. (1933) Wiener Klinische Wochenschrift 46(30):929-935, (In German), "Concerning shortwave therapy"; ibid., 46(31):964-969, "Concerning shortwave therapy"; ibid., 47, 9, (1934), "Biological effects of shortwave therapy"

543. GROSS, E. (1969) Science News (25 Oct.) 96(17):382-,, "Microwaves and health effects"
GROVE, M. H., see citation #2062
544. GROSSE, G., LINDNER, G., & SCHNEIDER, P. (1969) Zeitschrift fuer Mikroskopisch-anatomische Forschung, Germany, 80(2): 260-268, (In German with English summary), "The influence of electric fields on in vitro cultured nerve cells"

545. GRUTZNER, P., & HEIDENHAIN, R. (1878) Archives fur die Gesamte Physiologie 16:1-59, (In German), [Title?]

546. GRUZDEV, A. D. (1965) Biofizika 10:1091-, "The orientation of microscopic particles in electric fields"

547. GRYNBAUM, B., MEGIBOW, R. S., & BIERMAN, W. (1950) Arch. of Physical Med. 31:629-631, "The effect of shortwave diathermy upon the . . . circulation as determined by microplethysmography"

548. GUEHLBERGER, M. (1945) Malovet Med. Acta 12:173-183, "Changes in renal function produced by shortwave irradiation of the kidneys"

549. GULYAYEV, P. I. (1940) Trans. of 1st Conf. on Applied Problems of Shortwaves and Microwaves in Medicine, Medgiz, (Abstr. in: The Biological Effects of Electromagnetic Fields - Annotated Bibliography, ATD Rpt. P-65-17, 1965), "Maximum energy absorptions in a high frequency electromagnetic field"

550. GULYAYEV, P. I. (1967) Proc. of Symposium on Physics and Biology, Moscow, pp. 19-, "The electroauragram. The electric field of organisms as a new biological connection"

551. GULYAYEV, P. I., ZABUTIN, V. P., & SHLIPPENBAKH, N. YA. (1967) Paper read to the Leningrad Society of Naturalists, February 13, "The electroauragram; The electric field in the air around excited tissues"

552. GUNN, S. A., GOULD, T. C., & ANDERSON, W. A. D. (1961) Proc. 4th Tri-service Conf. on the Biological Effects of Microwave Radiation, Vol. 1 (Peyton, M. F., ed.), pp. 99-115, (Also, Deichmann, W. B., et al., (1959) Section in: Microwave Radiation Research), "The effect of microwave radiation (24,000 Mc) on the male endocrine system of the rat"

553. GUNN, S. A., GOULD, T. C., & ANDERSON, W. A. D. (1961) Laboratory Investigations 10:301-314, (Also in: Deichmann, W. B., et al. (1959), Section in: Microwave Radiation Research), "The effect of microwave radiation on morphology and function of rat testes"

554. GUNTER, R., et al. (1958) Arch. of Ophthalmology 60:437-442, "Some effects of diathermy currents on eye tissues"

555. GURYEV, V. N. (1962) In: Summaries of reports, Questions of the Biological Effect of a SHF-UHF Electromagnetic Field. Kirov Order of Lenin Military Medical Academy, Leningrad, pp. 20-21, "Some problems of the adjustment of people to SHF-UHF effects under industrial conditions"

556. GURYEV, V. N. (1965) Ekspertiza Trud i Trud Pri nerv i Psikhicheskikh Zabol. 18(18):121-127, (JPRS 36,164), "Diencephalic disorders in persons exposed to SHF-UHF electromagnetic fields for prolonged periods of time"

557. GUY, A. W. (1971) IEEE Trans. on Microwave Theory and Techniques (Special Issue on Biological Effects of Microwaves) MTT-19(2):205-214, "Analyses of electromagnetic fields induced in biological tissues by thermographic studies on equivalent phantom models"

558. GUY, A. W. (1971) IEEE Trans. on Microwave Theory and Techniques (Special Issue on Biological Effects of Microwaves) MTT-19(2):214-223, "Electromagnetic fields and relative heating patterns due to a rectangular aperture source in direct contact with bilayered biological tissue"

559. GUY, A. W., & LEHMANN, J. F. (1967) Digest of the 7th Internat. Conf. on Medical and Biological Engineering (Jacobson, B., ed.), Stockholm, p. 396 only, "Determination of electromagnetic heating patterns in human tissues by thermographic studies on phantom models"

560. GVOZDIKOVA, Z. M., ANAN'YEV, V. M., ZENINA, I. N., & ZAK, V. I. (1964) Biulleten Eksperimental'nov Biologii i Meditsiny, Moscow, 58(8):63-68, (Abstr. in The Biological Effects of Electromagnetic Fields - Annotated Bibliography, ATD Rept P-65-17, 1965; also abstr. in Biological Effects of Microwaves, ATD-P-65-68, 1965, pp. 45-47), (JPRS 26,725, TT 64-41982, Oct. 1964, pp. 31-, N64-32782), "Sensitivity of the rabbit central nervous system to a continuous (non-pulsed) ultrahigh frequency electromagnetic field"

561. GVOZDIKOVA, Z. M., ZENINA, I. N., & ZAK, V. I. (1964) Trudy Nii Gigiyena Truda i Profzabolevaniy AMN SSSR, (2):20-25, (Abstr. in: The Biological Action of Radio Frequency Electromagnetic Fields, Moscow), "The effect of continuous SHF-UHF electromagnetic fields on the central nervous system"

562. HAASE, W., & SCHLIEPHAKE, E. (1931) Strahlentherapie 40:133-158, (In German), "Investigations concerning the influence of short electrical waves on the growth of bacteria"

563. HADUCH, S., BARANSKI, S., & CZERSKI, P. (1960) Lekarz Wojskowy (Army Surgeon), Poland, 36(2):119-125, (Transl. NASA-TT-F-8143), "Research into the influence of high frequency electromagnetic fields on the human body"; ibid., 36(8):792-803, (FTD-TT 61-379-1, AD 270774), "Biological effect of cm and dm electromagnetic waves"

564. HADUCH, S., BARANSKI, S., & CZERSKI, P. (1962) In: Human Problems of Supersonic and Hypersonic Flight, Barbour, A. B., & Whittingham, H. F., (eds.), Pergamon Press, pp. 449-454, "The influence of ultrahigh frequency radio waves on the human organism"

565. HAGGIS, G. H., BUCHANAN, T. J., & HASTED, J. B. (1951) Nature 167:607-608, "Estimation of protein hydration by dielectric measurements at microwave frequencies"

566. HALL, G. A., & SCHLEGEL, W. A. (1967) Arch. of Ophthalmology 78:521-, "Relative bursting strength of rabbit sclera after cryosurgery and diathermy"

567. HALL, W. W., & WAKEFIELD (1927) J. of the Amer. Medical Assoc. 89:177-182, "A study of experimental heat stroke"

568. HALPHEN, A., & AUCLAIR, J. (1933) Arch. of Physical Therapy 14:69-71, "A new form of D'Arsonvalization; the short waves"

569. HANDELSMAN, M. (1957) Proc. of Tri-service Conf. on Biological Hazards of Microwave Radiation (Pattishall, E. G., ed.), 1:23-31, (Abstr. in: Naval Medical News Letter 30(11):36-, 1957, "Microwave radiation hazards"), (AF 115603, ARDC-TR-58-51), "Future microwave radiation hazards"

570. HENDLER, E., & HARDY, J. D. (1961) Federation Proceedings 20(Part 1):401-, "Microwave heating of the human skin" (See #613, this Biblio.)

571. HENDLER, E., & HARDY, J. D. (1961) Digest of 4th Internat. Conf. on Medical Electronics, Biological Effects of Microwaves I (Athermal Aspects), (Frommer, P. L., ed.), Plenum Press, New York, pp. 192-, "Heating of human skin by microwave radiation"

572. HANLON, J. J. (1970) In: Proc. of the "Biological Effects and Health Implications of Microwave Radiation" Symposium, (Cleary, S. F., ed.), Bur. of Rad. Health, Div. of Bio. Effects, Rept. No. 70-2, pp. 116-121, "Cellular effects of microwave radiation"

573. HANNEMAN, G. D. (1967) Aerospace Med. :275-277, "Changes produced in urinary sodium, potassium, and calcium excretion in mice exposed to homogeneous electromagnetic stress"

574. HARDEMAN, L. J. (1970) Microwaves 9(2):p. 17 and p. 24 (Feb.), "Microwave oven leakage: Federal regulations soon"

575. HARDY, J. D. (1961) Report to ONR from Univ. of Penna., Moore School of Electrical Engineering, (4 pages), (AD 615472), "Physiological effects of heating the skin with microwave and infrared radiation: final report"

576. HARDY, J. D. (ed.) (1968) Thermal Problems in Aerospace Medicine, The Advisory Group for Aerospace Res. & Develop., NATO, Technivision Services, Maidenhead, England [including microwave radiation effects], (Abs. No. N69-25051)

577. HARDY, J. D., & MURGATROYD, D. (1958 or later) ref.?, "Responses of man to high intensity thermal radiation"

578. HARRISON, F. G. (1935) Arch. of Physical Therapy 16:393-397, "Electrosurgery in urology"

579. HARTE, C. (1949) Chromosoma 3(5):440-447, "Mutation activity through ultrashort waves"

580. HARTMAN, F. W. (1937) J. of the Amer. Medical Assoc. 109:2116-2121, "Lesions of the brain following fever therapy: etiology and pathogenesis"

581. HARTMAN, F. W. (1958) Proc. 2nd Tri-service Conf. on the Biological Effects of Microwave Energy (Pattishall, E. G., & Banghart, F. W., eds.) 2:54-70, (AD 131477, ARDC-TR-58-54), "The pathology of hyperpyrexia"

582. HARTMAN, F. W. (1959) La presse medical 67:151-, (In French), "Biological effects of ultrashort electromagnetic radio waves"

583. HARTMUTH, Z. (1954) Zh. Naturforsch. 96:257-, (In German), "The electrical characteristics of biological substances at wavelengths of about 1/10 meter"

584. HARVEY, A. F. (1963) Microwave Engineering, Academic Press, New York

585. HAYWOOD, A. L. (1960) Wright Air Development Technical Rpt #60-501, (Oct. 1960), "Radar radiation hazards in the near field of aperture antennas"

586. HEALER, J. (1970) In: Proc. of the "Biological Effects and Health Implications of Microwave Radiation" Symposium, (Cleary, S. F., ed.), Bur. of Rad. Health, Div. of Bio. Effects, Rept. No. 70-2, pp. 90-97, "Review of studies of people occupationally exposed to radio frequency radiation"

587. HEALER, J., & POLLACK, H. (1967) Allied Research Assoc., Inc. (Concord, Mass.), Final Report No. ARA 348-1, "Review of information on hazards to personnel from high frequency electromagnetic radiation"

588. HEALER, J., & SMILEY, R. (1967) Allied Research Assoc., Inc. (Concord, Mass.), Rept. No. ARA 319-3-1 (38 pages), "Bibliography on biological effects of microwave radiation - a sampling of the world literature"

589. HEALER J., & SMILEY, R. (1968) Allied Research Assoc., Inc. (Concord, Mass.), Rept. No. ARA 376-1, "Some biological effects of radio-frequency radiation"

590. HEALER, J., & SMILEY, R. (1969) Allied Research Assoc., Inc. (Concord, Mass.), Summary Rept. No. ARA 9G61F, in three volumes, (AD 704712), "Bibliography on biological effects of radio-frequency electromagnetic fields"

591. HEARN, G. E. (1965) Thesis, Baylor Univ., 77 pages; and HEARN, G. E., & THOMPSON, W. D. (1968), In preparation (?), "Effects of UHF radio fields on visual acuity and critical flicker fusion in the Albino rat"

592. HEARON, J. Z. (1964) (Part of Ely and Goldman's (1964) report entitled "Heating characteristics of laboratory animals exposed to 10 cm microwaves"), IEEE Trans. on Biomedical Engineering , BME-11(4):135-137, "Some mathematical considerations"

593. HEDENIUS, P., ODEBLAD, E., & WAHLSTROM, L. (1966) Current Therapy Research 8:317-321, "Some preliminary investigations on the therapeutic effect of pulsed short waves in intermittent claudication"

594. HEDVIG, P., & ZENTAI, G. (1969) The Chemical Rubber Pub. Co., Cleveland, Ohio (Transl. from Hungarian), 462 pages, Microwave Study of Chemical Structures and Reactions

595. HEIMER, G. (1966) Unpublished Report (Naval Ship Engineering Center, Washington, D. C.), "Navy radio frequency radiation hazards program"

596. HEIMER, G. M. (1967) (Classified) "Report of shipboard (USS DECATUR (DDG-31)) electromagnetic radiation hazard measurements" (U)

597. HEIMER, G. M. (1970) Fathom (Surface Ship & Submarine Safety Review); U. S. Navy Safety Center, pp. 58-60, (Winter Issue), "Shipboard RF burn hazards"

598. HEIMER, G., & HEASTY, D. (1969) Naval Ship Engineering Center, Washington, D. C., "Report of RF burn investigation (on the) USS WICHITA (AOR-1)"

599. HEIMER, G., & HOWARD, K. (1961) Safety Review 18(4):11-, "Navy radio frequency radiation hazards program"

600. HEINLE, R., & PHELPS, R. (1933) Amer. J. of Physiology 104:349-, "The effects of short radio-waves on perfused cats hearts"

601. HEINMETS, F., & HERSHMAN, A. (1961) Physical Med. and Biology 5:271-, "Consideration of the effects produced by superimposed electric and magnetic fields in biological systems and electrolytes"

602. HELLER, J. H. (1959) Proc. of the 12th Annual Conf. on Electrical Techniques in Med. and Biology, Digest of Tech. Papers, (Lewis Winner, pub., New York, Nov.), p. 56 only, "The effect of electromagnetic fields on uni-cellular organisms"

603. HELLER, J. H. (1959) Radio Electronics (6):6-, "Effect of high-frequency electromagnetic fields on micro-organisms"

604. HELLER, J. H. (1963) U. S. Pat. 3,095,359, "High-frequency treatment of biological matter"

605. HELLER, J. H. (1969) Presented at the Hazards and Utility of Microwaves and Radiowaves Seminar, (Heller, J., Chm.), 11-12 Dec., Boston, "Chairman's remarks"; "Areas of national and industrial concern - noxious and beneficial"; and "Future research requirements"

606. HELLER, J. H. (1970) In: Proc. of the "Biological Effects and Health Implications of Microwave Radiation" Symposium, (Cleary, S. F., ed.), Bur. of Rad. Health, Div. of Bio. Effects, Rept. No. 70-2, pp. 116-121, "Cellular effects of microwave radiation"

607. HELLER, J. H., & MICKEY, G. H. (1961) Digest of the 4th Internat. Conf. on Medical Electronics (July), p. 152 only, "Non-thermal effects of radio frequency in biological systems"

608. HELLER, J. H., & TEIXEIRA-PINTO, A. A. (1958) Reticulo-Endothelial System Bulletin 4:10-11, "Futher investigation into radio frequency effects which appear to be active on the reticulo-endothelial system in whole-body irradiations"

609. HELLER, J. H., & TEIXEIRA-PINTO, A. A. (1959) Nature 183(4665):905-906, "A new physical method of creating chromosomal aberrations"

610. HENDLER, E. (1959) Proc. of the 12th Annual Conf. on Electrical Techniques in Med. and Biology, Digest of Tech. Papers, (Lewis Winner, pub., New York, 10-12 Nov.), p. 37 only, "Some observations regarding temperature sensations due to microwave irradiation"

611. HENDLER, E. (1968) In: Thermal Problems in Aerospace Medicine, (Hardy, J. D., ed.), The Advisory Group for Aerospace Research & Development, NATO, Maidenhead, England, p. 149-161, "Cutaneous receptor response to microwave irradiation"

612. HENDLER, E., & HARDY, J. D. (1960) Institute of Radio Engineers 7(3):143-152, (Presented at 12th Annual Conf. on Electrical Techniques in Med. and Biology, Nov. 1957, Philadelphia, Pa.), "Infrared and microwave effects on skin heating and temperature sensation"

613. HENDLER, E., & HARDY, J. D. (1961) See citation Nos. 570 & 571; incorrectly listed under HANDLER

614. HENDLER, E., HARDY, J. D., & MURGATROYD, D. (1963) In: Temperature - Its Measurement and Control in Science and Industry, 3, Part 3, Chapt. 21, Reinhold Pub. Co., New York, p. 211-230, "Skin heating and temperature sensation produced by infrared and microwave irradiation"

615. HENRY, G. C., TARSY, M., HALL, A. R., WATTS, H. M., & CAMPELLONE, R. (1970) In: Proc. of the "Biological Effects and Health Implications of Microwave Radiation" Symposium, (Cleary, S. F., ed.), Bur. of Rad. Health, Div. of Bio. Effects, Rept. No. 70-2, pp. 66-69, "Studies of biological hazards from high-power HF band transmitters"

616. HENRIQUES, F. C., JR. (1947) Arch. of Pathology 43:489-502, "Studies of thermal injury: V. The predictability and the significance of thermally-induced rate processes leading to irreversible epidermal injury"

617. HERRICK, J. F. (1952) Presented at Institute of Radio Engineers National Convention, New York, "Application of microwaves in physical medicine"

618. HERRICK, J. (1958) Proc. 2nd Tri-service Conf. on the Biological Effects of Microwave Energy (Pattishall, E.G., & Banghart, F. W., eds.) 2:88-96, (Also, Digest of Technical Papers, 12th Annual Conf. on Electrical Techniques in Medicine and Biology (Schwan, H. P., Chm.), (1959), Lewis Winner, Pub., New York, p. 60 only), "Pearl chain formation"

619. HERRICK, J. F., JELATIS, D. G., & LEE, G. M. (1950) Federation Proceedings 9:60-, "Dielectric properties of tissues important in microwave diathermy"

620. HERRICK, J. F., & KRUSEN, F. H. (1952) Paper presented at Amer. Institute of Electrical Engineers Summer Meeting, Minneapolis, Minn., June, (Also, Electrical Engineering 72:239-244, (1953)), "Certain physiologic and pathologic effects of microwaves"

621. HERRICK, J. F., & KRUSEN, F. H. (1956) Institute of Radio Engineers Trans. on Medical Electronics, PGME-4:10-12 (and Symposium on Physiologic and Pathologic Effects of Microwaves (Krusen, F. H., Chm.), Mayo Clinic, Sept. 1955) "Problems which are challenging investigators in medicine"

622. HERRICK, J. F., MARTIN, G., KRUSEN, F., & WAKIM, K. (1950) Medical Physics _:2 (Vol. or p.?), "Physical medicine: microwave diathermy"

623. HETHERINGTON, A. (1957) Proc. of 1st Tri-service Conf. on Biological Hazards of Microwave Radiation (Pattishall, E. G., ed.) 1:1-4, "Introduction to biological effects of microwave radiation conference"

624. HIGASI, K. (1950) Monograph Series of the Research Institute of Applied Electricity, Hokkaido Univ., Sapporo, Japan, 1:7-19, "Physical principles of ultra-short wave therapy and other high frequency applications" (In Polish), (A68-80352),

625. HIGIER, J., & KARANSKA, W. (1967) Wiadomosci Lekarskie 20:1435-1438, "Examinations of the genital organs and studies of the menstrual cycle in women working in the field of microwave radiation"

626. HILL, T. (1958) J. of the Amer. Chemical Society _(8):2142-, "Some possible biological effects of an electric field acting on nucleic acids or proteins"

627. HINES, H. M. (1958?)State Univ. of Iowa, College of Medicine (AF Rept. 41(657)-113), "Effects of 3, 10, and 12 cm radiation upon the avascular hollow viscera of dogs"

628. HINES, H. M., IMIG, C. J., & THOMASON, J. D. (1948) Proc. of the Society of Experimental Biology and Medicine 69:382-386, "Testicular degeneration as a result of microwave radiation"

629. HIRSCH, F. G. (1952) NASE Conf. on Industrial Health, Cincinnati, Ohio, April, "Microwave cataracts"

630. HIRSCH, F. G. (1956) Institute of Radio Engineers Trans. on Medical Electronics, PGME-4:22-24 (and Symposium on Physiologic and Pathologic Effects of Microwaves, (Krusen, F. H., Chm.), Mayo Clinic, Sept. 1955), "The use of biological simulants in estimating the dose of microwave energy"

631. HIRSCH, F. G. (1970) Paper presented at 4th Annual Midyear Topical Symposium, Health Physics Soc., Electronic Product Radiation and the Health Physicist, Louisville, Ky., 28-30 Jan.; Bureau of Radiation Health, Div. of Electronic Products Report No. 70-26, pp. 111-140, "Microwave cataracts"

632. HO, H. S., GUY, A. W., SIGELMANN, R. A., & LEHMANN, J. F. (1971) IEEE Trans. on Microwave Theory and Techniques (Special Issue on Biological Effects of Microwaves) MTT-19(2):224-231, "Microwave heating of simulated human limbs by aperture sources"

633. HODGE, D. M. (ed.)(1968) Report of U. S. Dept. of Health, Education, and Welfare, Public Health Service, Consumer Protection and Environmental Health Service, Environmental Control Admin., Bureau of Radiological Health, Rockville, Md., Summary Report Jan. - Dec., "Radiation bio-effects"

634. HOEFT, L. O. (1965) Aerospace Medicine 36(7):621-622, (AMRL TR-64-127, AD 624036), "Microwave heating, a study of the critical exposure variables for man and experimental animals"

635. HOLZER, W. (1934) (In German, with English Summary) Abstracts of the 1st Internat. Congress of Electro-Radio-Biology, (Capelli, L., ed., Bologna, Italy), pp. 367-368, "A spatial model for the thermic effects of electrical vibrations in therapy"

636. HOPKINS, A. L. (1960) Annals of the New York Academy of Science 85 (vol?, page?), "Radio frequency spectroscopy of frozen biological material: dielectric heating and the study of bound water"

637. HORN, G. (1965) Automaz. Automat. 9:5-, (In Italian) "The passive electrical characteristics of biological systems"

638. HORNOWSKI, J. (1965) Polski Tygodnik Lekarski (Warsaw) 20:1906-1907, "Case of skin burns by microwaves"

639. HORNOWSKI, J., MARKS, E., & CHMUREO, E. (1966) Medycyna Pracy 17:213-217, "Studies on the pathogenic effect of microwaves in men"

640. HORTEN, E. (1947) Klinische Wochenschrift 24-25(25/26):392-396, (In German), "The effect of electromagnetic short wave exposure of the midbrain on the vegetative functions of man"

641. HORVATH, S. M., MILLER, R. N., & HUTT, B. K. (1948) Amer. J. of Medical Sciences 216:430-436, "Heating of human tissues by microwave radiation"

642. HORVATH, S. M., MILLER, R. N., & HUTT, B. K. (1948) Federation Proceedings 7:58 only, "Heating of human muscle tissue by microwaves"

643. HOSHIKO, M. S. (1970) Proc. 3rd Annual National Conf. of the Neuro-Electric Society, "The nervous system and electric currents", (Wulfsohn, N. L., & Sances, A., Jr., eds.), (23-25 Mar., Las Vegas, Plenum Press, New York), pp. 85-93, "Electrostimulation of hearing" [RF]

644. HOWLAND, J. W., & MICHAELSON, S. M. (1959) Digest of Technical Papers, Proc. 12th Annual Conf. on Electrical Techniques in Medicine and Biology, 10-12 Nov., (Winner, L., Pub.), New York, p. 40 only, "Biological effects of pulsed electromagnetic (2880 Mc) irradiation"

645. HOWLAND, J. W., & MICHAELSON, S. (1959) Proc. 3rd Tri-service Conf. on Biological Effects of Microwave Radiating Equipments, (Susskind, C., ed.), 3:191-238, (RADC-TN-59-99, AD 212110), "Studies on the biological effects of microwave irradiation of the dog and rabbit"

646. HOWLAND, J. W., & MICHAELSON, S. (1964) Industrial Med. and Surgery 33:500-, "The effect of microwave on the biological response to ionizing radiation"

647. HOWLAND, J. W., MICHAELSON, S. M., THOMSON, R. A. E., & MERMAGEN, H. (1962) Rept., Univ. of Rochester, RADC-TDR-62-102, (AD 274338), "The effects of microwaves on the response to ionizing radiation"

648. HOWLAND, J. W., THOMSON, R. A. E., & MICHAELSON, S. M. (1961) Proc. 4th Tri-service Conf. on the Biological Effects of Microwave Radiation, Vol. 1 (Peyton, M. F., ed.) pp. 261-284, "Biomedical aspects of microwave irradiation of mammals"

649. HUBNER, ? (1950) Munchener Medizinische Wochenschrift 92(37/38):1546 only, (In German), "Bedside ultrashort wave treatment"

650. HULL, A., TIZARD, H., & LEDEN U. (1947) British J. of Physical Med. 10:177-184, "Preliminary studies on the healing and circulatory effects of microwaves (radar)"

651. HUNT, A. G. (1969) Non-ionizing Rad. 1(3):105-112, "Non-ionizing radiation: physical relationship between typical sources and human targets"

652. HUTT, B., MOORE, J., COLONNA, P., & HORVATH, S. (1952) Amer. J. of Physical Med. 31:422-428, "Influence of microwave irradiation on body temperature in dog and man"

653. HUTTON, C. C. (1962) Secret Report, AD 332918, "Biological effects of microwaves; an ASTIA report bibliography"

654. HUZL, F., KLIMKOVA-DEUTSCHOVA, E., JANKOVA, J., MAINEROVA, J., SALCMANOVA, Z., SCHWARTZOVA, K., SUCHANOVA, L., & SYKORA, J. (1966) Pracovni Lekarstvi, Prague, 18(3):100-108, (ATD Abstr. A66-81307), "Examination of workers in the West Bohemia Region exposed to electromagnetic waves one meter and longer"

655. HYDE, A. S., & FRIEDMAN, J. J. (1968) In: Thermal Problems in Aerospace Medicine, (Hardy, J. D., ed.), The Advisory Group for Aerospace Research & Development, NATO, Technivision Services, Maidenhead, England, pp. 163-175, "Some effects of acute and chronic microwave irradiation of mice" (Abstr. A69-20678),

656. IAKOVLEVA, M. I. (1968) Biulleten Eksperimental'noy Biologii Meditsiny 66(9):9-11, (In Russian with English summary), "The study of efferent impulsation in post-ganglionic sympathetic fibers under the influence of a super-high frequency electromagnetic field" (Also cited as #1822, this Bibliography, as YAKOVLEVA)

657. IAKOVLEVA, M. I. (1968) Zh. Evoliutsionnoi Biokhimii i Fiziologii (Akademiia Nauk SSSR), Moscow, 4(5):437-442, (In Russian with English summary), "The effect of ultrahigh frequency electromagnetic fields on regulation of the heart rate and respiration in birds"

658. IAKOVLEVA, M. I., SHLIAPER, T. P., & TSVETKOVA, I. P. (1968) Vysshei Nervnoi Deyatel'nosti imeni i p Pavlova, USSR. 18(6):973-978, (In Russian with English abstract), "On conditioned cardiac reflexes and the functional and morphological state of the cortical neurons under the action of electromagnetic fields of superhig.. frequencies" (Also cited as #1824)

659. IATSENKO, M. I. (1966) Fiziologicheskii Zh. (Kiev) 12:377-381, "Effect of microwaves on the absorptive capacity of the knee joint under the effect of atropine and carbocholine" (Also cited as #1831, this Bibliography, as YATSENKO)

660. IATSENKO, M. I. (1966) Voprosy Kurortologii, Fizioterapii i Lechebnoy Fizicheskoy Kul'tury (Problems in Health Resort Science, Physiotherapy, and Medical Physical Culture), Moscow, 31:446-448, "The absorption capacity of the knee joint following severance of the femeral and sciatic nerves, and under the effect of microwaves"

661. IBERALL, A. S. (1959) Proc. 3rd Tri-service Conf. on Biological Effects of Microwave Radiating Equipments (Susskind, C., ed.), 3:136-160, "Human body as an inconstant heat source and its relation to clothes insulation: 1. Descriptive models of heat source, 2. Experimental investigation into the dynamics of the source"

662. IL'IN, B. I., & KOROLEV, V. G. (1964) Voprosy Kurortologii, Fizioterapii i Lechebnoy Fizicheskoy Kul'tury (Problems in Health Resort Science, Physiotherapy, and Medical Physical Culture), Moscow, 29(2):172-, (JPRS 25121, pp. 20-21; OTS-64-31500), "Treatment of pedal hyperhydrosis with a UHF field"

663. ILLINGER, K. H. (1970) In: Proc. of the "Biological Effects and Health Implications of Microwave Radiation" Symposium, (Cleary, S. F., ed.), Bur. of Rad. Health, Div. of Bio. Effects, Rept. No. 70-2, pp. 112-115, "Molecular mechanisms for microwave absorption in biological systems"

664. IMIG, C. J., & SEARLE, G. W. (1958) Proc. 2nd Tri-service Conf. on Biological Effects of Microwave Energy (Pattishall, E. G., & Banghart, F. W., eds.) 2:242-253, "Review of the work conducted at State Univ. of Iowa"

665. IMIG, C. J., & SEARLE, G. W. (1959) In: Investigators' Conf. on Biological Effects of Electronic Radiating Equipments, held at Patrick Air Force Base, Florida, 14-15 Jan. (RADC-TR-59-67, Proj. 5545, pp. 3-5; AD #214693), "Report from State Univ. of Iowa, Dept. of Physiology"

666. IMIG, C. J., & SEARLE, G. W. (1962) Report, RADC TDR-62-358, AD 287160, 188 pages, "Review of work conducted at State Univ. of Iowa"; "Studies on organisms exposed to 2450 mc cw microwave irradiation"

667. IMIG, C. J., THOMSON, J. D., & HINES, H. M. (1948) Proc. of the Society for Experimental Biology and Medicine 69(2): 382-386, "Testicular degeneration as a result of microwave irradiation"

668. INGALLS, C. E. (1966) Report from Interference Consultants, Inc. (Preprint of paper, New York J. of Med. 67:2992-2997 (1967)), "The sensation of hearing in electromagnetic fields"

669. INMAN, R. A. (1970) NASA, Marshall Space Flight Center, Huntsville, Ala., (N70-33065, NASA-TM-X-64523), "RF radiation hazards to space station personnel"

670. IRISOVA, N. A. (1968) Vestnik Akademiia Nauk SSSR (10):63-71, (In Russian), "Experimental techniques of submillimeter wave measurements"

671. ISMAILOV, E. SH. (1966) Vestnik Leningradskogo Universiteta Seriia Biologiia 2(9):147-149, "Effect of microwaves on Opalina ranarum"

672. IVANOV, A. I. (1962) In: Summaries of reports, Questions of the Biological Effect of a SHF-UHF Electromagnetic Field. Kirov Order of Lenin Military Medical Academy, Leningrad. pp. 24-26, "Changes of phagocytic activity and mobility of neutrophils under the influence of microwave fields"

673. IVANOV, V. I., et al. (1957) In: Summaries of reports, Part 2, Jubilee Scientific Session of the Institute of Labor Hygiene and Occupational Diseases. Dedicated to the 40th Anniv. of the Great October Socialistic Revolution, Moscow, pp. 52-53, "Biochemical changes in the blood under the chronic influence of radiation"

674. IWAI, Y. (1965) Editor, Digest of the 6th Internat. Conf. on Medical Electronics and Biological Engineering, (Tokyo, 22-27 Aug.) (Chairman of Program and Publication of the Organizing Committee), Okumura Printing Co., Tokyo

675. IZAR, G., & MORETTI, P. (1933) Riforma Medica 49:1611-, (In Italian), "On the biological action of short electromagnetic waves; Note 7. Action on enzymes"

676. JACKSON, A. S. (1935) Arch. of Physical Therapy 16:342-344, "Physical therapy in general surgery"

677. JACKSON, W. (1946) Trans. of the Faraday Society 42A:91-, "The representation of dielectric properties and the principles underlying their measurements at centimeter wavelengths"

678. JACOBSON, B. (1967) Editor, Organizing Committee for the 7th Internat. Conf. on Medical and Biological Engineering, Stockholm, 14-19 Aug.

679. JACOBSON, B. S., PRAUSNITZ, S. B., & SUSSKIND, C. (1959) Institute of Radio Engineers Trans. on Medical Electronics :p.?, "Investigation of thermal balance in mammals by means of microwave radiation"

680. JACOBSON, B. S., & SUSSKIND, C. E. (1958) Proc. 2nd Tri-service Conf. on Biological Effects of Microwave Energy (Pattishall, E. G., & Banghart, F. W., eds.) 2:234-241, "Review of the work conducted at Univ. of California; Effects of microwave irradiation on internal temperature and viability in mice"

681. JACOBSEN, V. ..., & HOSOI, K. (1931) Arch. of Pathology 11:744-759, "Morphological changes in animal tissues due to heating by UHF oscillators"

682. JANES, D. E., LEACH, W. M., MILLS, W. A., MOORE, R. T., & SHORE, M. L. (1968) Radiation Bio-Effects, (Hodge, D. M., ed.), Report, U. S. Dept. of Health, Education and Welfare, Bureau of Radiological Health, pp. 89-93, "Effects of microwave radiation on Chinese hamsters"

683. JASKI, T. (1960) Radio Electronics 9:43-45, "Radio waves and life"

684. JASKI, T., & SUSSKIND, C. (1961) Science 133(3451):443-447, "Electromagnetic radiation as a tool in the Life Sciences"

685. JOHNSON, W., KINDSVATTER, V. H., & SHAW, C. C. (1959) U. S. Armed Forces Medical J. 10(5):513-523, "Radiation hazards aboard a guided missile cruiser"

686. JOLY, R. (1968) International Electronique 23:9-17, "VHF electromagnetic radiation hazards from radar antennas"

687. JOLY, R. (1969) In: Association Pour le Developpement des Sciences et Techniques de L'environment. French Conf. on Environmental Studies Ecole Nationale Superieure de L'Aeronautique, Paris, France, Proc. 31 March to 1 April, "The electromagnetic environment, biological effects, and possible danger of radar antenna radiation"

688. JONAS, H. (1941) Thesis (B.S.), Univ. of California (Berkeley), (Dissertation Abstr.), 148 pages, "Some Effects of Very Hig. Radio Frequency Irradiation on the Germination and Metabolism of Certain Small Seeds"

689. JONES, I. A. (1966) Thesis, Baylor Univ., Texas, "Human Detection of UHF Energy"

690. JUNG, R. W. (1935) Arch. of Physical Therapy 16:397-404, "Immunologic studies in hyperpyrexia"

691. JUSTESEN, D. R., & KING, N. W. (1970) In: Proc. of the "Biological Effects and Health Implications of Microwave Radiation" Symposium, (Cleary, S. F., ed.), Bur. of Rad. Health, Div. of Bio. Effects, Rept. No. 70-2, pp. 154-179, "Behavioral effects of low level microwave irradiation in the closed-space situation"

692. JUSTESEN, D. R., PENDLETON, R. B., & PORTER, P. B. (1961) Psychological Reports 9:99-102, "Effects of hyperthermia on activity and learning"

693. KACHKOVSKII, M. A. (1952) (In Russian), Eksperimental'nye i Klinicheskie issledovaniia, Leningrad, Respublikanskii nauchno-issledovatel'skii kozhno-venerologicheskii institut 9:78-84, (Abstr. in: The Biological Effects of Electromagnetic Fields - Annotated Bibliography, ATD Rpt P-65-17, Apr. 1965), "Reactivity of skin blood vessels and its variation under the influence of UHF fields"

694. KADO, R. T., & ADAI, W. R. (1965) Digest of 6th Internat. Conf. on Medical Electronics and Biological Engineering (Iwai, Y., ed.), pp. 551-552, "Method for the measurement of impedance changes in brain tissue"

695. KALANT, H. (1959) Canadian Medical Assoc. J. 81:575-582, "Physiological hazard of microwave radiation: A survey of published literature"

696. KALL, A. R., & WATTS, H. M. (1968) Ark Electronics Corp., Willow Grove, Pa., Report to U. S. Information Agency, 180 pages, "Final technical report on research projects to study radiation hazards caused by high power, high frequency fields"

697. KALYADA, T. V. (1959) In: Summaries of reports, Labor Hygiene and the Biological Effect of Radio Frequency Electromagnetic Waves, Moscow, "Physical hygienic characteristic of microwave radiation conditions in mooring tests"

698. KALYADA, T. V. (1964) In: Proc. Scientific Session Devoted to the 40th Anniv. of the Scientific Research Institute, Labor Hygiene and Occupational Diseases, Leningrad, (Abstr. No. 14P162 in JPRS 34,588), pp. 66-67, "Temperature sensitivity and functional mobility of thermoreceptors under the effect of ultrahigh frequency radiation"

699. KALYADA, U. V., KULIKOVSKAYA, YE. L., & OSIPOV, YE. A. (1959) In: Summaries of reports, Labor Hygiene and the Biological Effect of Radio Frequency Electromagnetic Waves, Moscow, p. 35 only, (Abstr. in: The Biological Effects of Electromagnetic Fields - Annotated Bibliography, ATD Rept. P-65-17, Apr. 1965), "Physiological shifts in work with high frequency electromagnetic fields"

700. KAMAT, G. P. (1968) Radiation Bio-Effects Report (Hodge, D. M., ed.), U. S. Dept. of Health, Education, and Welfare, Bureau of Radiological Health, p. 98-99, "Effect of X-ray radiation and microwave radiation in vitro and in vivo on human and rat gamma globulins"

701. KAMAT, G. P., & JANES, D. E. (1969) (Compilers), Unpublished report of Bureau of Radiological Health, U. S. Dept. of Health, Education, and Welfare, "Effect of radio-frequency energy on biological macromolecules"

702. KAMAT, G. P., & JANES, D. E. (1970) In: Proc. of the "Biological Effects and Health Implications of Microwave Radiation" Symposium, (Cleary, S. F., ed.), Bur. of Rad. Health, Div. of Bio. Effects, Rept. No. 70-2, pp. 104-111, "Studies of the effects of 2450 MHz microwaves on human immunoglobulin G"

703. KAMENSKIY, YU. I. (1964) Biofizika 9(6):695-700, (In Russian), (Biophysics 9:758-764, in English), (Also ATD-T-65-39, 1965; (AD 465383); (Abstr. in: Biological Effects of Microwaves: Compilation of Abstracts, ATD P-65-68, pp. 47-52, 1965), "The influence of microwaves on the functional condition of the nerve" (Transl. by DODGE, C.H., citation #314)

704. KAMENSKIY, YU. I. (1968) Trans. Moscow Society of Naturalists 28:164-172, "Effect of microwaves on the kinetics of electric parameters of a nerve impulse"

705. KAPELOVICH, YU. YA. (1942) Biulleten Eksperimental'noi Biologii i Meditsiny (Moskva) 3(4):55-56, (Abstr. in: The Biological Effects of Electromagnetic Fields - Annotated Bibliography, ATD Rpt P-65-17, Apr. 1965), "The effect of UHF on heart excitability"

706. KAPITANENKO, A. M. (1964) Voyenno-meditsinskiy Zh. _(10):19-23, (Abstr. in: Biological Effects of Microwaves: Compilation of Abstracts, ATD P-65-68, p. 10 only, Sept. 1964, "Clinical and therapeutical aspects of UHF"), "Clinical manifestations and therapeutic measures during chronic exposure to UHF"

707. KAPLAN, I. T., METLAY, W., ZARET, M. M., BIRENBAUM, L., & ROSENTHAL, S. W. (1969) Final Report #19 to Advanced Research Projects Agency (ARPA), Dept. of Defense, 30 Nov., "Absence of heart rate effects in rabbits during low-level microwave irradiation"

708. KARDASHEV, V. L., & GERSAMIYA, K. G. (1968) Doklady Akademii Sci. Nauk USSR, 180(3):730-733, "Some new data on the biological effects of microwaves"

709. KARELIN, O. N., & MISHINA, I. M. (1966) Gigiyena i sanitariya _(5):46-51, (JPRS 36,461), "Some protective measures for medical personnel and patients during the operation of SHF physiotherapy apparatus"

710. KARIMDZHANOV, A. (1959) Med. Zh. Uzbekistana _(7):32 only, "The effect of UHF field and diathermy on the permeability of blood capillaries"

711. KAY, C., & SCHWAN, H. (1957) Circulation 5:439-, "Capacitive properties of body tissues"

712. KAZHINSKIY, B. B. (1962) Kiyev, (Ref.?) "Biological effects of radio communication"

713. KEKCHEEV, K. KH. (1941) Problemy Fiziologicheskoi Optiki (Akademiia Nauk SSSR), _(1):77 only, (SAM-IT-R-880-0367, N67-39546, AD 653949), "Determination of achromatic visual thresholds in man following exposure to ultrashort, ultraviolet, and roentgen waves"

714. KEKCHEYEV, K. KH., ANISIMOV, A. I., & DIDENKO, N. YE. (1941) Fizioterapiya (2,3,4):44-, "Change of sensitivity of the visual brain centers under the action of SHF and UHF electric fields"

715. KELLY, M. (1962) Research Report #63-27, Univ. of California, Berkeley, "Electromagnetic effects on the nervous system"

716. KEMP, C. R., PAUL, W. D., & HINES, H. M. (1948) Arch. of Physical Med. 29:12-17, "Studies concerning effect of deep tissue heat on blood flow"

717. KEPLINGER, M. L. (1958) Proc. 2nd Tri-service Conf. on Biological Effects of Microwave Energy (Pattishall, E. G., & Benghart, F. W., eds.) 2:215-233, (ARDC-TR-58-54, AD 131477), "Review of the work conducted at Univ. of Miami" [Describes the orientation of rats in a waveguide at 24500 MHz]

718. KEPLINGER, M. L., & BERNAL, E. (1959) Industrial Med. and Surgery 28:212-218, "Relation of interrupted pulsed microwaves to biological hazards"

719. KEPLINGER, M. L., & LAMPE, K. F. (1959) J. of Occupational Med. _(1):369-381, "Acute effects of microwave radiation on experimental animals (24,000 megacycles)"

720. KERELUK, K., LLOYD, R. S., & DALEY, D. (1970) Presented before the New York Academy of Sciences, Nov. 1970, at the Symposium on "Effect of Controlled Electromagnetic[Microwave] Energy on Biological Systems", 16 pages, "Microbiological aspects of electromagnetic energy in combination with other physical factors"

721. KEROVA, N. I. (1964) Akademiya nauk Ukrainskoy SSR. Institut fiziologii. Biologicheskoye deystviye ul'trazvuka i sverkhvyso-kochastotnykh elektromagnitnykh kolebaniy (Biological Effect of Ultrasound and Superhigh Electromagnetic Oscillations), Gorodetskiy, A. A. (ed.), Kiev, Naukova dumka, pp. 108-118, (JPRS 30860, N65-28708), (Abstr. in Biological Effects of Microwaves: Compilation of Abstracts, ATD P-65-58, 1965, pp. 54-56, "Effect of SHF on polynuclease activity and nucleic acid content"), "The influence of SHF on polynuclease activity and the content of nucleic acid"

722. KEVORK'IAN, A. (1948) Institute of Work Hygiene of Professional Diseases, Academy of Medical Sciences USSR, (Moscow); (Transl. OTS 59-21098); Gigiyena i sanitariya _(4):26-30; (abstr. in: Biological Effects of Microwaves: Compilation of Abstracts, ATD P-65-68, Sept. 1965, pp. 2-3, "Industrial hygiene aspects of pulse UHF"; and abstr. in: The Biological Effects of Electromagnetic Fields - Annotated Bibliography, ATD Report P-65-17, Apr. 1965), "Work with UHF pulse generators from the point of view of industrial hygiene"

723. KHARCHENKO, N. S. (1939) Sbornik statei. Instytut fiziologii. Universitet. Dnepropetrovsk. _(2):77-81, (Abstr. in: The Biological Effects of Electromagnetic Fields - Annotated Bibliography, ATD Rpt.P-65-17, Apr. 1965), "The biological effect of HF and VHF fields on the higher nervous system of birds"

724. KHAZAN, G. L., & GONCHAROVA, N. N. (1959) In: Summaries of reports, Labor Hygiene and the Biological Effect of Radio Frequency Electromagnetic Waves, Moscow, p. 53 only, "The experimental effects of fields of different frequencies and different components of an electromagnetic field on the animal organism"

725. KHAZAN, G. L., GONCHAROVA, N. N., & PETROVSKIY, V. S. (1958) Gigiyena truda i Professional'nykh Zabolevaniya 2(1):9-16, (JPRS L-1474D, TT-59-11443), (Abstr. in: Biological Effects of Microwaves: Compilation of Abstracts, ATD P-65-68, Sept 1965, pp. 5-6, "Industrial hygiene aspects of high frequency currents"; also abstr. in: The Biological Effects of Electromagnetic Fields - Annotated Bibliography, ATD Rpt P-65-17, 1965), "Some problems of industrial hygiene in working with high frequency currents"

726. KHAZAN, G. L., PISKUNOVA, V. G., & ANATOVSKAYA, V. S. (1957) Theses of reports to the Jubilee Session of the Institute of Labor Hygiene and Occupational Diseases, Academy of Medical Science, USSR, Dedicated to the 40th Anniv. of the Great October Socialist Revolution, Part 2, Moscow, pp. 62-70, "Problems of labor hygiene and the state of health of workers with high frequency currents"

727. KHAZAN, G. L., PISKUNOVA, V. G., & ANATOVSKAYA, V. S. (1960) In: Physical Factors of the Environment, Letavet, A. A., (ed.), pp. 152-161, "Problems of labor hygiene and occupational pathology during work with high frequency equipment"

728. KHAZEN, I. M. (1940) Nauchno-issledovatel'skiy klinicheskiy institut. Trudy, Moscow oblast'. 4:25-, (Abstr. in: The Biological Effects of Electromagnetic Fields - Annotated Bibliography, ATD Rpt. P-65-17, 1965) [Irradiation of nerve/muscle preparations with UHF radiation]

729. KHLYSTOVA, I. P. (1962) Voprosy Okhrany Materinskaya i Detstva 7(3):47-52, (JPRS 13735, TT-62-24743), "The effect of an ultrahigh frequency electric field on the change of reactivity of children in treating sepsis in the newborn"

730. KHOLODOV, YU. A. (1959) In: Summaries of reports, Labor Hygiene and the Biological Effect of Radio Frequency Electromagnetic Waves, Moscow, p. 58 only, Title?

731. KHOLODOV, YU. A. (1962) Materials of the All Union Sci. Conf. on Exp. Physiology, Moscow, pp. 399-402, "The role of distant receptors in the electrical reaction of cerebral cortex in a rabbit exposed to HF-VHF fields"

732. KHOLODOV, YU. A. (1962) In: Summaries of reports, Questions of the Biological Effect of a SHF-UHF Electromagnetic Field. Kirov Order of Lenin Military Medical Academy, Leningrad, p. 58 only, "The effect of a pulsed SHF-UHF field on the electrical activity of the cortex of a normal and an isolated rabbit brain"

733. KHOLODOV, YU. A. (1962) Priroda, USSR, _(4):104-105, (JPRS 26990, FTD-TT-62-1107-1, AD 284123, and Abstr. in: Biological Effects of Microwaves: Compilation of Abstracts, ATD P-65-68, 1965), "The effect of an electromagnetic field on the central nervous system"

734. KHOLODOV, YU. A. (1963) 20th Conf. on the Problems of High Nervous Activity, Moscow, Leningrad, AN SSSR, pp. 253-, "Certain features of the physiological effect of electromagnetic fields as evidenced by the conditioned reflex and EEG methods"

735. KHOLODOV, YU. A. (1963) In: Nervous Mechanisms of Conditioned-Reflex Activity, Izdatel'stvo Akad. Nauk, Moscow, pp. 287-, "The role of the main divisions of the brain of fish in the elaboration of electric defense conditioned reflexes to different stimuli"

736. KHOLODOV, YU. A. (1963) Electrophysiology of the Nervous System, Rostov-on-Don, pp. 418-, "The effect of an electromagnetic field on the EEG of an isolated rabbit brain"

737. KHOLODOV, YU. A. (1963) Biulleten Eksperimental'noi Biologii i Meditsiny (Moskva), 56(9):42-46, (Bulletin of Experimental Biology and Medicine 56:969-972, (1963) in English), "Changes in the electrical activity of the rabbit cerebral cortex during exposure to a UHF-HF electromagnetic field: Part 2: The direct action of the UHF-HF field on the central nervous system" (See Kholodov & Yanson (1962) for Part 1).

738. KHOLODOV, YU. A. (1964) In: Biological Effects of Magnetic Fields, Barnothy, M. F. (ed.), Vol. 1, Plenum Press, New York, Chapt. 10, pp. 196-200, (also, Priroda 4:104-105, (1962); abstr. in: Biological Effects of Microwaves: Compilation of Abstracts, ATD-P-65-68, 1965, pp. 76-77, "Review of the effect of EMF's on the central nervous system", also JPRS 26990; FTD-TT-62-1107-1; AD 284123), "Effects of electromagnetic fields on the central nervous system"

739. KHOLODOV, YU. A. (1964) Biulleten Eksperimental'noi Biologii i Meditsiny (Moskva) 57(2):98-102, (N64-18972, JPRS 24301); (Abstr. in: The Biological Effects of Electromagnetic Fields - Annotated Bibliography, ATD Rpt. P-65-17, 1965; also abstr. in: Biological Effects of Microwaves: Compilation of Abstracts, ATD P-65-68, 1965, pp. 42-44, "Effect of UHF on brain bioelectricity"), "The influence of a VHF-HF electromagnetic field on the electrical activity of an isolated strip of cerebral cortex"

740. KHOLODOV, YU. A. (1965) In: Bionika, Gaaze-Rapoport, M. G., & Yakobi, V. E. (eds.), Nauka Publ. House, Moscow, (N66-24170, JPRS 35125, TT-66-31562), pp. 278-289, "A magnetic field as a stimulus"

741. KHOLODOV, YU. A. (1966) (In Russian) Acad. Sciences, USSR, Inst. of Higher Nervous Activity & Neurophysiology, Nauka Izdatel'stvo, Moscow, 283 pages, (Full Transl. NASA TT-F-465, June 1967,; Partial Transl. JPRS 37,102, No6-35763, TT-66-33535), The Influence of Electromagnetic and Magnetic Fields on the Central Nervous System

742. KHOLODOV, YU. A., & AKHMEDOV, K. B. (1962) Biologiya Belogo Morya. Tr Belomorskoy Biostantsii MGU, Moscow, Izdatel'stvo MGU, _(1):256-, "The effect of certain physical factors on the sensitivity of fish to a constant electric current"

743. KHOLODOV, YU. A., LUKYANOVA, S. N., & CHIZHENKOVA, R. A. (1967) In: Current Problems in Electrophysiology of the CNS, Moscow, pp. 273-380, "Electrophysiological analysis of CNS reaction to electromagnetic fields"

744. KHOLODOV, YU. A., & NOVITSKIY, YU. I. (1966) Vestnik Akad. Nauk SSSR, _(12):87-89, (ATD FSB 3(3), p.? 1967), "Biological effects of magnetic fields"

745. KHOLODOV, YU. A., & VEREVKINA, G. L. (1962) Biologiya Belogo Morya. Tr Belomorskoy Biostantsii MGU, Moscow, Izdatel'stvo MGU, _(1):248-, "The effect of a constant magnetic field on conditioned reflexes saltwater fish"

746. KHOLODOV, YU. A., & YANSON, Z. A. (1962) Biulleten Eksperimental'noi Biologii i Meditsiny (Moskva), 54(11):8-12, (Abstr. in: The Biological Effects of Electromagnetic Fields - Annotated Bibliography, ATD-P-65-17, 1965; also abstr. in: Biological Effects of Microwaves: Compilation of Abstracts, ATD-P-65-68, 1965, pp. 41-42, "Effect of UHF on the brain bioelectricity of intact rabbits"), "Changes in the electrical activity of rabbits cerebral cortex resulting from exposure to a VHF-HF electromagnetic field. Part 1, The effect of a VHF-HF field on the electroencephalogram of intact rabbits"

747. KHOLODOV, YU. A., & ZENINA, I. N. (1964) Trudy Nii Gigyena Truda i ProfzabolevaniyaAzm SSSR, _(2):33-38, "The effect of caffeine on EEG reaction during the action of pulsed SHF-UHF field on the intact and isolated brain of a rabbit"

748. KHOLODOV, YU. A., & ZHUKOVSKIY, V. D. (1967) Pervyy moditsinskiy institut, Moscow, Trudy, 50:300-307, (Diagnosis and treatment of tumors), (Abstr. in ATD 68-105-108-9, Soviet Radiobiology, June 1968, pp. 76-77; AD 671436), "Effect of magnetic fields on development of neoplasms"

749. KHVEDELIDZE, M. A., DUMBADZE, S. I., & SURGULADZE, T. D. (1965) In: Bionika (Bionics), USSR, Gaaze-Rapoport, M.G., & Yakobi, V. E., (eds.), Nauka Pub. House, Moscow, pp. 1-474, (JPRS 35,125), "On the bioelectromagnetic field"

750. KHVOLES, G. YA., BOGUTSKIY, B. V., & KONKO, A. P. (1962) Materials All Union Sci. Conf. Exp. Physiotherapy, Moscow, pp.?, "The effect of pulsed low frequency field on the blood pressure, respiration and electric brain processes"

751. KIEN, K. (1947) Arch. of Physical Med. 28:345-347, "Effect of the presence of metals in tissues subjected to diathermy treatment"

752. KIEPENHEUER, K. O., BRAUER, I., & HARTE, C. (1949) Naturwissenschaften 36:27-28, (In German) "Concerning the effect of meter waves on the growth of plants"

753. KING, D. D, (1965) Boston Tech. Pub., Cambridge, 327 pages, Measurements at Centimeter Wavelength

754. KING, G. R., HAMBURGER, A. C., FARSA, F., HELLER, S. J., & CARLETON, R. A. (1970) J. of the Amer. Medical Assoc. 212(7):1213 only, "Effect of microwave oven on implanted cardiac pacemaker"

755. KING, N. W. (1969) Dissertation Abstracts Internat., B, 30(6):2893B-2894B, "The effects of low level microwave irradiation upon reflexive, operant, and discrimination behaviors of the rat"

756. KING, N. W., JUSTESEN, D. R., & CLARKE, R. L. (1971) Science 172:398-401, "Behavioral sensitivity to microwave irradiation"

757. KINOSITA, H. (1963) J. of the Faculty of Science, Tokyo Univ., 4:137-, "Electrical stimulation of paramecium"

758. KINOSITA, H. (1964) J. of the Faculty of Science, Tokyo Univ., 7:1-, "Electrical potentials and ciliary response in Opalina"

759. KINOSHITA, J. H., (1966) Documenta Ophthalmologica, Netherlands, 20:91-103, "Biochemical changes in microwave cataracts"

760. KIRCHEV, K. K. (1937) Moskovskaia oblastnaia klinika fizicheskikh metodov lecheniia. Trudy, Moscow, 3:217-, "Influence of UHF electrical fields (6.5 m) on the blood vessels of the isolated rabbit's heart"

761. KIRCHEV, K. K. (1937) Trudy III vses. siezda fizioterap., Kiev, pp. 245-, "On the problem of the influence of ultra short-waves on blood vessels in the rabbit"

(EFTIMOV, _, & CHERNAEV, _)

762. KIRCHEV, K. K., et al. (1962) Proc. of the 5th Internat. Biochemical Congress, Section 14-28, "Biochemical changes in the muscles and blood of white rats due to microwaves"

763. KITSOVSKAYA, I. A. (1959) In: Summaries of reports, Labor Hygiene and the Biological Effect of Radio Frequency Electromagnetic Waves, Moscow, "Changes in the higher nervous activity of rats exposed to chronic effects of radio frequency (centimeter) waves"

764. KITSOVSKAYA, I. A. (1960) Trudy Nii Gigiyena Truda i Profzabolevaniya AMN SSR, _(1):75-80 (Also in: The Biological Action of Superhigh Frequencies, Letavet, A. A., & Gordon, Z. V., (eds.), (1960), Moscow, JPRS 12471, pp. 75-82, Abstr. in: The Biological Effects of Electromagnetic Fields - Annotated Bibliography, ATD Rpt. P-65-17, Apr. 1965), "Investigation of the interrelationships between the basic neural processes in rats under the influence of SHF-UHF of various intensities"

765. KITSOVSKAYA, I. A. (1964) Gigiena Truda i Professional'nye Zabolevaniya (Moskva) 8(6):14-19, (JPRS 31047, N65-28357, TT-65-31545), "The effect of centimeter waves of varying intensity on the blood and hemopoietic organs of white rats"

766. KITSOVSKAYA, I. A. (1964) Trudy Nii Gigiyena Truda i Prof Zabolevaniya AMN SSSR, _(2):39-42, (In: The Biological Action of Ultrahigh Frequencies, Letavet, A. A., & Gordon, Z. V., (eds.), (1960), Moscow, JPRS 12471), "Comparative evaluation of the action of microwaves of various wavelengths on the nervous system of rats susceptible to sound stimulus"

767. KLASCIUS, A. F. (1971) Jet Propulsion Lab. Rept. (8 pages), [Evaluation of the Navy's] "Microwave radiation protective suit" (Also: Amer. Indust. Hygiene Assoc. J. _( ):771-774 (Nov. 1971)

768. KLIMKOVA-DEUTSCHOVA, E. (1963) In: Transl. of Czechoslovakian Neurology, 26(3):184-189, (FTD-TT-64-267, pp. 22-, Aug. 1964; AD #450604), "Effect of (microwave) radiation on human EEG"

769. KLIMKOVA-DEUTSCHOVA, E., & ROTH, B. (1963) Electroencephalography and Clinical Neurophysiology 15(1):170 only, (Abstr. 17 of Meeting of Czech EEG Commission, HRADEC KRALOVE, Czech, June 1962), "The influence of a high frequency electromagnetic field on the human EEG"

770. KLIMKOVA-DEUTSCHOVA, E., & ROTH, B. (1963) International Archiv Gewerbepathol Gewerbehyg 20(1):1-10, "The effect of electromagnetic waves on the nervous system - an electroencephalographic study"

771. KLIMKOVA-DEUTSCHOVA, E., & ROTH, B. (1963) Chekhoslovatskoe Meditsinskoe Obozrenie 9:254-, "The effect of radiation on the human encephalogram"

772. KLING, D. H. (1935) Arch. of Physical Therapy 16:88-95, "Results of short wave and ultrashort wave therapy (radiathermy)"

773. KNAUF, G. M. (1957) Proc. 1st Tri-service Conf. on Biological Hazards of Microwave Radiation (Pattishall, E. G., ed.) 1:34-46, "Program for the investigation of the biological effects of electromagnetic radiation at the Rome Air Development Center"; Also, Appendix A, pp. 89-93, "Investigation of the biological effects of electromagnetic radiation; status report"

774. KNAUF, G. M. (1958) Proc. Tri-service Conf. on Biological Effects of Microwave Energy (Pattishall, E. G., & Hanghart, F. W., eds.) 2:3-8, "Outline and purpose of meeting"; Also, pp. 49-53, (AD 131477, July 1958), "New concepts in personnel protection"; also, pp. 124-125, "Review of the biological effects program (abstract)

775. KNAUF, G. M. (1958) AMA Arch. of Industrial Health 17:48-52, (Presented at 106th Annual AMA meeting, New York City, June 1957), "The biological effects of microwave radiation on Air Force personnel"; and ibid. 17:383-388, "Industrial medical problems in an electronic research center"

776. KNAUF, G. M. (1959) (Chairman), Technical Report, Investigators' Conf. on Biological Effects of Electronic Radiating Equipments (held at Patrick Air Force Base, Florida, Jan.), (RADC-TR-59-67, AD 214693, July 1959, 45 pages

777. KNAUF, G. M. (1959) Digest of Tech. Papers, Proc. of the 12th Annual Conf. on Electrical Techniques in Medicine and Biology (Schwan, H. P., ed.), p. 34 only, "Biological effects of microwave radiation: A research progress report"

778. KNAUF, G. M. (1961) Proc. 4th Tri-service Conf. on the Biological Effects of Microwave Radiation, Vol. 1 (Peyton, M. F., ed.), pp. 9-12, "Chairman's remarks"

779. KNAUF, G. M. (1960) Amer. J. of Public Health 50(3):364-367, "Microwave exposure and missile propellants as occupational health problems"

780. KNAUF, G. M. (1960) Aerospace Med. 31(3):225-228, "The bio-effects of radar energy"

781. KNAUF, G. M., & SPENCER, J. L. (1957) Proc. 1st Tri-service Conf. on Biological Hazards of Microwave Radiation (Pattishall, E. G., ed.) 1(Appendix B):94-103, (AD 115603, RADC-TR-58-51), "Bibliography of biological effects of radio frequency energies, 1940-1957"

782. KNAUS, H. (1940) Minerva Medica 31:322-323, "Thermal sensitivity of testes and spermatozoa"

783. KNICKERBOCKER, G. G., KOUWENHOVEN, W. B., & BARNES, H. C. (1967) IEEE Trans. on Power Apparatus and Systems 86(4): 498-505, "Exposure of mice to a strong AC electric field: An experimental study"

784. KNORRE, K. G. (1959) In: Summaries of reports, Labor Hygiene and the Biological Effect of Radio Frequency Electromagnetic Waves, Moscow, p. 22 only, Title?

785. KNORRE, K. G. (1960) Trudy Nii Gigiyena Truda i Profzaboleaniya AMN SSSR, (1):11-21, (Also in: The Biological Action of Ultrahigh Frequencies, Letavet, A. A., & Gordon, Z. V., (eds.), Moscow, JPRS #12471, (N62-11902, TT-62-19175), "Parameters of SHF-UHF fields determining the hygienic evaluation of working conditions and the problems of their measurement"

786. KNORRE, K. G. (1963) Referativnyy Zh., Elektronika i Yeye primeneniye, (3):11-21, (Also in: The Biological Action of Ultrahigh Frequencies, Letavet, A. A., & Gordon, Z. V. (eds.), Moscow, JPRS 12471, pp. 5-17), "Parameters of UHF fields determining the hygienic evaluation of working conditions and the problems of their measurement"

787. KNORRE, K. G., & BELITSKIY, B. M. (1959) In: Summaries of reports, Labor Hygiene and the Biological Effect of Radio Frequency Electromagnetic Waves, Moscow, p. 36 only, Title?

788. KNORRE, K. G., & GORDON, Z. V. (1960) In: Elektronika V Meditsine, Berg, A. I., (ed.), Moscow - Leningrad, pp. 374-382, "Methods of measuring SHF-UHF field parameters which determine the hygienic estimate of labor conditions during work with generators"

789. KNUDSON, A., & SCHAIBLE, P. J. (1929) Abstr. of Communications to the XIIIth Internat. Physiological Congress, held in Boston, Aug., pp. 147-143, "Chemical changes in the body resulting from exposure to UHF field. I. Blood chemical findings in the dog. II. Acid base balance in the plasma of dogs"

790. KOBAK, D. (1935) Arch. of Physical Therapy 16:171-173, (Editorial), "Priority in short wave therapy"; Also, ibid. 16:430-431, (Editorial), "Urologic electrosurgery"

791. KOCHERGA, L. O. (1940) Universitet. Instytut fiziologii, Sbornik statei, Dnepropetrovsk, (3): page?,"The effect of SHF-UHF fields on spinal cord functions"

792. KOGAN, A. B., & TKHOMOVA, N. A. (1965) Biofizika 10(2):292-296, "The effect of a constant magnetic field on the movement of paramecia"

793. KOIWA, M. (1939) Tohoku J. of Experimental Medicine 37:202-215, (In German) "Influence of short wave irradiation on the glomerulary filtration and the tubular resorption in the normal and in the denerved kidney"

794. KOKHANOVICH, N. P. (1941) Fizioterapia, Moskva, 3-4:47-49, (In Russian), (Abstr. in: The Biological Effects of Electromagnetic Fields - Annotated Bibliography, ATD Rpt. P-65-17, Apr. 1965), Title? [Irradiation of dogs with UHF radiation]

795. KOLESNIK, F. A., & MALYSHEV, V. M. (1967) Voenno-meditsinskiy Zh. (USSR Military Medical J.) (2):28-29, ACSI J2103), "Nomenclature of disorders caused by electromagnetic waves of ultrahigh frequency"

796. KOLESNIK, F. A., & MALYSHEV, V. M. (1967) Voyenno-meditsinskiy Zh. (USSR Military Medical J.) (4):21-23, (Abstr. in: Soviet Radiobiology, ATD #68-105-108-9, June 1968, pp. 77-78; AD #671436), "The problem of clinical observation of injuries caused by SHF electromagnetic fields"

797. KOLESNIK, F. A., MALYSHEV, V. M., & MURASHEV, B. F. (1967) Voyenno-meditsinskiy Zh. (USSR Military Medical J.) (7): 39-41, (Abstr. in: Soviet Radiobiology, ATD 68-105-108-9, June 1968, pp. 78-79; AD 671436), "Disturbances of the endocrine system by chronic action of a super-high-frequency microwave field"

798. KOLESNIKOV, V. M. (1969) Izvestiya Vysshikh Uchebnykh Zavedeniy, Priborostroyeniye, Russ., 12(7):9-12, (JPRS 49239), "New measurement techniques in studying the effect of superhigh frequency fields on biological subjects"

799. KOLIN, A. (1959) Proc. of the 1st National Biophysics Conf., 1:125-137, "Sorting of macromolecules and micro-organisms by means of electromagnetic and electrokinetic phenomenon"

800. KOLIN, A. (1968) Physics Today :39-50 (Nov.), "Magnetic fields in biology"

801. KOLIN, A. (1969) Final report, May 1960 - Aug. 1969. Univ. of Los Angeles, Calif. (NONR 233-(64), NR 136-505), "Electromagnetic separation of biological particles"

802. KOMAROVA, L. A. (1967) Voprosy Kurortologii Fizioterapii i Lechebnoi Fizicheskoi Kulturi (1):9-13, "Mechanism of action of superhigh frequency magnetic fields (microwaves)"

803. KONCHALOVSKAYA, N. M., KHMARA, S. N., & GLOTOVA, K. V. (1964) Trudy Nii Gigiyena Truda i Profzaboleaniy AMN SSSR, (2):114-118, (Abstr. in: The Biological Action of Ultrahigh Frequencies, Letavet, A. A., & Gordon, Z. V., (eds.), Moscow, JPRS 12471), "Condition of the cardiovascular system under the action of radio waves of various ranges"

804. KONIN, P. M., FRANKE, V. A., et al. (1960) In: Electronika V. Meditsine, Berg, A. I., (ed.), Moscow, Leningrad, (FTD-TT-63-1200, AD 600581), pp. 383-392, "Electronics and industrial safety"

805. KORBEL, S. (1966) Report, 4 pages, "Behavioral effects of ultrahigh frequency radio waves: abstracts"

806. KORBEL, S. F. (1970) In: Proc. of the "Biological Effects and Health Implications of Microwave Radiation" Symposium, (Cleary, S. F., ed.), Bur. of Rad. Health, Div. of Bio. Effects, Rept. No. 70-2, pp. 180-184, "Behavioral effects of low intensity UHF radiation"

807. KORBEL, S. F., & FINE, H. L. (1967) Psychonomic Science 9(9):527-528, "Effects of low intensity UHF radio fields as a function of frequency"

808. KORBEL, S., & THOMPSON, W. D. (1965) Psychological Reports 17:595-602, "Behavioral effects of stimulation by UHF radio fields"

809. KORENEVA, L. G., & GAIDUK, V. I. (1970) Doklady Akad. Nauk, USSR, 193(2):465-468, "Resonance effects in hemoglobin resulting from irradiation with SHF electromagnetic waves are, in principle, possible"

810. KORNER, H. J. (1967) Zentralblatt fur Arbeitsmedizin und Arbeitsschutz (Frankfort am Main), 17:(12 pages), "Potential radiation hazard in radar installations"

811. KORSUN, G. S., & MIKHAYLOV, G. V. (1956) Voyenno-meditsinskoy Zh. (9):32-36 (Abstr. in: Biological Effects of Microwaves: Compilation of Abstracts, ATD-P-65-68, Sept. 1965, pp. 4-5, "Clinical examination of radar-set operators"; also abstr. in: The Biological Effects of Electromagnetic Fields - Annotated Bibliography, ATD-P-65-17, Apr. 1965), "Some problems concerning the physiological and clinical evaluation of people working on UHF generators"

812. KORTELING, G. J., & BACH, S. A. (1964) Report No. 548, U. S. Army Medical Research Laboratory, Ft. Knox, Kentucky, (AD 443679), 14 pages, "Activity changes in alpha-amylase solutions following their exposure to radio-frequency energy"

813. KOSIERADZKI, K. (1936) Biochemische Zeitschrift 287:265-, "Investigations on the effect of shortwave radiation on enzymes; Report No. 1. Studies on diastase"

814. KOSLOV, S. (1969) Presented at the Hazards and Utility of Microwaves and Radiowaves Seminar, (Heller, J., Chm.), 11-12 Dec., Boston, "The U. S. -- Soviet radiation gap"

815. KOSMAN, A. J., OSBORNE, S. L., & IVY, A. C. (1948) Arch. of Physical Med. 29:559-562, "Importance of current from and frequency in electrical stimulation of muscles"

816. KOTTKE, F., KOZM, D., KUBICEK, W., & OLSON, M. (1949) Arch. of Physical Med. 30:431-437, "Deep circulatory response to short wave diathermy and microwave diathermy in man"

817. KOUWENHOVEN, W. B., LANGWORTHY, O. R., SINGEWALD, M. L., & KNICKERBOCKER, G. G. (1967) IEEE Trans. on Power Apparatus and Systems 86(4):506-511, "Medical evaluation of man working in AC electric fields"

818. KOVACS, R. (1935) Arch. of Physical Therapy 16:743-744, "Vacuum type wave generator of faradic and galvanic current"

819. KOVACS, R. (1951) Annals of Western Med. and Surgery (Los Angeles) 5:199-200, "Radar and ultrasound in therapy"

820. KOWLOWSKI, B. (1967) Klinika Oczna. Acta Ophthalmologica Polonica (Warszawa), 37:413-418, "Effect of electromagnetic and molecular radiation"

821. KOZENKO, G. (1942) Biulleten Eksperimental'noi Biologii i Meditsiny, Moscow, 13(3-4):57-59, (Abstr. in: The Biological Effects of Electromagnetic Fields - Annotated Bibliography, ATD Rept P-65-17, Apr. 1965), (In Russian) "Effect of UHF on the function of denervated kidneys in the dog"

822. KRAMER, G. (1951) Die Vogelwarte 16(2):55-59, (NRC-TT-1162, N65-28590), "Experiments on the perception of ultrashort waves by birds"

823. KRASNY-ERGEN, W. (1936) Hochfrequenztechnik und Elektroakustik, Jahrbuch der Drahtlosen Telegraphie und Telephonie 48:126-133, (In German) "Non-thermic effects of alternating electrical fields on colloids"

824. KRASNY-ERGEN, W. (1937) Hochfrequenztechnik und Elektroakustik, Jahrbuch der Drahtlosen Telegraphie und Telephonie 49:195-199, (In German) "Field effects with very short waves; spontaneous alternating fields"

825. KREBS, J. S. (1968) NRDL-TR-68-104, Sept. (AD 677924), "Analysis of the radiation-induced loss of testes weight in terms of stem cell survival"

826. KRICHAGIN, V. I. (1962) In: Summaries of Reports, Questions of the Biological Effect of a SHF-UHF Electromagnetic Field. Kirov Order of Lenin Military Academy, Leningrad, "Practical points in standardization of microwave radiation fields"

827. KROTOV, A. V., GAYSINSKIY, B. YE., KAL'KAYEV, M. Z., & MININA, L. A. (1967) Meditsinskaya Tekhnika (4):52-54, (Abstr. in: ATD 68-105-108-9 Soviet Radiobiology, June 1968, p. 79 only; AD 671436), "Application of an ultra-high-frequency magnetic field in radiculitis"

828. KRUSEN, F. H. (1935) J. of the Amer. Medical Assoc. 104:1237-1239, "Short wave diathermy: preliminary report"

829. KRUSEN, F. H. (1950) Proc. of the Royal Society of Med. 43:641-658, "Medical applications of microwave diathermy: laboratory and clinical studies"

830. KRUSEN, F. H. (1951) Arch. of Physical Med. 32:695-698, "New microwave diathermy director for heating large regions of the human body"

831. KRUSEN, F. H. (1956) Institute of Radio Engineers Trans. on Medical Electronics, PGME-4:3-4, (From Symposium on Physiologic and Pathologic Effects of Microwaves, Krusen, F. H., Chm., Sept. 1955), "Address of welcome, Session I, Problems which are challenging investigators"

832. KRUSEN, F. H., HERRICK, J., LEDEN, W., & WAKIM, K. (1947) Proc. of Staff Meeting of the Mayo Clinic 22:209-234, "Preliminary report of experimental studies of heating effect of microwaves (radar) in living tissues"

833. KRUSTANOV, L., & GOSHEV, I. (1966) Voenno Meditsinsko Delo _(4):41-46, "The peripheral blood characteristics of personnel exposed to a superhigh frequency electromagnetic field"

834. KRYLOV, V., & SOLOVEY, A. P. (1961) State Sci. Tech. Pub. House, Moscow, 17 pages, (FTD-TT-62-339/1+2+4, Nov. 1962; AD 292611), Safety Measures Recommended for Work on Radio-Frequency Generator Installations

835. KU'AKOVA, V. V. (1964) Trudy Nii Gigyena Truda i ProfzaboleániyaAMM SSR, (Biological Effects of Radio Frequency Electromagnetic Fields, Inst. of Industrial Hygiene and Occupational Diseases, Academy of Medical Sci., USSR), Moscow, _(2):70-74, "The effect of microwaves in the centimeter and decimeter range on the general and specialized patterns of appetite in animals"

836. KULAKOVA, V. V. (1966) In: Konferentsiya molodykh nauchnykh rabotnikov (Report summaries, Conf. of Young Scientific Workers), Moscow, Tezisy dokladov, pp. 73-74, (Abstr. in: ATD 68-105-108-9 Soviet Radiobiology, June 1968, p. 80 only, AD 671436), "Methods for investigating electrolyte requirements and their content in blood and urine in studying the biological effects of microwaves"

837. KULIK, J. J. (1963) Final Report Federal Aviation Agency (No. RD-64-1), (AD 435491), "Microwave radiation hazard to aircraft transiting radio and radar beams"

838. KULIKOVSKAYA, YE. L. (1961) In: Materials of the Scientific Session Concerned with the Results of Work Conducted by the Leningrad Institute of Industrial Hygiene and Occupational Diseases for 1959-1960, Leningrad, "The problem of microwave radiation of ship crews of the civil ocean fleet"

839. KULIKOVSKAYA, YE. L. (1962) In: Summaries of reports, Questions of the Biological Effect of an SHF-UHF Electromagnetic Field. Kirov Order of Lenin Military Medical Academy, Leningrad, "Effects of high frequency electromagnetic fields (medium and short wave lengths) on Navy ships crews"

840. KULIKOVSKAYA, YE. L. (1963) Gigiyena Truda i Professional'nyye Zabolevaniya (Labor Hygiene and Occupational Diseases), Moscow, _(2):24-27, (JPRS 19,068, OTS 63-21756, May 1963, pp. 1-5), (In Russian), "Ultra-high frequency electromagnetic waves on the decks of merchant ships"

841. KULIKOVSKAYA, YE. L. (1968) Gigiena Truda i Professional'nye Zabolevaniia (Moskva) _(5):22-28, "Shielding radio operators on sea-going vessels from MF-LF radiation"

842. KULIKOVSKAYA, YE. L. (1970) Izd-vo "Sudostroyeniye", Leningrad, 152 pages, (JPRS 52622, Mar. 1971), (In Russian), (Zashchita ot Deystviya Radiovoln) Protection from the Effect of Radio Waves (in the maritime industry)

843. KULIN, YE. T. (1965) In: Papers on the Physicochemical Basis of Autoregulation in Cells, Moscow, pp. 26-, "Concentration and radio-frequency dependence of autoregulation of functions of unicellular organisms (paramecia)"
DEMIDOVA, S.I., & KASIMENKO, V.B.

844. KULIN, YE. T. (1968) Biofizika 13(1):81-85, "Dependence of the phagocytic function of paramecia on the frequency and intensity of the electromagnetic field"

845. KULIN, YE. T., & MOROZOV, YE. I. (1964) Doklady Akademii Sci. BSSR, 8(5):329-331, "The effect of decimeter wavelength radiation on the physiological functions of one-celled organisms"

846. KULIN, YE. T., & MOROZOV, YE. I. (1965) Vestnik Akademii Nauk BSSR, Ser. Biologich, Nauk -(4):91-, "Some features of the effect of electromagnetic fields of the SHF range on the phagocytic function of paramecia"

847. KUPALOV, P. S., & FRENKEL, G. L., (Eds.), (1937) (In Russian), All Union Inst. of Experimental Medicine, Moscow, 471 pages, The Biological Action of VHF-HF-Ultrashort Waves

848. KUSSEL, G. (1949) Ophthalmologica (Basel), 177:299-, "Late form of electrical cataract case"

849. KUSABAYASHI, S., LARONGE, T. M., & LABES, M. M. (1967) Report (10 pages), June-Dec., (NASA, CR-91523), (N68-13316), "Mechanisms for the effects of electric and magnetic fields on biological systems"

850. KYLEN, A. M., et al. (1964) J. of the Amer. Dietetic Assoc. 45:139-145, "Microwave and conventional cooking of meat"

851. KYUNTSEL', A. A., & KARMILOV, V. I. (1947) Klinicheskaya Meditsina, Moscow, (24), "The problem concerning the effect of electromagnetic fields on the blood coagulation rate"

852. LACEY, B. A., WINNEK, H. I., & McLELLAN, M. E. (1965) J. of Applied Bacteriology 28:331-335, "Effects of microwave cookery on the bacterial count of food"

853. LaFOND, C. (1959) Missiles and Rockets _(?):20-, (14 Dec.) "Microwave 'hazards' are exaggerated"

854. LAIRD, E. (1952) Canadian J. of Physiology 30:663-, "Dielectric properties of some solid proteins at wavelengths of 1.7 m and 3.2 cm"

855. LAIRD, E., & FERGUSON, K. (1949) Canadian J. of Research, A, 27:218-230, "Dielectric properties of some animal tissues at meter and centimeter wave lengths"

856. LANG, O., & KOLLER, G. (1956) Zenth. Arbeitsmed. Arbeitsschutz 6:13-, (In German) "Protective measures for working spaces in high frequency installations"

857. LANTSMAN, M. N. (1965) Trans., Scientific Conf., Central Science Lab. TOMSK, _(2):360-362, "The effect of an alternating magnetic field on the phagocytic function of the reticulo endothelial system in experimentation"

858. LARKIN, C. R. (1957) Proc. 1st Tri-service Conf. on Biological Hazards of Microwave Radiation (Pattishall, E. G., ed.) 1:47-51, "Hazards of electromagnetic radiation to ordnance"

859. LaROCHE, L. P., ZARET, M. M., & BRAUN, A. F. (1970) Arch. of Environmental Health 20:350-355, "An operational safety program for ophthalmic hazards of microwaves"

860. LAVRENTIEVA, B. I., & FEDOROV, B. G. (1937) Shornik Bio. Deistvii, UHF, Moscow, pp. 145-, (Abstr. in: Biological Effect of Ultrahigh Frequencies Symposium, Moscow; also Abstr. in: The Biological Effects of Electromagnetic Fields - Annotated Bibliography, AID Rpt. P-65-17, Apr. 1965), "Observations on live synapses under the action of UHF on the frog's heart"

861. LAWRENCE, J. C. (1968) British J. of Industrial Med. 25:223-228, "Effect of microwaves at X-band on guinea pig skin in tissue culture. Part I. Microwave apparatus for exposing tissue and the effect of radiation on skin respiration"

862. LAWRENCE, J. C. (1969) Non-Ionizing Radiation 1(2):80-84, "Effect of pulsed microwaves at X-band on skin metabolism"

863. LAWRENCE, L. G. (1969) Electronics World 82(4):25-28, "Electronics and the living plant"

864. LAWRENS, L., SIEMS, B., KOSMAN, P., STAFFORD, L., & OSBORNE, M. (1948) Arch. of Physical Med. 29:12-, Title?

865. LAZAREV, P. P. (1935) Klinicheskaia Meditsina, Moskva, 13(11):1583-1590, "Theory of the action of short and ultrashort waves"

866. LAZELL, J. A. (1960) Health Physics 16:525-, "Radiation Control for Health and Safety Act of 1968"

867. LEARY, F. (1959) Electronics 32(8):49-53, "Researching microwave health hazards"

868. LEAVY, I. M. (1935) Arch. of Physical Therapy 16:145-149, "Physical therapy in chronic diseases: With special reference to peripheral vascular disease and ulcerations" [diathermy]

869. LEBEDINSKIY, A. V. (1937) In: Materials of the Leningrad Conf. on VHF-HF Waves, Leningrad, pp. 45-54, "The physiological mechanism involved in the action of VHF-HF on the organism of animals and man"

870. LEBEDINSKIY, A. V. (1940) Pervoye soveshchaniye po voprosam primeneniya KV i UKV v meditsine. Trudy. (Trans. of the 1st Conf. on problems of the applications of shortwaves and ultrashort waves in medicine) Medgiz, pp. 121-129, (Abstr. in: The Biological Effects of Electromagnetic Fields - Annotated Bibliography, AID Rpt. P-65-17, Apr. 1965), Title? [Discusses the exposure of humans to UHF electromagnetic fields]

871. LEDEN, U. M., HERRICK, J. F., WAKIM, K. G., & KRUSEN, F. H. (1947) British J. of Physical Med. 10:177-184, "Preliminary studies on the heating and circulatory effects of microwaves - 'Radar'"

872. LEHMANN, J. F., GUY, A. W., JOHNSTON, V. C., BRUNNER, G. D., & BELL, J. W. (1962) Arch. of Physical Med. 43:69-76, "Comparison of relative heating patterns produced in tissues by exposure to microwave energy at frequencies of 2,450 and 900 megacycles"

873. LEHMANN, J. F., et al. (1964) Arch. of Physical Med. 45:555-563, "Modification of heating patterns produced by microwaves at the frequencies of 2456 and 900 MC by physiologic factors in the human"

874. LEITES, F. L., & SKURIKHINA, L. A. (1961) B'ulleten Eksperimental'noi Biologii i Meditsiny (Moskva) 52(12):47-50, (Bulletin of Experimental Biology and Med. 52(12):1387-1390, 1961), (FTD-TT-62-277, AD 281169), (In Russian), "The effect of microwaves on the hormonal activity of the adrenal cortex"

875. LENKO, J., WANIEWSKI, E., & WOCHNA, Z. (1966) Polski Tygodnik Lekarski 39(21):1475-1477, "Studies of the effects of microwaves of low power flux density on the testicles of rabbits"

876. LENNAN, I. (1931) Arch. of Physical Therapy 12:1 3-, "The heating effect of short radio-waves"

877. LENSON, P., HERRICK, J., & KRUSEN, F. (1950) Arch. of Physical Med. 31:687-695, "Temperatures produced in bone marrow, bone, and adjacent tissues by diathermy: experimental study"

878. LEONTOVICH, A. V. (1937) Fiziologicheskiy Zh. SSSR, Sechenov, 22(3,4):377-385, (Abstr. in: The Biological Effects of Electromagnetic Fields - Annotated Bibliography, AID Rept. P-65-17, Apr. 1965), "The problem of nerve excitation"

LERMAN (See citation #392)

879. LETAVET, A. A., & GORDON, Z. V., (Eds.) (1960) Institute of Labor Hygiene and Occupational Diseases, Acad. of Medical Science, USSR, Moscow, 142 pages, (JPRS 12,471, 1962), (Abstr. in: The Biological Effects of Electromagnetic Fields - Annotated Bibliography, AID Rpt. P-65-17, Apr. 1965), The Biological Action of Ultrahigh Frequencies

880. (LETAVET, A. A., & GORDON, Z. V. , ?), (1960) In: The Biological Action of Ultrahigh Frequencies, Letavet, A.A., & Gordon, Z. V., (eds.), pp. 123-125, (JPRS 12471, 1962); (Abstr. in: The Biological Effects of Electromagnetic Fields - Annotated Bibliography, AID Rpt P-65-17, Apr. 1965), "Recommendations for conducting preliminary and periodic medical examinations of workers using UHF sources"

881. LEVITINA, N. A. (1964) Biulleten Eksperimental'noi Biologii i Meditsiny (Moskva), 58(7):67-69, (Abstr. in: Biological Effects of Microwaves: Compilation of Abstracts, 1965, p. 44 only, 'Effect of pulsed UHF on cardiac rhythm"), (Also abstr. in: The Biological Effects of Electromagnetic Fields - Annotated Bibliography, AID Rpt. P-65-17, Apr. 1965), "Effect of microwaves on cardiac rhythm of rabbits during local irradiation of body areas"

882. LEVITINA, N. A. (1966) Author's abstr. of Candidate's Dissertation, Moscow, "An investigation of the nonthermal action of microwaves on the heart rate"

883. LEVITINA, N. A. (1966) Biulleten Eksperimental'noi Biologii i Meditsiny (Moskva), 62(12):64-66, "Nonthermal action of microwaves on the cardiac rhythm of the frog"

884. LIBBER, L. M. (1970) Bioscience 20(21):1169-1170, "Extremely low frequency electromagnetic radiation biological research"

885. LICHT, S. H. (Ed.) (1958, Physical Medicine Library, Vol. 2); (1967, Vol. 4, 2nd Edition), E. Licht, pub., New Haven, Conn., Vol. 2, Therapeutic Heat and Cold; Vol. 4, Therapeutic Electricity and Ultraviolet Radiation

886. LICHT, S. H. (1967) Chapt. 1 in: Therapeutic Electricity and Ultraviolet Radiation, Physical Medicine Library, Vol. 4, 2nd Edition; E. Licht, pub., New Haven, Conn., pp. 1-70, "History of electrotherapy"

887. LICHTER, I., BORRIE, J., & MILLER, W. M. (1965) British Medical J. 1(5449):1513-1518, "Radio-frequency hazards with cardiac pacemakers"

888. LIDMAN, B. I., & COHN, C. (1945) Air Surgeons Bulletin 2:448-449, "Effects of radar emanations on the hematopoietic system"

889. LIEBESNY, P. (1934) Abstr. of the 1st Internat. Congress of Electro-Radio-Biology, (Licunio Cappelli, ed., Bologna, Italy), pp. 369-382, (In German with English Summary), "Biological effects of Hertzian shortwaves"

890. LIEBESNY, P. (1935) Urban and Schwarzenberg, pub., Vienna, (Book Review in: Arch. of Physical Therapy 16:306 only, 1935), Short and Ultrashort Waves in Biology and Therapy

891. LIEBESNY, P. (1938) Arch. of Physical Therapy 19:736-740, "Athermic short wave therapy"

892. LERMAN, S. (1962) N. Y. State J. of Medicine 62(19):3075-3085, "Radiation cataractogenesis" [ionizing and non-ionizing radiation] (Out of place, should follow citation #878)

893. LIKHTERMAN, B. V. (1933) Byull. Gosudarstvennogo Tsentral'nogo Instuta imeni Sechenova, (Bull. of the State Central Institute of Sechenova), 8(10): "The effect on attending personnel of work with high frequency electromagnetic equipment"

894. LIKHTERMAN, V. B., BORODINA, M. A., LINCHENKO, V. M., & ORLOV, L. M. (1936) Sevastopol'. Gosudarstvennyy Tsentral'nyy Nauchno-issledovatel'skiy Institute Zicheskikh Metodov Lecheniya. Izvestiya 3(3, 4):pp. ?, (Abstr. in: The Biological Effects of Electromagnetic Fields - Annotated Bibliography, ATD Rept P-65-17, Apr. 1965), "The therapeutic use of short waves"

895. LINGEMANN, A., et al. (1964) Zeitschrift fur Gesamte Innere Medizin und ihre Grenzgebiete, Leipzig, 19:705-711, "Effect of short waves on some functions of the liver"

896. LINDQUIST, R. J. (?) Reference?, 20 pages, "Short wave diathermy"

897. LINDQUIST, R. J. (?) Reference?, 19 pages, "Galvanism"

898. LINKE, C. A., LOUNSBERRY, W., & GOLDSCHMIDT, V. (1962) J. of Urology 88(2):303-311, "Effects of microwaves on normal tissues"

899. LION, K. S. (1947) Arch. of Physical Med. 28:344-347, "The effect of the presence of meters in tissues subjected to diathermy treatment"

900. LIVANOV, M. N. (1944) Academy of Medical Sciences, USSR, (Biol.) (6), "Cerebral cortex electrical reactivity curves for man and animal under normal and pathological conditions"

901. LIVANOV, M. N. (1960) Biulleten Eksperimental'noi Biologii i Meditsiny (Moskva) 49(5):478-481, "Influence of electromagnetic fields on the electrical activity of rat cerebral cortex"

902. LIVANOV, M. N., TSYPIN, A. B., GRIGORY'EV, YU. G., KRUSHCHEV, V. G., STEPANOV, S. M., & ANAN'YEV, V. M. (1960) Biulleten Eksperimental'noi Biologii i Meditsiny (Moskva) 49(5):63-67, "The effect of electromagnetic fields on the bioelectric activity of cerebral cortex in rabbits"

903. LIVENSON, A. R. (1959) Novosti Meditsinskoi Tekhniki, USSR, _(1):31-44, (JPRS 9409), "The use of SHF-UHF electromagnetic fields in medicine"

904. LIVENSON, A. R. (1960) (In Russian) In: Electronics in Medicine (Electroniki V Meditsin), A. I. Berg. (ed.), Moscow, Leningrad, pp. 233-238, (Abstr. in: The Biological Effects of Electromagnetic Fields - Annotated Bibliography, ATD Rpt P-65-17, Apr. 1965), "High frequency therapeutic apparatus"

905. LIVENSON, A. R. (1960) Meditsinskaya Gazeta Navy USSR _(5):57-63, "The use of microwaves in physiotherapy (The Luch 58 Apparatus)"

906. LIVENSON, A. R. (1962) Proc. of the 2nd All-Union Conf. on the Use of Radioelectronics in Biology and Medicine, Moscow, pp. 25-, "Dosimetric methods in microwave therapy"

907. LIVENSON, A. R. (1963) Trudy Vsesoyuznogo Nauchno-Issledovatel'skogo Instituta Meditsinskikh Instrumentov Oborudovanii 3:12-, "Dosimetric methods in centimeter and decimeter-wave therapy"

908. LIVENSON, A. R. (1963) Meditsinskaya Promyshlennost, USSR Med. Industry, _(11):10-17, (JPRS 23167, N64-14920), "Dosimetry methods in microwave and decimeter wave therapy"

909. LIVENSON, A. R. (1964) Voprosy Kurortologii Fizioterapii i Lechebnoi Fizicheskoi Kulturi _(5):450-, "Questions of occupational hygiene relating to the operation of equipment for microwave therapy"

910. LIVENSON, A. R. (1964) Meditsinskaya Promyshlennost, USSR Med. Industry, 18(6):14-20, (JPRS 26191, TT-64-41450, N64-28092), (Abstr. in: The Biological Effects of Electromagnetic Fields - Annotated Bibliography, ATD Rpt P-65-17, Apr. 1965), (Also in: Biological Effects of Microwaves, Compilation of Abstracts, ATD P-65-68, 1965, pp. 82-90), "Electrical parameters of biological tissue in the microwave range; Part 1"

911. LIVENSON, A. R. (1964) Meditsinskaya Promyshlennost, USSR Medical Industry, 18(7):10-17, (JPRS 26429, TT-64-41687), (Abstr. in: The Biological Effects of Electromagnetic Fields - Annotated Bibliography, ATD Rpt P-65-17, Apr. 1965), "Electrical parameters of biological tissue in the microwave range; Part 2, Methods of gauging electrical parameters of biological tissue"

912. LIVENSON, A. R. (1966) Meditsinskaya Promyshlennost, USSR Medical Industry, _(10):17-24, (Transl. by Transl. Div., Foreign Technology Div., WP-AFB, Ohio, Document # FTD-HT-23-232-68, May 1968), (In Russian) "Determination of the coefficient of reflection for multilayered systems of biological tissues in the microwave range"

913. LIVENSON, A. R., & FRENK, A. A. (1966) Meditsinskaya Promyshlennost, USSR Medical Industry, 20(4):18-24, (JPRS 36332, July 1966), "On the problem of dosimetry of the energy of decimetric waves"

914. LIVENSON, A. R., & GAVRILIN, V. A. (1964) Section in: Recent Developments in Medical Instruments, State Sci. Inst. Sci. Tech. Info., Moscow, (JPRS 25587, TT-64-31859, M64-30396), "An apparatus for synchronized treatment of biological objects with modulated microwaves (Sinkhroimpuls)"

915. LIVSHITS, N. N. (1947) Akademiya nauk SSSR, Fiziologicheskiy Institut. Trudy, 2:64-, (Abstr. in: The Biological Effects of Electromagnetic Fields - Annotated Bibliography, ATD Rpt P-65-17, Apr. 1965), "Visual adaptation to darkness under the action of SHF-UHF fields upon the occipital region"

917. LIVSHITS, N. N. (1954) Dissertation, Moscow, (Abstr. in: The Biological Effects of Electromagnetic Fields - Annotated Bibliography, ATD Rpt P-65-17, Apr. 1965), "The effect of an ultrahigh frequency electric field and ionizing radiation on the CNS"

917. LIVSHITS, N. N. (1957) Biofizika 2(3):387-389, (In Russian), (Biophysics 2(3):372-374, 1957, (In English)), (Abstr. in: The Biological Effects of Electromagnetic Fields - Annotated Bibliography, ATD Rpt P-65-17, Apr. 1965); (Also Abstr. in: Biological Effects of Microwaves: Compilation of Abstracts, ATD P-65-68, 1965, p. 68 only, "Review of the role of the nervous system in reactions to UHF"), "The role of the nervous system in reactions to UHF electromagnetic fields"

918. LIVSHITS, N. N. (1957) Biofizika 2(2):197-208, (Abstr. in: The Biological Effects of Electromagnetic Fields - Annotated Bibliography, ATD Rpt P-65-17, Apr. 1965), "Conditioned reflex activity in dogs under local influence of a VHF-HF field upon certain zones of the cerebral cortex"

919. LIVSHITS, N. N. (1957) Doklady Akademii Nauk SSSR 112:1145-1147, (Abstr. in: Biological Effects of Microwaves: Compilation of Abstracts, ATD P-65-68, 1965, pp. 27-28, "Effects of UHF on conditioned reflex activity"), (Also abstr. in: The Biological Effects of Electromagnetic Fields - Annotated Bibliography, ATD Rpt P-65-17, Apr. 1965), "Conditioned reflex activity of dogs during exposure to the cerebellum to VHF-UHF fields"
also 426-436,

920. LIVSHITS, N. N. (1958) Biofizika 3(4):409-421,/(Abstr. in Biological Effects of Microwaves: Compilation of Abstracts, ATD P-65-68, 1965, pp. 70-71, "Review of the effect of UHF fields on the functions of the nervous system"), (Also, abstr. in: The Biological Effects of Electromagnetic Fields, ATD Rpt P-65-17, Apr. 1965), "The effect of an ultrahigh-frequency field on the functions of the nervous system"

921. LOBANOVA, YE. A. (1959) Gig. Biol. Deystviya, Moscow, (In: Summaries of Reports, Labor Hygiene and the Biological Effect of Radio Frequency Electromagnetic Waves, Moscow, pp. 46-47), "Changes of the conditioned reflex activity in animals (rats and rabbits) under continuous exposure to centimeter waves"

922. LOBANOVA, YE. A. (1960) Trudy Nii Gigiyena Truda i Profzabolevaniya AMN SSSR, _(1):61-64, (Abstr. in: Biological Effects of Microwaves: Compilation of Abstracts, ATD P-65-68, 1965, pp. 30-31, "Survival and development of mammals in UHF fields"), (Also abstr. in The Biological Action of Ultrahigh Frequencies, Letavet, A. A., & Gordon, Z. V., (eds.), Moscow, JPRS 12471, pp. 60-63), "Survival and development of animals exposed to various intensities and durations of pulsed SHF-UHF"

923. LOBANOVA, YE. A. (1964) Trudy Nii Gigiyena Truda i Profzabolevaniya AMN SSSR, _(2):13-19, (Abstr. in: The Biological Action of Radio Frequency Electromagnetic Fields, Inst. of Industrial Hygiene & Occupational Diseases, Acad. of Med. Sciences, USSR, Moscow), "Changes in conditioned reflex activity of animals exposed to various ranges of microwaves"

924. LOBANOVA, YE. A. (1964) Trudy Nii Gigyena Truda i Profzabolevaniya AMN SSSR, _(2):75-77, (Also in: The Biological Action of Radio Frequency Electromagnetic Fields, Institute of Industrial Hygiene and Occupational Diseases, Academy of Medical Science, USSR, Moscow), "Study of temperature reaction of animals to the effects of microwaves of various wave ranges"

Trudy Nii
925. LOBANOVA, YE. A. (1966)/Gigiena Truda i Professional'nye Zabolevaniya (Moskva) USSR, 10(10):7-12, (JPRS 39820), "Effect of chronic exposure to pulsed and nonpulsed 10 cm waves on the conditioned reflex activity of white rats"

Trudy Nii
926. LOBANOVA, YE. A. (1968)/Gigiena Truda i Professional'nye Zabolevaniya (Moskva), USSR, _(11):23-27, "The problem of establishing standards for periodic microwave radiation exposure: An experimental study"

927. LOBANOVA, YE. A., & GORDON, Z. V. (1960) Trudy Nii Gigiyena Truda i Profzabolevaniya AMN SSSR, _(1):52-56, (Also in: The Biological Action of Ultrahigh Frequencies, Letavet, A. A., & Gordon, Z. V., (eds.), Moscow, 1960, JPRS 12471 (1962), pp. 50-56,), (Also abstr. in: The Biological Effects of Electromagnetic Fields - Annotated Bibliography, ATD Rpt P-65-17, Apr. 1965), "Investigation of the olfactory sensitivity in persons subjected to the influence of SHF-UHF"

928. LOBANOVA, YE. A., & TOLGSKAYA, M. S. (1960) Trudy Nii Gigiyena Truda i Profzabolevaniya AMN SSSR, _(1):69-74, (In Russian), (Abstr. in: The Biological Action of Ultrahigh Frequencies, Letavet, A. A., & Gordon, Z. V., (eds.), Moscow, JPRS 12471, (OTS-62-19175-R-816), pp. 68-), (Also abstr. in: The Biological Effects of Electromagnetic Fields - Annotated Bibliography, ATD Rpt P-65-17, Apr. 1965), also, (Abstr. in: Biological Effects of Microwaves: Compilation of Abstracts, ATD P-65-68, Sept. 1965, pp. 31-32, "Effect of UHF on nervous activity and inter-neuron connections"), "Change in the higher nervous activity and inter-neuron connections in the cerebral cortex of animals under the influence of SHF-UHF"

929. LOGA, S., & ZACIU, R. (1966) Fiziologia Normala Patologica 12:395-402, "Determination of the electric parameters of biological systems at microwave frequencies"

930. LOSHAK, A. YA. (1963) In: Aviation and Space Medicine, Parin, V. V., (ed.), Academy of Med. Sciences, USSR, Moscow, pp. 292-295. (Transl. in: NASA TT-F-228, N65-13729), "Labor hygiene and occupational pathology involved in the work with centimeter wave generators in the Civil Air Fleet"

931. LOSHAK, A. YA. (1965) Gigiena i Sanitariya, USSR, _(6):18-22, (Abstr. in ATD Press, Special Issue "Biomedical Microwave Research": Vol. 4 (43) pp. 9-10; Transl. in: CFSTI TT-66-51033, 4-6; also JPRS 31280, and N65-29246), "The effect of climatic conditions during chronic irradiation with SHF-UHF energy"

932. LOSHAK, A. YA. (1966) In: Problems of Space Medicine, Moscow, pp. 262-263, (ATD Rept. 66-116), "The problem of the combined biological effect of X-ray and UHF irradiation"

933. LOSHAK, A. YA. (1968) Gigiena Truda i Professional'nye Zabolevaniya (Moskva) USSR, _(5):15-18, "Radio frequency irradiation from aircraft communication systems as a health hazard"

934. LOSHAK, A. YA., & MAR'YEVSKIN, YE. P. (1964) Gigiyena i Sanitariya, USSR, _(7):39-44, (FTD TT-65-345/1 and 4, AD 618635, N65-32289), (Abstr. in: Biological Effects of Microwaves: Compilation of Abstracts, ATD P-65-68, Sept. 1965, pp. 21-22, "Working conditions around Civil Air Fleet radar stations"), (Also abstr. in: The Biological Effects of Electromagnetic Fields - Annotated Bibliography, ATD Rpt P-65-17, Apr. 1965), "Evaluation of working conditions of civilian airport radar installations"

935. LUBIN, M., CURTIS, G. W., DUDLEY, H. R., BIRD, L. E., DALEY, P. F., COGAN, D. G., & FRICKER, S. J. (1960) AMA Archives of Industrial Health 21( ):555-558, "Effects of ultrahigh frequency radiation on animals"

936. LUDFORD, J. P. (Report), (unpublished? Issuing Agency?), 17 pages, "Status of the field of biological effects of radio-frequency radiation"

937. LUDWIG, F., & RIES, J. (1944) Manatschr. F. Gebrutsch Gynak 118:291-298, "Influence of short electromagnetic waves on embryonic development"

938. LUKYANOVA, S. N. (1967) Zh. Vysshei Nervno' Deyatel'nosti imeni i Pavlov, USSR, 17(4):722-729, "The effect of a permanent magnetic field on the bioelectric activity of various brain formations in rabbit"

939. LUZZIO, A. J. (1965) In: U. S. Army Med. Research Lab. Progress Report, pp. 37-38, (AD - 3368), "Immune mechanisms [Athermal biological effect of RF energies]"

940. LYALINA, O. V. (1937) In: All Union Inst. for Experimental Medicine, Moscow, "Hyperglycemic reaction to ultrahigh frequencies in connection with dosimetry"

941. LYSINA, G. G. (1965) Gigiena i Sanitariya, USSR, (6):95-96, (ATD Press, Special Issue "Biomedical Microwave Research", Vol. 4(43), pp. 4-5 (Aug. 1965); also in: CFSTI TT-66-51033/4-6), "Changes in the morphological composition of blood under the influence of SHF-UHF"
(or LYSCOV?)

942. LYSTSOV, V. N., FRANK-KAMENETSKI, D. A., & SHCHEDRINA, M. V. (1965) Biofizika 10:105-109, (In Russian), (Biophysics 10:114-119, 1965, In English), "Effect of centimeter radiowaves on vegetative cells, spores, and transforming DNA"

943. LYUDKOVSKAYA, R. G., & ALEKSEYENKO, N. YU. (1956) Materials on Evolutionary Physiology, Symposium, Moscow-Leningrad, 1:183-, (Abstr. in: The Biological Effects of Electromagnetic Fields - Annotated Bibliography, ATD Rept P-65-17, Apr. 1965), Title not given [Deals with exposure of muscle to UHF radiation]

944. LYUTOV, A. I. (1964) In: Some Problems of Physiological Biophysics, Voronezh, Izd-vo Voronezh, Univ., pp. 92-98, "Dynamics of excitability and efficiency of spinal cord motor neurons during brain incisions at various levels, and the action of sound and RF electromagnetic oscillations upon the CNS"

945. McAFEE, R. D. (1959) Proc. 3rd Tri-service Conf. on Biological Effects of Microwave Radiating Equipments (Susskind, C., ed.) 3:314-331, "Neurophysiological effects of microwave irradiation"

946. McAFEE, R. D. (1961) Amer. J. of Physiology 200(2):192-194, "Neurophysiological effect of 3 cm microwave radiation"

947. McAFEE, R. D. (1963) Amer. J. of Physiology 203(2):374-378, "Physiological effects of thermode and microwave stimulation of peripheral nerves"

948. McAFEE, R. D. (1963) Biomedical Sciences, Instrumentation 1:167-170, "Microwave stimulation of the sympathetic nervous system"

949. McAFEE, R. D. (1970) In: Proc. of the "Biological Effects and Health Implications of Microwave Radiation" Symposium, (Cleary, S. F., ed.), Bur. of Rad. Health, Div. of Bio. Effects, Rept. No. 70-2, pp. 150-153, "The neural e[illegible] hormonal response to microwave stimulation of peripheral nerves"

950. McAFEE, R. D., BERGER, C., & PIZZOLATO, P. (1960) Proc. 4th Tri-service Conf. on the Biologic[illegible]ffects of Microwave Radiation, Vol. 1, (Peyton, M. F., ed.) pp. 251-260, "Neurological effect of 3 cm microwave irradi[illegible]

951. McELHANEY, J. H., & STALNAKER, R. (1968) J. of Biomechanics 1:47-52, "Electric fields and bone loss of disuse"

952. McILWAIN, H. (1953) Biochem. J. 55:618-624, "Glucose level, metabolism and response to electrical impulse in cerebral tissues from man and laboratory animals"

953. McLAUGHLIN, J. T. (1957) California Medicine 86(5):336-339, "Tissue destruction and death from microwave radiation (radar)"

954. McLEES, B. D., FINCH, E. D., & ALBRIGHT, M. L. (1971) Naval Medical Research Institute Report (Rept. No. 1 on Project MF12.524.015-0001B), "An examination of regenerating hepatic tissue following in vivo exposure to RF radiation" (Also: J. Applied Physiology 32(1):77-85 (1972))

955. McLEES, B. D., & FINCH, E. D. (1971) Naval Medical Research Institute Report (Rept. No. 2, on Project MF12.524.015-0001B), "Bibliography on the hazards of artificial cardiac pacemaker exposure to radio frequency fields and electric shock"

956. McLEES, B. D., & FINCH, E. D. (1971) Naval Medical Research Institute Report (Rept. No. 3 on Project MF12.524.015-0001B), "Analysis of the Physiologic Effects of Microwave Radiation" (Also: see citation #2086, this Bibliography)

957. McNALLY, E. M., & BENCHIMOL, A. (1968) Amer. Heart J. (Part I) 75:pp? (Mar.); (Part II) 75:679-695, (May), "Medical and physiological considerations in the use of artificial cardiac pacing", Parts I and II

958. McNALLY, J. B., NUNN, A. S., CICHON, J. V., & RICHARDSON, A. W. (1962) Federation Proceedings 21(2):1-255, "Microwave effects on glucose absorption and transfer in the rat"

959. MACHABELI, M. YE., KHUBUTIYA, V. A., & CHINCHALADZE, J. J. (1957) Gigiena i Sanitariya 22(11):81-83, (In Russian), "Working conditions and the state of health of workers employed in radio frequency installations"

960. MACHLE, W., & LANDEEN, K. (1959) Proc. 3rd Tri-service Conf. on Biological Effects of Microwave Radiating Equipments (Susskind, C., ed.) 3:71 only, "The effect of repeated microwave exposures on the formed elements in the blood of rats"

961. MACKAY, R. S. (1960) Inst. of Radio Engineers Trans. ME-7:111-113, "Some electrical and radiation hazards in the laboratory"

962. MACLEOD, J., & KOTCHKISS, R. S. (1941) Endocrinology 28:780-784, "The effect of hyperpyrexia upon spermatozoa counts in man"

963. MACMURRAY, L. C. (1958) Proc. 2nd Tri-service Conf. on Biological Effects of Microwave Energy (Pattishall, E. G., & Benghart, F. W., eds.) 2:79-87, (AD 131477), "Microwave radiation hazards problems in the U. S. Army"

964. MACMURRAY, L. C., DEHNE, E. J., & DUGUID, R. H. (1958) U. S. Army Environmental Hygiene Agency, Tech. Pub., "Health hazards associated with microwave radiation"

965. MADSON, R. A., CORDARO, J. T., KILLER, R. L., & VOELKER, G. E. (1970) USAF School of Aerospace Medicine Rept. SAM-TR-70-87, "Effects of microwaves on bacteria in frozen foods"

966. MAKAROV, P. O. (1967) Vestnik Leningradskogo Universitat/ Seriya Biologii, USSR, (21):150-15., "On the resonance and selective absorption of microwaves by the Flagellate Opalina ranarum"

967. MAKSIMOV, G. A., & KRYUKOVA, I. M. (1956) Biofizika 1:201-205, (In Russian) "Study of the mechanism of heat and mass exchange in seeds of plants grown with heat provided by an rf electrical field"

968. MALAKHOV, A. N., MAKSIMOV, A. S., & NEFEDOV, YU. YA. (1965) In: Bionika (BIONICS), GAAZE-RAPOPORT, M. G., & Yakobi, V. E., (eds.), Nauka Pub. House, Moscow, pp. 377-381, (JPRS 35125, Apr. 1966), "On the electromagnetic hypothesis of biological communication"

969. MALAKHOV, A. N., ROMANOV, I. V., SMIRNOV, YU. V., & UL'YANOV, M. YU. (1965) In: Bionika (BIONICS), Gaaze- Rapoport, M. G., & Yakobi, V. E., (eds.), Nauka Pub. House, Moscow, pp. 302-305, (ATD Transl. N66-24173; JPRS 35125: TT-66-31562), "Biological indication of a SHF-UHF electromagnetic field"

970. MALAKHOV, A. N., SMIRNOV, YU. V., & UL'YANOV, M. YU. (1963) Materials of the 3rd Povolzhskaya Conf. of Physiologists, Biochemists, and Pharmacologists, Gor'kiy, "The SHF-UHF electromagnetic field as a signal factor in the conditioned reflex of white mice"

971. MALLARD, J. R., & LAWN, D. G. (1967) Nature (London) 213:28-30, "Dielectric absorption of microwaves in human tissues"

972. MALLARD, J. R., & WHITTINGHAM, T. A. (1968) Nature (London) 218(5139):366-367, "Dielectric absorption of microwaves in human tissues"

973. MANDELTSVAYG, YU. B. (1962) Meditsinskaya Radiologiya 7(8):100-101, (JPRS 15553), The second all union conference on the use of radio-electronics in biology and medicine

973. MANDLER, F. H. (1934) Abstr. of the 1st Internat. Congress on Electro-Radio-Biology, Cappelli, L., (ed.), Bologna, Italy, pp. 543-552, "Some aspects of combined radiation therapy"

974. MANSFIEL, P. B. (1966) Amer. J. of Medical Electronics 5:61-65, "On interference signals and pacemakers"

975. MANYASHIN, YU. A. (1967) Gigiyena Truda i Professional'nyye Zabolevaniya (6):47-49, (AD 671436), (Abstr. in: Soviet Radiobiology, ATD 68-105-108-9, pp. 80-81, June 1968), "Disturbance of aromatic amino-acid exchange products excreted with urine in persons exposed to the action of HF and UHF electromagnetic waves"

976. MAREK, H. (1959) Pracovni Lekarstvi, Prague, 11:401-403, (In Czech.) "Protective measures against the effects of centimeter radiation on the human organism"

977. MARHA, K. (1963) Pracovni Lekarstvi, Prague, 15(6):238-242, (In Czech), (AD 460316, FTD TT-64-898, N65-35916, AD 618465; A64-80014; also ATD Rept. 65-56, July 1965); (Abstr. in: The Biological Effects of Electromagnetic Fields - Annotated Bibliography, ATD Rept. P-65-17, Apr. 1965), "Certain experimental observations of the effect of a high frequency electromagnetic field in vivo and in vitro"

978. MARHA, K. (1963) Pracovni Lekarstvi, Prague, 15(9):387-393, (In Czech.) "Biological effects of rf electromagnetic waves"

979. MARHA, K. (1963) Final Report of the Institute of Industrial Hygiene and Occupational Diseases, Prague, (In Czech.), "Complex theory of the mechanism of the effects of electromagnetic fields on the organism"

980. MARHA, K. (1967) U. S. Govt. Res. & Dev. Reports, 25 pages (AD 642029) (Summary of Unclassified Report), "Biological effects of high-frequency electromagnetic waves" (Transl. of item #978 (above))

981. MARHA, K. (1970) In: Proc. of the "Biological Effects and Health Implications of Microwave Radiation" Symposium, (Cleary, S. F., ed.), Bur. of Rad. Health, Div. of Bio. Effects, Rept. No. 70-2, pp. 188-196, "Maximum admissible values of HF and UHF electromagnetic radiation at work places in Czechoslovakia"

982. MARHA, K., & MUSIL, J. (1962) Slaboproudy obzor 7:409-413, (In Czech.) "Measurement of the power density at centimeter wavelengths for health purposes"

983. MARHA, K., MUSIL, J., & TUHA, H. (1963) Pracovni Lekarstvi, Prague, 15(9):387-393, (In Czech.); (ATD Rept. 66-92; AD 642029), (Abstr. in: The Biological Effects of Electromagnetic Fields - Annotated Bibliography, ATD Rpt P-65-17, Apr. 1965), "Biological effects of high frequency electromagnetic waves"

984. MARHA, K., MUSIL, J., & TUHA, H. (1968) (In Czech.), State Health Publishing House, Praha, Czechoslovakia, 138 pages, (Transl. SBN 911302-13-7, Pub. by San Francisco Press, Inc., 1971), Electromagnetic Fields and the Living Environment

985. MARKS, Z., & HORNOWSKI, J. (1968) Neurologia i Neurochirurgia Polska 2(1):25-29, (In Polish with English summary) "Clinical observations concerning the effect of microwaves on the nervous system"

986. MARKS, J., CARTER, E. T., SCARPELLI, D. G., & EISEN, J. (1961) Ohio State Medical J. 57(3):274-279, "Microwave radiation to the anterior mediastinum of the dog: I. Histologic and electrocardiographic observations"; pp. 1132-1135, "II. Thermal, cardiovascular, respiratory, and blood enzyme observations"

987. MARRIOTT, I. A. (1964) Medical Service J. of Canada 20:546-552, "Three cases of apparent chemical burns of the hands following contact with a magnetron tube"

988. MARSHALL, R. (1963) Tradex - O and M, 11(2):pp.? "Safety notes on microwave generation hazards"

989. MARTIN, E. J., CONSTANT, P. C., JONES, B. L., FARGO, E. T., & CARTWRIGHT, E. G. (1962) Final Report on Bureau of Ships (Navy) Contract #Nobs-77142 (June) by Midwest Research Institute, Kansas City, Mo., "Survey of radio frequency radiation hazards"

990. MARTIN, G., & ERIKSON, D. (1950) J. of the Amer. Medical Assoc. 142:27-30, "Medical diathermy"

991. MARTIN, G., & HERRICK, J. (1955) J. of the Amer. Medical Assoc. 159:1286-1287, "Further evaluation of heating by microwaves and by infrared radiation as used clinically"

992. MARTIN, G., RAE, J., JR., & KRUSEN, F. (1950) Southern Medical J. 43:518-524, "Medical possibilities of microwave diathermy"

993. MASOERO, P., et al. (1965) Minerva Pediatrica 17:1133-, (In Italian) "Preliminary Report: Influence of electrostatic fields and of 'activated' water on weight increase"

994. MASON, J. F. (1959) Electronics _:34-35, (Dec. 1), (Also in: Digest of Tech. Papers, Proc. of the 12th Annual Conf. on Electrical Techniques in Medicine and Biology (Schwan, H. P., Chm.)), "Germ-gas electronic [radiation] detectors"

995. MATUZOV, N. I. (1959) Biulleten Eksperimental'noi Biologii i Meditsiny (Moskva) 48(7):27-30, "Changes in the excitation of the optic analyzer in man by microwaves"

996. MAY, L., KAMBLE, A. B., & ACOSTA, I. P. (1970) J. of Membrane Biology 2:192-200, "The effect of electric fields on brain cephalin and lecithin films"

997. MAYER, O. (1954) Science Newsletter 47:296-, "Effect of radar waves studied by Army and Navy"

998. MAZURKIEWICS, J. (1968) Lekarz Wojskowy _(3):165-170, (ATD 68-129), "Classification of the harmful effect of microwaves on man"

999. MEADE, K. (1959) The Engineer's Digest (U. S. Coast Guard Pub.) CG-133, #118, (Sept.-Oct.), p. 42, "Radio frequency radiation hazards"

1000. MEAHL, H. R. (1956) Institute of Radio Engineers Trans. on Medical Electronics, PGME-4:16 only, (Abstr. from Symposium on Physiologic and Pathologic Effects of Microwaves (Krusen, F. H., Chm.), 23-24 Sept. 1955, Mayo Clinic), "Protective measures for microwave radiation hazards: 750 to 30,000 Mc"

1001. MEAHL, H. R. (1961) Proc. 4th Tri-service Conf. on the Biological Effects of Microwave Radiation, Vol. 1, (Peyton, M. F., ed.) pp. 15-22, "Basic problems in measuring RF field strength"

1002. MEAHL, H. R. (1961) Digest of the Internat. Conf. on Medical Electronics, Biological Effects of Microwaves I (Athermal Aspects), (Frommer, P. L., ed.) pp. 229-, "Ion orb omnidirectional, fixed level, visual indicator of radio frequency field strength"

1003. MELLON, R. R., SZYMANOWSKI, W. T., & HICKS, R. A. (1930) Science 72:174-175 (Aug. 15), "An effect of short electric waves on diphtheria toxin independent of the heat factor"

1004. MEOSSIKINE, B. (1948) Rev. Morrel 60:364-366, "Rapid modification of local temperature following application of short waves and its clinical significance"

1005. MERJANIAN, S. V. G., & SCHWAN, H. P. (1966) ONR Tech. Rept. No. 42, and M.S. Thesis of S.V.G.M., Moore School of Electrical Engineering, Univ. of Pennsylvania, "Optimization study of an electrical method for the rapid thawing of frozen blood"

1006. MERMAGEN, H. (1959) Digest of Tech. Papers, Proc. of the 12th Annual Conf. on Electrical Techniques in Medicine and Biology, (Schwan, H. P., Chm.) p. 41 only, "Studies on the behavior of phantoms in electromagnetic (radar) fields"

1007. MERMAGEN, H. (1961) Proc. 4th Tri-service Conf. on the Biological Effects of Microwave Radiation, Vol. 1, (Peyton, M. F., ed.) pp. 143-152, "Phantom experiments with microwaves at the University of Rochester"

1008. MEROLA, L. O., & KINOSHITA, J. H. (1961) Proc. 4th Tri-service Conf. on the Biological Effects of Microwave Radiation, Vol. 1, (Peyton, M. F., ed.) pp. 285-291, "Changes in the ascorbic acid content in lenses of rabbit eyes exposed to microwave radiation"

1009. MERREY, J. L. (1963), AD 415814, 11 pages, "Some biological aspects of microwave radiation"

1010. MERRIMAN, J. R., HOLMQUEST, H. J., & OSBORNE, S. L. (1934) Amer. J. of Medical Science 187:677-, Title?

1011. MEYERS, G. H., PARSONNET, V., ZUCKER, I. R., & LEWIN, G. (1968) Medical Research Engineering 7:13-16, "An experimental radio-frequency carotid-sinus pacemaker"

1012. MIALE, J., & LANDEEN, K. (1964) Toxicology and Applied Pharmacology 6:71-77, "Effect of microwave radiation on the hemopoietic system of the rat"

1013. MICHAELSON, S. M. (1958) Communication at the 2nd Tri-service Conf. on Biological Effects of Microwave Energy, July 1958, Univ. of Virginia, reported by Baldwin and Bach, "Dogs turned toward the beam at 2800 MHz"

1014. MICHAELSON, S. M. (1968) Report #59-25298, UR-49-1012, 28 pages, "The effect of 2800 MHz microwaves on the eye of rabbits and dogs"

1015. MICHAELSON, S. M. (1969) J. of Microwave Power 4(2):114-119, "Microwave hazards evaluation: concepts and criteria"

1016. MICHAELSON, S. M. (1970) In: Proc. of the "Biological Effects and Health Implications of Microwave Radiation" Symposium, (Cleary, S. F., ed.), Bur. of Rad. Health, Div. of Bio. Effects, Rept. No. 70-2, pp. 35-58, "Biological effects of microwave exposure"

1017. MICHAELSON, S. M. (1971) IEEE Trans. on Microwave Theory and Tachniques (Special Issue on Biological Effects of Microwaves) MTT-19(2):131-146, "The Tri-Service Program - A tribute to George M. Knauf, USAF (MC)"

1018. MICHAELSON, S. M., & DODGE, C. H. (1968) 21st Annual Conf. on Engineering in Med. and Biology, 18-21 Nov., (Also, Rept. N69-25367, UR-49-976), "Soviet views on the biologic effects of microwaves"

1019. MICHAELSON, S. M., & DODGE, C. H. (1971) Health Physics (in press), "Soviet views on the neural effects of microwaves" (Expanded in citation #2057)

1020. MICHAELSON, S., HOWLAND, J. W., & DUNDERO, R. (1958) Proc. 2nd Tri-service Conf. on Biological Effects of Microwave Energy (Pattishall, E. G. & Banghart, F. W., eds.) 2:175-189, "Review of work conducted at University of Rochester (USAF sponsored)"

1021. MICHAELSON, S. M., HOWLAND, J. W., THOMSON, R. A. E., & HERMAGEN, H. (1959) Proc. 3rd Tri-service Conf. on Biological Effects of Microwave Radiating Equipments (Susskind, C., ed.) 3:161-190, "Comparison of responses to 2800 MHz and 200 MHz microwaves or increased environmental temperature"

1022. MICHAELSON, S. M., THOMSON, R. A. E., El-TAMAMI, M. Y., SETH, H. S., & HOWLAND, J. W. (1964) Aerospace Med. 35(3):824-829, / "The hematologic effects of microwave exposure" (Abstr. No. A64-80830)

1023. MICHAELSON, S. M., THOMSON, R. A. E., & HOWLAND, J. W. (1959) Digest of Tech. Papers, 12th Annual Conf. on Electrical Techniques in Medicine and Biology (Schwan, H. P., Chm.) pp. 38-39, "Characterization of the thermal response among animals exposed to microwaves or increased environmental temperature"

1024. MICHAELSON, S. M., THOMSON, R. A. E., & HOWLAND, J. W. (1960) Proc. 3rd Internat. Conf. on Medical Electronics and Biological Engineering, pp. 399-400, "Biomedical aspects of microwave irradiation of mammals"

1025. MICHAELSON, S. M., THOMSON, R. A. E., & HOWLAND, J. W. (1961) Amer. J. of Physiology 201(2):351-356, "Physiologic aspects of microwave irradiation of mammals"

1026. MICHAELSON, S. M., THOMSON, R. A. E., & HOWLAND, J. W. (1962), Radiation Research 16(4):476-, "The potential influence of microwaves on injury and recovery from ionizing radiation"

1027. MICHAELSON, S. M., THOMSON, R. A. E., & HOWLAND, J. W. (1965) Aerospace Med. 36:1059-1064, "Comparative studies on 1285 and 2800 MHz pulsed microwaves"

1028. MICHAELSON, S. M., THOMSON, R. A. E., & HOWLAND, J. W. (1966) In: Proc. of the Symposium on Biomedical Engineering, (Sances, A., Jr., ed.), (held at Marquette Univ., Milwaukee), 1:215-218, "Microwaves in biomedical investigations"

1029. MICHAELSON, S. M., THOMSON, R. A. E., & HOWLAND, J. W. (1967) Rome Air Development Center Tech. Rept. No. RADC-TR-67-461, Sept., (AD 824242L;/ (Also in Senate Hearings), "Biologic effects of microwave exposure"; Final Rept. 1958-1965 [Studies on bone marrow, thyroid function, & CNS] N68-36850; & X68-12450)

1030. MICHAELSON, S. M., THOMSON, R. A. E., KRASAVAGE, W. J., QUINLAN, W. J., & HOWLAND, J. W. (1961) Digest of the Internat. Conf. on Medical Electronics, Biological Effects of Microwaves I (Athermal Aspects), (Frommer, P. L., ed.) Plenum Press, New York, pp. 194-, "The biological effects of microwave irradiation"

1031. MICHAELSON, S. M., THOMSON, R. A. E., ODLAND, L. T., HOWLAND, J. W. (1963) Aerospace Med. 34(2):111-116, "The influence of microwaves on ionizing radiation exposure" (A66-32156),

1032. MICHAELSON, S. M., THOMSON, R. A. E., & QUINLAN, W. J., JR. (1967) Aerospace Med. 38(3):293-298/ "Effects of electromagnetic radiations on physiologic responses"

1033. MICHAELSON, S., et al. (1961) Industrial Med. and Surgery 30:298-, "Tolerance of dogs to microwave exposure under various conditions"

1034. MICKEY, G. H. (1963) New York State J. of Med. 63(13):1935-1942, "Electromagnetism and its effect on the organism"

1035. MICKEY, G. H. (1969) Presented at the Hazards and Utility of Microwaves and radiowaves Seminar, (Heller, J., Chm.), 11-12 Dec., Boston, "Effects of microwaves and radiowaves on plant and animal cells; human genetic and somatic damage"

1036. MICKEY, G. H., & HELLER, J. H. (1964) / "Radio frequency treatment for breaking dormancy and controlling virus infections of plants" Trans. of the Amer. Soc. of Agricultural Engineers 7(4):398-401

1037. MICKEY, G. H., & KOERTING, L. (1970) Newsletter of the Environmental Mutagen Society, No. 3, pp. 25-26, "Chromosome breakage in cultured Chinese hamster cells induced by radio-frequency treatment"

1038. MIKHAILOVA, R. I. (1966) Stomatologiia (Moskva) 45:49-53, "Experience with microwave therapy in stomatology"

1039. MILCZAREK, H., ZALEJSKI, S., & MAZURKIEWICZ, J. (1967) Polski Tygodnik Lekarski, Poland, 22:1924-1927, "Changes in the nervous system in individuals working within the range of microwave radiation"

1040. MILITSIN, V. A. (1937) Trudy III vses. S'iezda fizioterap., (Monograph), Kiev, pp. 199-, (Abstr. in: The Biological Effects of Electromagnetic Fields - Annotated Bibliography, ATD Rept. P-65-17, Apr. 1965), "Problems of using short- and ultra-short waves in medicine"

1041. MILITSIN, V. A. (1938) Fizioterapiya, Moskva, _(1): "The first international congress on SHF-UHF radiation"

1042. MILITSIN, V. A., & VOZNAYA, A. TS. (1957) Fizioterapiya, Moskva, _(2):33-43, "The influence of chronic action of ultra-high frequency (in weak doses) on the morphology of the blood, hematopoietic, and reticulo-endothelial system"

1043. MILLARD, J. B. (1955) Annals of Physical Med. _(2):248-252, "Changes in tissue clearance of radioactive sodium from skin and muscle during heating with shortwave diathermy"

1044. MILLER, J. W., & GERUSKY, T. M. (Co-Chairmen), (1969) Conf. on Federal-State Implementation of Public Law 90-602, "Radiation Control for Health & Safety Act of 1968", held in Montgomery, Alabama, 24-28 Mar., U. S. Dept. of Health, Education, and Welfare; Public Health Service; Bureau of Radiation Health, Rept. #ORO 69-4, (Sept.)

1045. MILLS, W. A. (1969) Conf. on Federal-State Implementation of P.L. 90-602, "Radiation Control for Health & Safety Act of 1968", (Miller, J. W., & Gerusky, T. M., Co-Chm.), held in Montgomery, Ala., U. S. Dept. of H. E. W., P. H. S., B. R. H., Rept. #ORO 69-4, (Sept.), pp. 13-25, "Bioeffects of non-ionizing electronic product radiation"

1046. MINECKI, L. (1961) Medycyna Pracy 12(4):329-335, (In Polish), (AD 271865), (FTD-TT-61-390/1, Dec. 1961, pp. 1-8), "The health of persons exposed to the effect of high frequency electromagnetic fields"

1047. MINECKI, L. (1962) Rept. of the 6th Polish Conf. of Occupational Medicine, "The thermal effect of microwave radiation"; and "Changes in activity of cholinesterase in mice subjected to single and repeated action of microwaves"

1048. MINECKI, L. (1964) Arhiv za higijenu rada i toksikologiju 15(1):47-55, (In Polish), (Delivered before the 1st Yugoslav Congress of Occupational Medicine, Belgrad, Nov. 1963), "Critical evaluation of maximum permissible levels of microwave radiation"

1049. MINECKI, L. (1964) Med. pracy 15:307-315, (In Polish), "Effect of microwave radiation on the sight organs"

1050. MINECKI, L. (1964) Med. pracy 15:391-396, (In Polish), "Effect of an rf electromagnetic field on embryonal development"

1051. MINECKI, L. (1965) Medycyna Pracy 16:300-304, "Clinical symptoms in workers exposed to the effect of high frequency electromagnetic fields"

1052. MINECKI, L. (1966) Medycyna Pracy 17(2):134-136, "Critical evaluation of the health protetction of personnel occupationally exposed to high frequency electromagnetic radiations"

1053. MINECKI, L. (1966) Warsaw, (In Polish), Electromagnetic Radiation: Biological Effects and Safeguarding of Health (Public Health)

1054. MINECKI, L. (1967) Zdraw Publiczne/ (2):213-220, "High frequency electromagnetic fields, a new environmental hazard"

1055. MINECKI, L., & BILSKI, R. (1961) Medycyna Pracy 12(4):337-344, (In Polish), (AD 271865), (FTD-TT-61-380/1, Dec. 1961, pp. 9-15), "Histopathological changes in the internal organs of mice exposed to the effect of microwaves (S-Band)"

1056. MINECKI, L., OLUBEK, K., & ROMANIUK, A. (1962) Medycyna pracy 13(4)255-264, (In Polish), "Changes in the activity of conditioned reflexes of rats under the influence of the action of microwaves (S-band): 1. Single exposure to microwaves" (4)

1057. MINECKI, L., & ROMANIUK, A. (1963) Medycyna Pracy 14:355-360, and 361-372, "Changes in conditioned reflexes of rats under the influence of S-band microwaves (I, and II)"

1058. MINTZ, M., & HEIMER, G. (1965) IEEE Trans. on Electromagnetic Compatibility 7(2):179-183, "New techniques for microwave radiation hazard monitoring"

1059. MIRAHORIAN, L. (1934) (In French with English Summary), Abstr. of the 1st Internat. Congress of Electro-Radio-Biology, (Cappelli, L., ed.) Bologna, Italy, pp. 383-386, "The possibility of clinical diagnostic differentiation of mutations due to electromagnetic energy"

1060. MIRAULT, h. (1950) Praxis, Switzerland, 39:927-931, "Microwaves (radar) in electrotherapy"

1061. MIRO, L. (1962) Revue de Medicine Aeronatique, Paris, 1 (4):16-17, (In French), "Hematological modifications and clinical disorders observed in persons exposed to radar waves"

1062. MIRO, L., LOUBIERE, R., & PFISTER, A. (1965) Revue de Medicine Aeronatique, Paris, 4:37-39, (In French), "Research on visceral lesions observed in mice and rats exposed to ultrashort waves: special study of the effects of these waves on the reproduction of the animals"

1063. MIRO, L., LOUBIERE, L., & PFISTER, A. (1966) Revue de Medicine Aeronatique, Paris, 5:9-13, "Morphological and metabolic changes observed experimentally under the influence of high frequency electromagnetic fields"

1064. MIRO, L., LOUBIERE, R., & PFISTER, A. (1967) In: Proc. of the 2nd Internat. Symposium in Basic Environmental Problems of Man in Space, (Bjurstedt, H., ed.), held in Paris, June 1965,, Springer Verlag, publisher, pp. 288-297, "Effects of high frequency electromagnetic fields on the uptake of methionine S-35 by the spleen and liver of mice" (A65-26302)

1065. MIRO, L., LOUBIERE, R., & PFISTER, A. (1968) In: Thermal Problems in Aerospace Medicine, (Hardy, J. D., ed.), The Advisory Group for Aerospace Research & Development, NATO, Maidenhead, England, pp. 177-183, "Visceral lesions observed in mice and rats exposed to ultrashort waves: special study of the effects of these waves on the reproduction of the animals"

1066. MIRO, L., ATLAN, H., ARNAUD, Y., DELTOUR, G., & LOUBIERE, R. ( ) Ref? "A note on the radio protection experienced by bacteria exposed to ultrahigh frequency waves"

1067. MIRUTENKO, V. I. (1962) Fiziologii Zh. Akademiya Nauk UKR SSR, 8(3):382-389, (AD 292205), (FTD TT-62-1361/1+2), "Investigating local thermal effect of electromagnetic (3 cm) waves on animals"

1068. MIRUTENKO, V. I. (1964) In: The Biological Action of Ultrasound and Super-high-Frequency Electromagnetic Vibrations, Naukova Dumka, Akademiya nauk Ukrainskov SSR. Institut Fiziologii, Kiev, pp. 62-79, (Abstr. in Biological Effects of Microwaves: Compilation of Abstracts, ATD P-65-68, pp. 92-93 (1965), "SHF dosimetry and nonthermal threshold determination"), "The thermal effects of a SHF electromagnetic field on animals, and some problems of SHF-field dosimetry"

1069. MIRUTENKO, V. I. (1964) Fiziologii Zh. Akademiya Nauk UKR SSR 10(5):641-646, (JPRS 29375), (Abstr. in: The Biological Effects of Electromagnetic Fields - Annotated Bibliography, ATD Rept. P-65-17, Apr. 1965), "Effect of blood circulation on the distribution of heat, and the magnitude of the thermal effect during action of a SHF-UHF electromagnetic field on animals"

1070. MIRUTENKO, V. I. (1965) (In Russian), In: Problems in Biophysics and the Mechanism of Action of Ionizing Radiation, Kiev, Zdorovya, pp. 79-82, 'Heat distribution in the organs and tissues of animals exposed to a UHF electromagnetic field"

1071. MISHENKO, L. I. (1969) Biulleten Eksperimental'noi Biologii i Meditsiny (Moskva) 68(7):56-58, (In Russian with English Summary), "The influence of an ultra high frequency electromagnetic field on the carbohydrate metabolism in the brain of rats"

1072. MISHIN, V. V. (196?) Vsesoyuznoye Fiziologicheskoye Obshchestvo. Voronezhskoye Otdeleniye Nekotoryye Voprosy Fiziologii i Biofiziki, Trudy Otdeleniya. Izd-vo Voronezh Univ., pp. 40-46, "Change of lability of the neuromuscular system under the influence of electromagnetic oscillations in the audio frequency range"

1073. MITCHELL, J. P., & LUMB, G. N. (1960) Proceedings of the Royal Society of Medicine 53:348-354, "Hazards of diathermy in urology"

1074. MITTLEMANN, E. (1961) Digest of Internat. Conf. on Medical Electronics, Biological Effects of Microwaves I (Athermal Aspects), (Frowner, P. L., ed.), Plenum Press, New York, pp. 193-, "Relationship between heat sensation and high frequency power absorption"

1075. MOGENDOVICH, M. R. (1937) Biulleten Eksperimental'noi Biologii i Meditsiny (Moskva) 4:246-, (Abstr. in: The Biological Effects of Electromagnetic Fields - Annotated Bibliography, ATD Rept. P-65-17, Apr. 1965), Title not given, [Discusses changes in conductivity of nerves upon exposure to UHF]

1076. MOLCHANEV, K. (1944) Biulleten Eksperimental'noi Biologii i Meditsiny (Giesen) 18:1-20, "Bactericidal effect of ultrashort waves on microflora of metallic foreign bodies: experimental studies"

1077. MONAYENKOVA, A. M., & SADCHIKOVA, M. N. (1966) Gigiyena Truda i Professional'nyye Zabolevaniya 10(7):18-21, (JPRS 38663; ATD Rept 66-123, Oct. 1966), "Hemodynamic indices during the action of super-high frequency electromagnetic fields"

1078. MOORE, R. T. (1969) Presented at the Hazards & Utility of Microwaves & Radiowaves Seminar (Heller, J., Chm.), Boston, 11-12 Dec., "Government relations: problems and plans"

1079. MOORE, W., JR. (1968) Report TSB-68-4, 25 pages, U.S. Dept. of Health, Education, and Welfare, Public Health Service, Consumer Protection & Environmental Health Service, Environmental Control Admin., Bur. of Radiation Health, Rockville, Md., "Biological aspects of microwave radiation: a review of hazards"

1080. MOOS, W. (1964) Aerospace Med. 35:374-377, "A preliminary report on the effects of electric fields on mice"

1081. MOOSSIKINS, B. (1948) Rev. Morrel 60:364-366, "Rapid modification of local temperature following application of short waves and its clinical significance"

1082. MORELLINI, M., & INGRAO, F. (1943) Abstr. only in: Zentralblatt fur die gesamte radiologie, p. 216 only, (In German), "Effect of short waves on the vegetative nervous system"

1083. MORESSI, W. J. (1964) Experimental Cell Research 33:240-253, "Mortality patterns of mouse sarcoma-180 cells resulting from direct heating and chronic microwave irradiation"

1084. MORGAN, W. E. (1960) AMA Arch. of Industrial Health 21:570-573, (Also, Safety Maintenance _:16-, July 1959), "Microwave radiation hazards"

1085. MORRELL, R. M. (1959) Digest of Tech. Papers, 12th Annual Conf. on Electrical Techniques in Medicine and Biology (Schwan, H. P., Chm.) pp. 32-33, "Radio telemetry of whole-nerve action potentials"

1086. MORTIMER, B., & OSBORNE, S. L. (1935) J. of the Amer. Medical Assoc. 104:1413-1419, "Tissue heating by short wave diathermy: some biologic observations"

1087. MOSES, P. (1951) Medecine Aeronautique, Paris, 6:143-144, "Recent investigations on the biologic effect of radar"

1088. MOSINGER, M., & BISSHOP, G. (1960) C. r. seances soc. biol. filiales associees 154:1016-1017, (In French), "On the histological reactions following irradiation of intratissular metal pieces by microwaves"

1089. MOSKALENKO, YU. YE. (1958) Biofizika 3(5):619-626, "The use of SHF-UHF fields in biological research"

1090. MOSKALENKO, YU. YE. (1960) in: Electronika v Meditsine, (Berg, A. I., ed.) Moscow, Leningrad, pp. 207-218, (Abstr. in: The Biological Effects of Electromagnetic Fields - Annotated Bibliography, ATD Rept. P-65-17, Apr. 1965), "Clinical and biological application of SHF-UHF electromagnetic fields"

1091. MOSKALENKO, J. E. (1961) Nov. med. techn. Moskva, _:79-88, (In Russian), "Some of the possible biophysical mechanisms for the interaction of the energy of an electromagnetic field with living structures"

1092. MOSKALYUK, A. I. (1949) Avtoref., Kand. Dissertation (Author's abstract of dissertation, Candidate), Leningrad, "Latent reflex period as an indicator of SHF-UHF field effect"

1093. MOSKALYUK, A. I. (1957) Tr. VMVLA (Report of Military Medical "Order of Lenin", Akad. imeni S. M. Kirova) 73:133-, "Effect of a SHF field on oxidation reduction processes in some rabbit tissues"

1094. MOSKWA, W., et al. (1965) Kosmos-Seria A Biologia _:277-284, (JPRS 33,500), "Biophysical effects of a constant magnetic field"

1095. MOTSNYI, P. E. (1936) Dnepropetrovsk, Universitet. Nauchnyye Zapiski 4:4-, (Abstr. in: The Biological Effects of Electromagnetic Fields - Annotated Bibliography, ATD Rept. P-65-17, Apr. 1965), Title not given, [Discusses altered response in muscle following UHF exposure]

1096. MOYNIEL, G. (1950) Revue de Medecine 25:39-40, "Biologic effect of electromagnetic radiation (short wave) on isolated cells"

1097. MUCH, V. (1951) Ophthalmologica (Basel) 121:41-43, "Ultra short wave therapy following extra capsular cataract extraction"

1098. MULLER, H. (1949) Arch. of Physical Med. 29:765-769, "Experimental lenticular opacities produced by microwave irradiations"

1099. MULLER, H. (1950) Amer. Scientist 38:33-59, "Radiation damage to the genetic material"

1100. MUMFORD, W. E. (1936) Bell [Telephone] Labs. Progress Rept. 717, "Hazards to personnel near high power UHF transmitting antennas"

1101. MUMFORD, W. W. (1961) Proc. of the Institute of Radio Engineers 49(2):427-447, "Some technical aspects of microwave radiation hazards"

1102. MUMFORD, W. W. (1969) Proc. of the Institute of Electrical & Electronics Engineers 57(2):171-178, "Heat stress due to RF radiation" (Also: Non-Ionizing Rad. 1(3):113-119 (1969))

1103. MUMFORD, W. W. (1970) In: Proc. of the "Biological Effects and Health Implications of Microwave Radiation" Symposium, (Cleary, S. F., ed.), Bur. of Rad. Health, Div. of Bio. Effects, Rept. No. 70-2, pp. 21-34, "Heat stress due to RF radiation"

1104. MUNGO, A. (1962) Folia Medica (2):156-, (In Italian), "Radar: Technology, pathology, and prevention"

1105. MURASHOV, B. F. (1966) Voenno Meditsinskii Zh. (Moskva) (6):82-83, "The lingering effect of an ultrahigh frequency field on the hypophyseal system: the cortex of the adrenal glands"

1106. MURPHY, A. J., PAUL, W. D., & HIKES, H. M. (1950) Arch. of Physical Med. 31:151-156, "A comparative study of the temperature changes produced by various thermogenic agents"

1107. MURPHY, R. M., KLAUSEN, J., JUSTESEN, D. R., & PENDLETON, R. B. (1967) Scientific Proc., Amer. Psychiatric Assoc. 123(1): 201-202, "Enhanced relearning following electroshock and fibrille (microwave) induced convulsions"

1108. MURR, L. (1965) Nature 206:467-, "Biophysics of plant growth in an electrostatic field"

1109. MURRAY, J. L. (1963) M. S. Thesis, Dept. of Radiation Biology, Univ. of Rochester, School of Med. and density, Rochester, New York, 12 pages, (AD 415814), "Some Biological Aspects of Microwave Radiation"

1110. MURRAY, R. J. (1959) Safety Manual, Sperry Gyroscope Co., "Microwave safety precautions"

1111. MURRAY, R., ABRAHAM, J. D. R., CHAMBERS, J. H., ELLIOTT, P. M., FFRENCH, G. E., GILBERT, P. R., HOLDEN, H., & MUIRHEAD, A. (1969) Non-Ionizing Radiation 1(1):7-8, "How safe are microwaves?"

1112. MUSIL, J., & MARHA, K. (1963) Final Report of the Institute of Industrial Hygiene and Occupational Diseases, Prague, (In Czech), Measurement of Rf Field Intensity in Work Areas According to the Guidelines Issued by the Surgeon General

1113. MUSIL, J. (1964) Final Report of the Institute for Industrial Hygiene and Occupational Diseases, Prague, (In Czech), Reflection and Absorption of Electromagnetic Energy in a Model of the Body

1114. MUSIL, J., & MARHA, K. (1965) Czech. patent No. 115-714, "Wide-band device for measuring the intensity of an electromagnetic field for health purposes"

1115. MUSIL, J. (1965) Final Report of the Institute for Industrial Hygiene and Occupational Diseases, Prague, (In Czech.), The Effect of Clothing on the Absorption of UHF Energy in the Organism

1116. MUSIL, J. (1965) Slaboproudy Obzor, Prague, 26(7):391-397, (In Czech.), "Effect of the constitution of the body on the absorption of electromagnetic waves"

1117. MUSIL, J. (1965) Sdelovaci technika 13(4):145-146, (In Czech.), (ATD 68-129), "Measurement of the intensity of an electromagnetic field for hygienic purposes"

1118. MUSIL, J. (1965) Final Report of the Institute of Industrial Hygiene and Occupational Diseases, Prague, (In Czech.), Possibilities of Using Simple Measurements of Power Density of Electromagnetic Waves for Health Purposes

1119. MUTH, E. (1927) Kolloid-Zeitschrift 41:97-102, (In German), "Concerning the appearance of the (string of) pearl chain formation of emulsion particles under the effect of an alternating field"

1120. MUTSCHALL, V. E. (1969) Foreign Science Bulletin, Library of Congress, 5(2):13-36, (AD 6692), "Biological effects of high frequency electromagnetic waves"

1121. MUTSCHALL, V. E. (1969) Foreign Science Bulletin, Library of Congress, 5(6):18-55, (AD 689769; N69-33390), "Response of the nervous system to microwave radiation"

1122. NADEL, A. B. (1961) General Electric Co., Technical Military Planning, Santa Barbara, Calif., Report #RM 61TMP-29, 21 pages, "Selected biologic effects of microwave radiation"

1123. NAKAMURA, H., OKAMURA, H., & TANAKA, K. (1939) Gann (Japanese J. of Cancer Research) 32:294-300, "Short and ultrashort waves, their effects on glycogen, Vitamin C, glutathione, calcium and potassium contents, and on cytochrome oxidase reaction"

1124. NAGELSCHMIDT, F. (1935) Arch. of Physical Therapy 16:457-465, "The condenser field: an improved method of application" [diathermy]

1125. NALIVAYKO, G. T. (1939) Dnepropetrovsk. Universitet. Institut Fiziologii. Sbornik rabot, 2:2-, (Abstr. in: The Biological Effects of Electromagnetic Fields - Annotated Bibliography, ATD Rept. P-65-17, Apr. 1965), (Title not given) [Discusses alteration in muscle response following UHF irradiation]

1126. NEIDLINGER, R. W. (1971) IEEE Trans. on Microwave Theory and Techniques (Special Issue on Biological Effects of Mirco-waves) MTT-19(2):250-251, "Microwave cataract"

1127. NEIFELD, H. (1935) Arch. of Physical Therapy 16:544-549, "Some effects of electric currents on human respiratory movements" [Diathermy]

In:

1128. NELSON, D. J., JR., & SOLEM, D. L. (1969)/Bureau of Radiation Health Rept. #ORO 69-4, (Conf. on Federal-State Implementation of Public Law 90-602, (Miller, J. W., & Gerusky, T. M., co-chm.)), pp. 54-56, "Laser and microwave problems"

1129. NETREBA, M. I. (1963) In: Aviation & Space Medicine, (Parin, V. V., ed.), Acad. of Med. Sci., USSR, Moscow, (NASA transl. TT-F-728, pp. 321-324; N65-13739), "The sanitary aspect of the working conditions around SHF-UHF generators"

1130. NEWMAN, H. F., & WILHELM, S. F. (1950) J. of Urology 63(2):349-352, "Testicular temperature in man"

1131. NIEPCIOMSKI, W., & SMIGLA, K. (1966) Polish Medical J. 5:396-405, (Also, Patologie Polska (Warszawa) 16:129-139, 1965), "Visceral pathomorphology of experimental animals subjected to the action of 10.7 MHz electromagnetic fields"

1132. NIESET, R. T., et al. (1957-1961) Progress Reports (Tulane Univ.) on Investigations of the Biological Effects of Microwave Irradiation: (1956, AD 149246; 1958, AD 225409 and 225837; 1959, AD 214693, AD 230822, RADC-TR-59-67-215, and -311; 1960, AD 229023, AD 257198; 1961, RADC-TR-61-65); (Also: Proc. 2nd Tri-service Conf. on Biological Effects of Microwave Energy (Pattishall, E. G., & Banghart, F. W., eds.), (1958), pp. 202-214, "Review of the work conducted at Tulane University") and (Investigators' Conf. on Biological Effects of Electronic Radiating Equipments, (Knauf, G. M., (chm.), RADC-TR-59-67, pp. 6-11), "Neural effects of microwave radiation"

1133. NIKOGOSYAN, S. V. (1959) In: Summaries of reports, Labor Hygiene and the Biological Effect of Radio Frequency Electromagnetic Waves, p. 51 only

1134. NIKOGOSYAN, S. V. (1960) Trudy Nii Gigiyena Truda i Profzabolevaniya AMN, SSSR, (1):81-84, (Also in: The Biological Action of Ultrahigh Frequencies, Letavet, A. A., & Gordon, Z. V., (eds.), Moscow, JPRS 12471, pp. 83-88, "Influence of UHF on cholinesterase activity in the blood serum and Erythrocytes"); (Abstr. in: The Biological Effects of Electromagnetic Fields - Annotated Bibliography, ATD Rept. P-65-17, Apr. 1965); (Also, abstr. in: Biological Effects of Microwaves: Compilation of Abstracts, ATD Rept. P-65-68, Sept. 1965, pp. 33-34, "Effect of UHF on blood-serum cholinesterase activity"), (In Russian), "Influence of SHF-UHF on the cholinesterase activity in the blood serum, and on the organs of animals"

1135. NIKOGOSYAN, S. V. (1962) In: Summaries of reports, Questions of the Biological Effect of a SHF-UHF Electromagnetic Field. Kirov Order of Lenin Military Medical Academy, Leningrad, "The effect of centimeter and decimeter waves on the content of protein and protein fractions in the blood serum of animals"

1136. NIKOGOSYAN, S. V. (1964) Trudy Nii Gigiyena Truda i Profzabolevaniya AMN, SSSR, (2):43-48, "A study of cholinesterase activity in the blood serum and organs of animals subjected to the chronic effects of microwaves"; ibid., pp. 66-67, "Effects of 10 cm waves on the content of nucleic acids in animal organs"; ibid., Issue 9, pp. 56-, "Effect of 10 cm waves on amount of protein fractions in animal blood serum; (Also in: The Biological Action of Radio-Frequency Electromagnetic Fields, Institute of Industrial Hygiene and Occupational Diseases, Academy of Medical Sciences, USSR, Moscow)

1137. NIKOGOSYAN, S. V. (1967) Biulleten Eksperimental'noi Biologii i Meditsiny (Moskva) 64(9):56-58, (Abstr. in: Soviet Radiobiology, ATD 68-105-108-9, pp. 81-82. June 1968; AD 671436), "Changes in protein metabolism under chronic exposure to 10 cm low-intensity waves"

1138. NIKOGOSYAN, S. V., & KITSOVSKAYA, I. A. (1968) Gigiyena Truda i Professional'nye Zabolevaniya (Moskva) (5):53-55, "Changes in the activity of cholinesterase in the central nervous system of animals with different functional conditions under the action of low intensity decimeter waves"

1139. NIKOLAEVA, E. N. (1953) Sborn. Eksp. Klin. Neurolog. (Monograph), "On experimental basis of use of UHF currents in medical practice"

1140. NIKOLOVA-TROYEVA, L. (1964) Voprosy Kurortologii, Fizioterapii i Lechebnoy Fizicheskoy Kul'tury (Problems in Health Resort Sci., Physiotherapy and Medical Physical Culture), Moscow, 29(3):239-242, (JPRS 26038; N64-27670), "Results of microwave treatment of some diseases"

1141. NIKONOVA, K. V. (1960) Gigiena Truda i Pro: sional'nye Zabolevaniya (Moskva) (1):9-12, "The hygienic characteristic of labor conditions during work with high frequency heating in the electrovacuum industry"

1142. NIKONOVA, K. V. (1960) In: Physical Factors of the Environment, Letavet, A. A., (ed.), pp. 163-170, "The problem of labor hygiene during work with high frequency generators in the electrovacuum industry"

1143. NIKONOVA, K. V. (1963) Kand (Candidate's)Dissertation, Moscow, (Abstr. in: The Biological Effects of Electromagnetic Fields - Annotated Bibliography, ATD Rept. P-65-17, Apr. 1965), "Materials on the hygienic assessment of high frequency electromagnetic fields (medium and long waves)"

1144. NIKONOVA, K. V. (1964) Trudy Nii Gigiyena Truda i Profzabolevaniya AMN, SSSR, (2):49-56, "Effects of high frequency electromagnetic fields on the functions of the nervous system"; ibid., pp. 61-65, "Effects of high frequency electromagnetic fields on blood pressure and body temperature of experimental animals"; (Also in: The Biological Action of Radio-Frequency Fields, Institute of Industrial Hygiene and Occupational Diseases, Academy of Medical Sciences, USSR, Moscow)

1145. NIKONOVA, K. V., & FUKALOVA, P. P. (1962) Gigiena Truda i Professional'nye Zaholevaniia (Moskva), 6(3):8-13, (JPRS 13920; N62-12615), "Hygienic evaluation of working conditions and the effectiveness of protective (safety) measures during the induction heating of metal using high frequency tube generators"

1146. NIZHNIK, S. V. (1956) Zh. Obshchei Biologii, Moscow, 17(4):311-316, "Viability changes in sexual cells of male rabbits and mice under the action of VHF-HF fields"

1147. NOVAK, J. & Cerny, V. (1963) Casopis Lekaru Ceskych, Prague, 102:496-497, (In Czech) "Influence of a pulsed electromagnetic field on the human organism"

1148. NRUMORI, N., & TORRISI, S. (1930) Amer. J. of Physical Therapy, (9):130-, "A specific effect of high frequency electric currents on biological objects"; and ibid, (11):102-, "Ultra-high frequency electromagnetic vibrations: their effects upon living organisms"

1149. NYROP, J. E. (1946) Nature 157(3976):51 only, (12 Jan.), "A specific effect of high-frequency electric currents on biological objects"

1150. O'BRIEN, C. K., RICHARDSON, A. J., & KAPLAN, H. M. (1971), (Tower International Technomedical Institute)/J. of Life Sciences 1(1):1-8, "Histopathologic changes in rat liver following 2450 MHz microwave radiation"

1151. OBROSOV, A. N. (1960) In: Elektroniki V. Meditisin, Berg, A. I. (ed.), Moscow, pp. 197-206, "Basic trends in the application of electronics in physiotherapy"

1152. OBROSOV, A. N. (1963) Proc. of 1st Republican Conf. of Physiotherapists and Health-Resort Specialists of the Ukrainian SSR, Kiev, pp. 238-, "A pulsed UHF field - a new therapeutic factor"

1153. OBROSOV, A. N. (1967) In: Therapeutic Electricity and Ultraviolet Radiation, Licht, S. H., (ed.), E. Licht, Publisher, New Haven, Conn., 2nd Edition, (Vol. 4 of the Physical Medicine Library), Chapt. 5, pp. 179-187, "Electrosleep therapy"

1154. OBROSOV, A. N., & KROTOV, A. (1966) Meditsinskaya Gazeta, Navy, USSR, p. 3 only, "VHF-HF pulse therapy"

1155. OBROSOV, A. N., & SKURIKHINA, L. A. (1964) Klinicheskaya Meditsina 42:(4):139-144, (JPRS 25235), "Experience in the treatment of patients using microwaves"

1156. OBROSOV, A. N., SKURIKHINA, L. A., & SAFIULINA, S. N. (1963) Voprosy Kurortologii, Fizioterapii i Lechebnoy Fizicheskoy Kul'tury (Problems in Health Resort Science, Physiotherapy & Medical Physical Culture), Moscow, 28(2):223-229, (JPRS 21067; N63 22435), "Effect of microwaves on the cardiovascular system of a healthy person"

1157. OBROSOV, A. N., & YASNOGORODSKI, V. G. (1961) Digest of the Internat. Conf. on Medical Electronics in Biology and Engineering, p. 156 only, "A new method of physical therapy: pulsed electric fields of ultrahigh frequency"

1158. ODINTSOV, YU. N. (1965) Trans. of the Sci. Conf. Central Sci. Lab., TOMSK, No. 2, pp. 382-386, "The effect of an AC magnetic field on some immunobiological indices in experimental listerellosis"

1159. OLDENDORF, W. H. (1949) Proc. of the Society for Experimental Biology and Med. 72:432-434, "Focal neurological lesions produced by microwave irradiation"

1160. ONCLEY, J. L. (1942) Chemical Reviews 30:433-450, "The investigation of proteins by dielectric measurements"

1161. OPPEAN, R. (1966) The Health Worker, Bucharest, _:2-, (JPRS 36,639), "The biological effect of electrostatic and magnetic fields"

In:

1162. ORLOVA, A. A. (1957)/Summaries of reports, Part 2, Jubilee Scientific Session of the Institute of Labor Hygiene & Occupational Diseases Dedicated to the 40th Anniv. of the Great October Socialistic Revolution, Moscow, p. 65 only, "The action of ultrahigh and high frequency fields on the internal organs"

1163. ORLOVA, A. A. (1959) In: Summaries of reports, Labor Hygiene and the Biological Effect of Radio Frequency Electromagnetic Waves, Moscow, pp. 25-26, (Abstr. in: The Biological Effects of Electromagnetic Fields - Annotated Bibliography, ATD Rept. P-65-17, Apr. 1965), "Clinical aspects of changes in the internal organs during exposure to radiowaves of various frequencies"

1164. ORLOVA, A. A. (1960) In: Physical Factors of the Environment, Letavet, A. A., (ed.), pp. 171-176, "The c tion of the cardiovascular system during exposure to SHF-UHF and high frequency fields"

1165. ORLOVA, A. A. (1960) Trudy Nii Gigiyena Truda i Profzabolevaniya AMN, SSSR, _(1):36-40, (Also in: The Biological Action of Ultrahigh Frequencies, Letavet, A. A., & Gordon, Z. V., (eds.), Moscow, JPRS 17471, pp. 30-35); (Abstr. in: The Biological Effects of Electromagnetic Fields - Annotated Bibliography, ATD Rept. P-65-17, Apr. 1965), "Clinical aspects of changes in the internal organs caused by exposure to UHF"

1166. OSBORN, C. M. (1959) Technical Rept., Investigators' Conf. on the Biological Effects of Electronic Radiating Equipments, pp. 20-,

1167. OSBORN, R. R. (1943) Lancet 2:277-, "Findings in 262 fatal accidents"

1168. OSBORNE, S. L., & BELLENGER, J. (1950) British J. of Physical Med. 13:177-180, "Heating of human maxillary sinus by microwaves"

1169. OSBORNE, S. L., & FREDERICK, J. N. (1948) J. of the Amer. Medical Assoc. 137(12):1037-1041, (Also, Quarterly Bull. Northwestern Univ. Medical School 23:222-228 (1949)), "Heating of human and animal tissues by means of high frequency current with wavelength of twelve centimeters (the Microtherm)"

1170. OSBORNE, S. L., & HOLMQUEST, H. J. (1944) Charles C. Thomas, (Pub.), Springfield, Ill., 799 pages, Technic of Electrotherapy and its Physical and Physiological Basis

1171. OSIPOV, YU. A. (1952) Gigiena i Sanitariya, USSR, _(6):22-23, (Abstr. in: The Biological Effects of Electromagnetic Fields - Annotated Bibliography, ATD Rept. P-65-17, Apr. 1965); (Abstr. in: Biological Effects of Microwaves: Compilation of Abstracts, ATD P-65-68, Sept. 1965, pp. 3-4, "Biological effects of ultrahigh frequencies under industrial conditions"), "The effect of VHF-HF under industrial conditions"

1172. OSIPOV, YU. A. (1952) Vrachebnoe Delo nauchnyy meditsinskiy zh., Kharkov, _(11):1018-1020, "High frequency currents from the standpoint of occupational pathology"

1173. OSIPOV, YU. A. (1953) Sovetskoe Zdravookhranenie Kirgizii _(2):46-47, "Dispensary service offered workers engaged in work with high frequency currents"

1174. OSIPOV, YU. A. (1953) Gigiyena i sanitaria 8:39-42, (In Russian) "Induction heating of metals by high-frequency currents from the health point of view"

1175. OSIPOV, YU. A. (1954) Papers of the 2nd Leningrad Conf. on Industrial Use of High Frequency Currents, Moscow, pp. 26-31, "Labor hygiene problems in the industrial use of high frequency currents [fields]"

1176. OSIPOV, YU. A. (1955) Vrachebnoe Delo nauchnyi meditsinskii zh., Kharkov, _(4):345-346, "Potential organic lesions during work with high frequency currents"

1177. OSIPOV, YU. A. (1965) Izd. Meditsina Publishing House, Leningrad, 220 pages, Occupational Hygiene and the Effect of Radio Frequency Electromagnetic Fields on Workers; pp. 78-103, "Biological effect of radio frequency electromagnetic fields"; pp. 104-144, "Occupational hygiene and the health of workers exposed to radio frequency radiation"; and pp. 156-202, (JPRS 32725, TT:65-33213, Nov. 1965; and N66-11812), "Measures of protection, therapy, and prophylaxis to be taken during work with radio-frequency oscillators" [Describes "Microthermal Effects"]

1178. OSIPOV, YU. A., & KALYADA, T. V. (1962) Summaries of Reports, Questions of the Biological Effect of a SHF-UHF Electromagnetic Field. Pirov Order of Lenin Military Medical Academy, Leningrad, "Results of an experimental study into the effects of low intensity centimeter waves on man"

1179. OSIPOV, YU. A., & KALYADA, T. V. (1963) Gigiyena i Sanitariya (Hygiene and Sanitation), Moscow, _(10):73-78, (JPRS 23287, Feb. 1964; OTS 64-21594; & N64-15335), "Temperature response of the skin during irradiation with microwaves of low intensity"

1180. OSIPOV, YU. A., KALYADA, T. V., & KULIKOVSKAYA, YE. L. (1961) Materials of the scientific Session Concerned with the Results of Work Conducted by the Leningrad Institute of Industrial Hygiene and Occupational Diseases for 1959-1960, Leningrad, p. 24-, "Problems of industrial hygiene in work with centimeter radiowave measuring equipment"

1181. OSIPOV, YU. A., KALYADA, T. V., & KULIKOVSKAYA, YE. L. (1962) Gigiena i Sanitariya, Moscow, _(6):81-86, (Abstr. in: The Biological Effects of Electromagnetic Fields - Annotated Bibliography, ATD Rept. P-65-17, Apr. 1965), (JPRS 15644), "Observations on certain functional changes which occur in people exposed to irradiation with centimeter electromagnetic waves during work"

1182. OSIPOV, YU. A., KULIKOVSKAYA, YE. L., & KALYADA, T. V. (1962) Gigiena i Sanitariya, Moscow, 27(2):100-102, (JPRS 13691), "Conditions of SHF-UHF electromagnetic field irradiation of those working on the tuning and testing of radio engineering instruments"

1183. OSIPOV, YU. A., VOLFOVSKAYA, R. N., ASANOVA, T. P., KULIKOVSKAYA, YE. L., KALYADA, T. V., & SHCHEGLOVA, A. V. (1963) Gigiena i Sanitariya, Moscow, 28(6):35-38, (JPRS 20872; N63-20696), "Concerning the problem of the combined effect of a MF-LF electromagnetic field and X-ray irradiation under industrial conditions"

1184. OTT, V. R., RUSCH, D., & RUIZ-BLANCO, B. (1966) Arch. of Physical Therapy (Leipzig) 18:1-17, "Experimental and clinical studies with decimeter waves"

1185. OVERMAN, H. S. (1959) U. S. Naval Proving Ground Technical Memorandum No. W-3/59, Jan., "Microwave radiation hazards to personnel from Bureau of Ordnance (Navy) radar"

1186. OVERMAN, H. S. (1961) Proc. 4th Tri-service Conf. on the Biological Effects of Microwave Radiation, Vol. 1, (Peyton, M. F., ed.) pp. 47-54, "Quick formulas for radar safe distances"

1187. PACAKOVA, L., & HYTHA, M. (1962) Prague, p. 219, (In Czech.), Very Short Waves and Their Applications in Modern Technology

1188. PACELLI, M. (1959) Annali di Medicina Navale e Tropicale 64:533-, (In Italian) "On the biological effects of microwaves"

1189. PAFF, G. H., BOUCEK, R. J., & DEICHMANN, W. V. (1960) Anatomical Record 142(2):264-, (Also, Section in: Microwave Radiation Research (1960), pp. 42-47; Univ. of Miami Annual Report, RADC-TR-61-42, AD 256500), "The effects of microwave irradiation on the embryonic chick heart as revealed by electrocardiographic studies"

BOUCEK, R. J., NIEMAN, R. E., 386

1190. PAFF, G., & DEICHMANN, W. V., (1963) Anatomical Record 147:379-, "The embryonic heart subjected to radar"

1191. PALIYEV, B., & GOSHEV, K. (1966) Voenno Meditsinsko Delo 21(4):34-41, "EKG changes occurring under the effects of a SHF-UHF electromagnetic field"

1192. PALLADIN, A. M., SPASSKAYA, I. M., & YAKUBOVICH, R. S. (1959) In: Summaries of reports, Labor Hygiene and the Biological Effect of Radio Frequency Electromagnetic Waves, Moscow, "On the health of women working around intermediate frequency generators"

1193. PALLADIN, A. M., SPASSKAYA, I. M., & YAKUBOVICH, R. S. (1962) Akusherstvo i Ginyekologiya (Obstetrics and Gynecology) 39(4):69-74, (In Russian), "The effect of SHF-UHF on the specific functions of women working with generators"

1194. PALMISANO, W. A., & PECZENIK, A. (1966) Military Medicine 131:611-618, "Some considerations of microwave hazards exposure criteria"

1195. PANOV, A. G., PORTNOV, A. A., LOBZIN, V. S., & POLYAK, V. P. (1966) Voenno Meditsinskii Zh. (Moskva), _(12):12-15, "Diencephalic asthenic conditions"

1196. PANOV, A. G., & TYAGIN, N. V. (1966) Voyenno Med. Zh. (Military Med. J.), USSR, _(9):13-16, "Symptomatology classification and expertise of SHF-UHF after-effects on the human organism"

1197. PARDZHANADZE, SH. K. (1954) Thesis, Collected Abstr. of Papers from the Research Institute of Spa Therapy and Physiotherapy of the Georgian SSR 21:198-, (Abstr. in: The Biological Effects of Electromagnetic Fields - Annotated Bibliography, ATD Rept P-65-17, Apr. 1965), "The mechanism of action of HF-VHF electromagnetic fields on the organism"

1198. PARIN, (1963) Akademiya Meditsinskikh Nauk SSSR, Moscow, (NASA-TTF 228), "Aviation and space medicine"

1199. PARIN, V. V., & DAVYDOV, I. N. (1940) In: Problems of Physiotherapy and the Science of Health Resorts, Collection, Sverdlovsk, pp. 178-181, "The influence of a UHF field on experimental hypertension"

1200. PARKER, B., FURMAN, S., & ESCHER, D. J. W. (1969) Annals of the N. Y. Acad. of Science 167:823-, "Input signals to pacemakers in a hospital environment"

1201. PATTISHALL, E. G. (ed.) (1957) Proc. (1st) Tri-service Conf. on Biological Hazards of Microwave Radiation, 1, (15-16 July), (ARDC-TR-58-51; AD 115603). Sponsored by Air Research & Development Command Hdqs., U. S. Air Force

1202. PATTISHALL, E. G., & BANGHART, F. W., (eds.), (1958) Proc. 2nd Tri-service Conf. on Biological Effects of Microwave Energy, 2, (8-10 July), Sponsored by Rome Air Dev. Center, Air Res. & Dev. Command (Knauf, G. M., Chm.), 264 pages, (ARDS-TR-58-54; AD 131477)

1203. PAULY, H., PACKER, L., & SCHWAN, H. P. (1960) J. of Biophysics & Biochemical Cytology 7(4):589-, "Electrical properties of mitochondrial membranes"

1204. PAYNE, J. N. (1961) Proc. 4th Tri-service Conf. on the Biological Effects of Microwave Radiation, Vol. 1, Peyton, M. F., (ed.), pp. 319-325, "Similarities and differences between the technical aspects of the Navy HERO (Hazards from Electromagnetic Radiation to Ordnance) program for ordnance and the personnel hazard program"

1205. PEAKE, W. H. (1959) Ohio State Univ. Columbus. AF 336166158, (AD 417869), "The interaction of electromagnetic waves with some natural surfaces"

1206. PEARLMAN, W., & BALDWIN, M. (19__), (ref?) pp. 157-166, "Experimental designs in the study of biological effects during radio frequency transmission"

1207. PELIS, L., JR. (1964) Industrial Medicine & Surgery 33:866-868, "The hazards of low voltage radiation"

1208. PENNOCK, B. E., & SCHWAN, H. P. (1967), (Ph.D. Thesis), (ONR Tech. Rept. #41), (Electromedical Div., The Moore School of Electrical Engineering, Univ. of Pa., (Rept. #68-01)); (AD 655127), "The Measurement of the Complex Dielectric Constant of Protein Solutions at Ultrahigh Frequencies: Dielectric Properties of Hemoglobin Bound Water"

1209. PEREIRA, F. A. (1933) Comptes Rendus Acad. Sci. 197:1124-1125, (In French), "Oscillatory chemical mechanics: modification of chemical reactions under the influence of waveguide oscillator circuits"

1210. PEREIRA, F. A. (1935) Biochem. Z. 238:53-58, (In French), "On the effect of electromagnetic waves on enzyme systems"

1211. PERVUSHIN, V. YU. (1957) Biulleten Eksperimental'noy Biologii i Meditsiny (Moskva), 43(6):87-92, (Abstr. in Biological Effects of Microwaves: Compilation of Abstracts, ATD P-65-68, (1965), pp. 26-27, "Changes in the cardiac nervous mechanism due to SHF"), "Changes in the cardiac nervous mechanism during exposure to an SHF-UHF field"

1212. PERVUSHIN, V. YU., & TRIUMFOV, A. V. (1957) Trans. Milit. Med. Acad. imeni S. M. Kirov, (USSR) VMOLA, 73:141-151, "Morphological changes in some organs of rabbits subjected to the action of a SHF field"

1213. PETERS, W. J., JACKSON, R. W., IWANO, K., & GROSS, A. E. (1970) Presented before the New York Academy of Sciences, 4 Nov. at the Symposium entitled, "Effect of Controlled Electromagnetic Energy on Biological Systems", 11 pages, "The effect of microwave electromagnetic radiation on the growth of mammalian cells in tissue culture"

1214. PETROV, F. P. (1929) New Findings in the Reflexology and Physiology of the Nervous System, 3:pp?, Moscow, (In Russian), "The effect of electromagnetic fields on nerve stimulation"

1215. PETROV, F. P. (1935) In: Physicochemical Bases of Higher Nervous Activity, Leningrad, pp. 97-, "Effect of an electromagnetic field on isolated organs"

1216. PETROV, F. P. (1952) Trudy Instituta fiziologii imeni I. P. Pavlova. Akademiia nauk SSSR, Moskva, 1:369-376, "Effect of a low-frequency electromagnetic field on higher nervous activity"

1217. PETROV, I. R. (Ed.), (1967) VMOLA im. S. M. Kirov Publ. House, (USSR), Medical-Biological Problems of SHF-UHF Radiation (In Russ.)

1218. PETROV, I. R. (1968) Voyenno Med. Zh. (Military Med. J.), USSR, (5):21-24, "Factors involved in the etiology of injuries due to SHF-UHF electromagnetic energy"

1219. PETROV, I. R., & SUBBOTA, A. G. (1964) Voyenno Med. Zh. (Military Med. J.), USSR, (9):26-31, "Mechanism of the action of SHF-UHF electromagnetic radiation"

1220. PETROV, I. R., & SUBBOTA, A. G. (1966) Voenno Meditsinskii Zh., (2):16-21, (ATD Abstract (?) 1-9841, pp. 21-,), "Effect of electromagnetic radiations of superhigh frequency range upon the organism" (Review of the literature)

1221. PETROV, I. R., & YAROKHNO, N. Y. (1967) Voyenno Meditsinskii Zh., USSR Military Med. Journal, (7):26-30, (Abstr. in: Soviet Radiobiology, ATD 68-105-108-9, June 1968, pp. 83-84), "The combined effect on animal organisms of SHF-UHF electromagnetic waves, and breathing of a gas mixture with low oxygen content"

1222. PETROV, I. R., & YAROKHNO, N. Y. (1967) Voyenno-Meditsinskiy Zh., USSR Military Med. Journal, (4):20-21, (Abstr. in: Soviet Radiobiology, ATD 68-105-108-9, June 1968, pp. 82-83), "Increased resistance to SHF-UHF irradiation under conditions of systematic muscular activity"

1223. PEYTON, M. F. (ed.) (1961) Proc. 4th Tri-service Conf. on the Biological Effects of Microwave Radiation, Vol. 1, (Knauf, G. M., Chm.) held at New York Univ. Medical Center, 16-18 Aug. 1960, (Plenum Press)

1224. PEZZI, G. (1954) Annali di Medicina Navale e Tropicale 59:473-, "Radar waves in therapy"

1225. PFLOMM, E. (1931) Archiv fur Klinische Chirurgie 166:251-305, (In German), "Experimental and clinical investigations concerning the effect of ultrashort electrical waves on inflammation"

1226. PICCARDI, G. (1959) Ricerca sci. 29:1252-1254, "The structure of water and the influence of low-frequency electromagnetic fields"

1227. PICKET, J., & SCHRANK, A. (1965) Texas J. of Science 17:245-, "Responses of coleoptiles to magnetic and electric fields"

1228. PICKERS, B. A., & GOLDBERG, M. J. (1969) British Medical J. 2:504-506, "Inhibition of a demand pacemaker and interference with monitoring equipment by radio-frequency transmissions"

1229. PIESLAK, W. (1967) Ochrona pracy, Warsaw, 22(8):22-24, (In Polish), (English abstr. in Nuclear Science Abstr. 22(23): #49597, 1968), "Protection from the effects of high frequency electromagnetic radiation"

1230. PINAKATT, T. L., COOPER, T., & RICHARDSON, A. W. (1963) Aerospace Med. 34(6):497-499, "Effect of onabain on the circulatory response to microwave hyperthermia in rat"

1231. PINAKATT, T. L., & RICHARDSON, A. W., (1963) Federation Proceedings 22(2):176-, "Effects of onabain on the circulatory response of the rat to microwave hyperthermia"

1232. PINAKATT, T. L., RICHARDSON, A. W., & COOPER, T. (1965) Archives Internationales de Pharmacodynamie et de Therapie, Gand, Belgium, 156(1):151-160, "The effect of digitoxin on the circulatory response of rats to microwave radiation"

1233. PINNEO, L. R., BAUS, R., McAFEE, R. D., & FLEMING, J. D. (1962) Summary rept., Tulane Univ., New Orleans, La., 24 pages, (AD 277684; RADC-TDR-62-231), "The neural effects of microwave radiation"

1234. PINNEO, L., SPEAR, V., & FLEMING, J. (1961) In: Digest of Internat. Conf. on Medical Electronics, Biological Effects of Microwaves, I (Athermal Aspects), Frommer, P. L., (ed.), p. 227 only, "Relationships involved in considering effects of microwaves in the central nervous system"

1235. PIONTKOVSKIY, I. A. (1936) Nauch Khronika GIFF, Moscow, (2), pp? "The effect of ultrashort waves on reflex excitability"

1236. PIONTKOVSKIY, I. A., & YANOSHEVSKAYA, R. K. (1944) Moscow, (In Russian), Physical Methods of Frostbite Therapy

1237. PIROVANO, A. (1934) In: Proc. of the 1st Internat. Congress of Electro-Radio-Biology, (Cappelli, L., ed.), pp. 134-144, (In Italian with English Summary), "Interaction of electromagnetic fields with biological materials"

1238. PISH, G. W., STOREY, W. H., TRUBY, F., & ROLLWITZ, W. (1959) USAF Report RADC-TR-59-81, (AD 216431), (Also in: Proc. 3rd Tri-service Conf. on Biological Effects of Microwave Radiating Equipments, Susskind, C., (ed.), pp. 251-270), and (In: Investigators' Conf. on Biological Effects of Electronic Radiating Equipments, Knauf, G. M. , (chm.), pp. 33-36), "A preliminary investigation of the applications of magnetic resonance absorption spectroscopy to the study of the effects of microwaves on biological materials"

1239. PISKUNOVA, V. G. (1957) Gigiena Truda i Professional'nye Zabolevaniya (Moskva) (6):27-30, (In Russian), "The health of workers exposed to high frequency electromagnetic fields"

1240. PISKUNOVA, V. G. (1958) Sborn. Rabot i Avtoref Po Voprosam Gig. Tr., Kharkov, pp. 144-146, (Also in: Papers of the Scientific Sessions of the Institute on Questions of Industrial Hygiene in Mining, Chemical, and Machine Construction Industries, Khar'kov, (1956), pp. 45-46), "The health of workers exposed to high frequency electromagnetic fields"

1241. PITENIN, I. V. (1962) In: Summaries of reports, Questions of the Biological Effect of a SHF-UHF electromagnetic field. Kirov Order of Lenin Military Medical Academy, Leningrad, pp. 36-38, "Pathological and anatomical changes in animal organs and tissues during the influence of a SHF-UHF electromagnetic field"

1242. PITENIN, I. V., & SUBBOTA, A. C. (1965) Biulleten Eksperimental'noi Biologii i Meditsiny, Moskva, 60(9):55-59, "On the development of gastric ulcer in rabbits following irradiation of the epigastrium with ultrahigh frequency radiation"

1243. PIVIVAROV, M. A. (1962) In: Summaries of reports, Questions of the Biological Effect of a SHF-UHF Electromagnetic field. Kirov Order of Lenin Military Academy, Leningrad, "The effect of microwave fields of low intensity on some physiologic 'detectors'"

1244. PIZZOLATO, P., BERGER, C., & McAFEE, R. D. (1961) Digest of the Internat. Conf. on Medical Electronics, Biological Effects of Microwaves, I (Athermal Aspects), (Frommer, P. L., ed.), Plenum Press, New York, pp. 196-, "Tissue injury from microwave radiation"

1245. PLEKHANOV, G. F. (1965) In: Bionika Gaaze, Rapoport, M. G., & Yakobi, V. E., (eds.), Nauka Publ. House, Moscow, pp. 273-277, (N66-24170; JPRS 35125; TT-66-31562), "Some material on interpretation of information by living systems"

1246. PLEKHANOV, G. F., & VEDYUSHKINA, V. V. (1966) Zh. Vyssh. Nervnoi Deyatel'nosti imeni i p Pavlova, USSR, 16(1):34-37 (N66-26928),"Elaboration of a vascular conditioned reflex in man to a change in the intensity of an electromagnetic field of high frequency [Effect of an EMF on human reflexes]"

1247. PLURIEN, G., SENTENAC-ROUMANOU, H., JOLY, R., & DROUET, J. (1966) Comptes Rendus des Seances de la Societe Biol., Paris, 160:597-599, "Influence of electromagnetic radiation emitted by radar on the phagocytic function of cells in the reticulo endothelial system of mice"

1248. POKORNY, J., & JELINEK, V. (1967) Neoplasma 14(5):479-485, "Investigations of the effect of combined electromagnetic fields on neoplastic malignancy growth - A contribution to the problem"

1249. POKORNY, J., & JELINEK, V. (1968) Casopis Lekaru Ceskych 107(16):474-482, "The effect of coherent electromagnetic field on neoplastic malignant processes"

1250. POL, W. (1962) Lekarz Wojskowy, Poland, (4) 4:318-327, (AD 433135; FTD-TT-63-1070), "Effect of microwaves emitted by radar transmitters on the origin of cataracts"

1251. POLLACK, H., & HEALER, J. (1967) Institute for Defense Analysis, Research & Engineering Support Div., (Internal Report No. N-451;/ "Review of information on hazards to personnel from high-frequency electromagnetic radiation" IDA/HQ 67-6211),

1252. PONOMAREV, A. V. (1940) In: Papers on the Use of Short- and Ultra-short Waves in Medicine, Medgiz, Moscow, pp. 90-, "Action of UHF on micro-organisms and on immuno-biological processes"

1253. PONOMAREV, A. V., & KAMBAROVA, O. I. (1937) In: Biological Action of Ultrahigh Frequency Ultrashort Waves, pp. 193-, (Abstr. in: The Biological Effects of Electromagnetic Fields - Annotated Bibliography, ATD Rept. P-65-17, Apr. 1965), "Influence of UHF on the nervous system in immunization reactions"

1254. POPOV, N. A., GUBAREV, F. A., VADIMOVA, M. A., & MALEVANNAIA, J. T. (1940) Trudy State Sci. Res. Inst. Fizioterap. 6:314-, (Moscow Gosudarstvenny nauchno-issledovatel'skii institut fizioterapii), (Abstr. in: The Biological Effects of Electromagnetic Fields - Annotated Bibliography, ATD Rept. P-65-17, Apr. 1965), "On local action of diathermy and UHF on the so-called vegetative centers of the brain"

1255. POPOV, N. A., & MARKOVNIKOVA, YE. P. (1940) Biulleten Eksperimental'noi Biologii i Meditsiny (Moskva) 6(1):pp?, (Abstr. in: The Biological Effects of Electromagnetic Fields - Annotated Bibliography, ATD Rept. P-65-17, Apr. 1965), "The problems of the effect of a high frequency electromagnetic field on the vegetative cerebral centers" [Discusses reduction of blood sugar level by irradiation of the head of dogs with UHF]

1256. POTTER, R. R. (1961) U. S. Naval Weapons Laboratory, Technical Memorandum No. W-2/61 (Jan.), "Proposed Naval weapons design requirements to preclude hazards from environmental electromagnetic fields"

1257. POVZHITKOV, V. A., TYAGIN, N. V., & GRESESHECHNIKOVA, A. M. (1961) Biulleten Eksperimental'noi Biologii i Meditsiny, Moskva, 51(5):103-109? (Abstr. in: Biological Abstracts, 37, No. 12874 (1962)), "The influence of SHF pulsed electromagnetic field on conception and the course of pregnancy in white mice" *in English Transl. 51, pp. 615-618 (1961),

1258. POWELL, C. C. (1959) Amer. J. of Public Health 49:1-9, "Radiation hazards"

1259. POZOS, R. S., RICHARDSON, A. W., & KAPLAN, H. M. (1969) Proc. of the "Biological Effects and Health Implications of Microwave Radiation" Symposium, (Cleary, S. F., ed.), Medical College of Va., Richmond, 17-19 Sept., Bureau of Radiological Health/ Division of Biological Effects, Rept. No. 70-2, pp. 70-75, "Non-uniform biophysical heating with microwaves"

1260. PRATT, C. B., & SHEARD, C. (1935) Arch. of Physical Therapy 16:268-271, "Thermal changes produced in tissues by local applications of radiothermy"

1261. PRATT, C. B., & SHEARD, C. (1935) Protoplasma 23:24-33, "The effects of intravenous injection into rabbits of strains of streptococci which have been exposed to the high-frequency field"

1262. PRAUSNITZ, S., & SUSSKIND, C. (1959) Proc. 3rd Tri-service Conf. on Biological Effects of Microwave Radiating Equipments, (Susskind, C., ed.) 3:33-45, "Temperature regulation in laboratory animals irradiated with 3-cm microwaves"

1263. PRAUSNITZ, S. & SUSSKIND, C. (1962) In: "Nonthermal Effects of Microwave Radiation", Scientific Rept., Institute of Engineering Research, Univ. of Calif., Berkeley, Series No. 60, Issue No. 478, (Also, Institute of Radio Engineers Trans. on Bio-Medical Electronics, BME-9:104-108), "Effects of chronic microwave irradiation on mice"

1264. PRAUSNITZ, S., SUSSKIND, C., & VOGELHUT, P. O. (1961) Proc. 4th Tri-service Conf. on the Biological Effects of Microwave Radiation, Vol. 1, (Peyton, M. F., ed.),/"Longevity and cellular studies with microwaves" pp. 135-142

1265. PRESMAN, A. S. (1954) Gosenergoizdat, Moscow, Centimeter Waves

1266. PRESMAN, A. S. (1954) In: Annotations of Scientific Works of the Academy of Medical Sciences of the USSR, Moscow, pp. 479-, "An instrument for measuring the intensity of irradiation of 10-centimeter waves in industrial conditions"

1267. PRESMAN, A. S. (1956) Gigiena i Sanitariya, USSR, _(9):32-37, "The electromagnetic field as a hygienic factor"

1268. PRESMAN, A. S. (1956) Uspekhi Sovremennoy Biologii, USSR, (Progress of Modern Biology) 41(1):40-54, (Abstr. in: The Biological Effects of Electromagnetic Fields - Annotated Bibliography, ATD Rept. P-65-17, Apr. 1965), (OTS-59-21107), "Physical aspects of the biological action of centimeter waves"

1269. PRESMAN, A. S. (1956) Biulleten Eksperimental'noi Biologii i Meditsiny (Moskva) 43(2):51-54, "Temperature changes of the human skin irradiated with low intensity waves several centimeters in length"

1270. PRESMAN, A. S. (1957) Biulleten Eksperimental'noi Biologii i Meditsiny, Moskva, 43(2):51-54, "Change in the human body and skin temperature due to irradiation with low-intensity electromagnetic waves several centimeters in length"

1271. PRESMAN, A. S. (1957) Gigiena i Sanitariya, USSR, _(1):29-35, (OTS-59-21101, H-3825), "Methods of evaluation of the effective energy of the electromagnetic field under industrial conditions"

1272. PRESMAN, A. S. (1957) Proc. of the Jubilee Scientific Session of the Institute of Labor Hygiene and Occupational Diseases, Moscow, pp. 72-, "The hygienic evaluation of high-frequency electromagnetic fields"

1273. PRESMAN, A. S. (1958) Biofizika 3(3):335-338, (Abstr. in: Biological Effects of Microwaves: Compilation of Abstracts, ATD P-65-68, 1965, pp. 69-70, "Methods of irradiating animals with UHF fields"), (Also, Abstr. in: The Biological Effects of Electromagnetic Fields - Annotated Bibliography, ATD Rept. P-65-17, Apr. 1965), "Methods of experimentally irradiating small animals with centimeter waves"

1274. PRESMAN, A. S. (1958) Gigiena i Sanitariya, USSR, _(1):21-27, "Method of protection from the action of radio frequency electromagnetic fields under industrial conditions"

1275. PRESMAN, A. S. (1960) In: Physical Factors of the Environment, (Letavet, A. A., ed.), pp. 142-151, "A hygienic evaluation of high frequency electromagnetic fields"

1276. PRESMAN, A. S. (1960) In: Elektronika V Meditsine (Electronics in Medicine), Berg, A. I., (ed.), pp. 219-227, (Abstr. in: Biological Effects of Microwaves: Compilation of Abstracts, ATD P-65-68, pp. 72-74, "The use of microwaves for therapeutic and biological purposes"), (Also, Abstr. in: The Biological Effects of Electromagnetic Fields - Annotated Bibliography, ATD Rept. P-65-17, Apr. 1965), "Microwaves in physiotherapy and biological investigations"

1277. PRESMAN, A. S. (1960) Novosti Meditsinskoi Tekhniki, Moskva, _(4):51-55, (Abstr. in: The Biological Effects of Electromagnetic Fields - Annotated Bibliography, ATD Rept. P-65-17, Apr. 1965), "An experimental device for the dosed irradiation of rabbits with microwaves in the 10 centimeter range"

1278. PRESMAN, A. S. (1961) Biofizika 6(3):370-371, (In Russian), "Experimental apparatus for microwave irradiation of protein solutions"

1279. PRESMAN, A. S. (1961) Nauka i Zhizn' _(7):88-89, (Abstr. in: The Biological Effects of Electromagnetic Fields - Annotated Bibliography, ATD Rept. P-65-17, Apr. 1965), "More intricate methods of investigation are needed"

1280. PRESMAN, A. S. (1962) In: Summaries of reports, 2nd All Union Conf. on the Application of Radioelectronics in Biology and Medicine, Miiteir, (Publisher?), pp. 21-, "Problems concerning the mechanism of the nonthermal action of microwaves"; and pp. 23-, "Methods of measured irradiation with microwaves in biological experiments"

1281. PRESMAN, A. S. (1963) Biofizika 8(1):138-140, "Excitability in paramecium stimulated with DC and AC pulses"

1282. PRESMAN, A. S. (1963) Biofizika 8(2):258-260, (Abstr. in: The Biological Effects of Electromagnetic Fields - Annotated Bibliography, ATD Rept. P-65-17, Apr. 1965), "Effect of microwaves on paramecium" (Letters to the Editor)

1283. PRESMAN, A. S. (1963) Uspekhi Sovremennoy Biologii (Progress of Modern Biology) 56(2):161-179, (Abstr. in: Biological Effects of Microwaves: Compilation of Abstracts, ATD P-65-68 (1965), pp. 78-79, "Review of the mechanism of the biological effect of microwaves"), (JPRS 22580, Jan. 1964; OTS 64-21190; X64-12357), "Problems of the mechanism of the biological effect of microwaves"

1284. PRESMAN, A. S. (1963) Biol. i Med. Elektronika _(5):56-, "A method of determining the excitation thresholds of the neuromuscular apparatus of animals"; and ibid. (6):76-, "A method of comparative irradiation of protein solutions with microwaves and infrared rays"

1285. PRESMAN, A. S. (1964) Zarubezhnaya Radioelektronika _(3):63-, (Part I), and _(4):67-, (Part II), "Investigation of the biological effect of microwaves"

1286. PRESMAN, A. S. (1964) Biofizika 9(1):131-134, (In Russian), (Abstr. in: The Biological Effects of Electromagnetic Fields - Annotated Bibliography, ATD Rept. P-65-17, Apr. 1965), (Also abstr. in: Biological Effects of Microwaves: Compilation of Abstracts, ATD P-65-68, (1965), pp. 81-82, "The role of electromagnetic fields (EMF) in living processes"), (AD 625857; N66-18516; FSTC 381-T65-601), "The role of electromagnetic fields in living processes"

1287. PRESMAN, A. S. (1965) Nauka i Zhizn' _(6):82-88, (JPRS 31501; TT-65-31997; N65-31004), "Effect of electromagnetic radiations on living organisms"

1288. PRESMAN, A. S. (1965) Uspekhi Fizicheskikh nauk, Moscow, 86(6):263-302, (In: Soviet Physics Uspekhi 8(3):463-488; Amer. Inst. of Physics), (JPRS 33054; N66-12294; TT-65-33631), "The action of microwaves on living organisms and biological structures"

1289. PRESMAN, A. S. (1966) Proc. of Symposium on Problems of Neurocybernetics, Moscow, pp. 41-, "Electromagnetic fields in neurocybernetics"

1290. PRESMAN, A. S. (1966) Proc. of Conf. on the Effect of Magnetic Fields on Biological Objects, Moscow, pp. 59-, "Some general methodological questions of bioelectromagnetic investigations"

1291. PRESMAN, A. S. (1967) In: Questions of Bionics, Nauka, Moscow, pp. 341-, "Electromagnetic fields and regulation processes in biology"

1292. PRESMAN, A. S. (1967) Byulleten Moskovskogo Obshchestva Ispytatelei Prirody Otdel Biologicheskii, USSR, 52:149-, "The role of electromagnetic fields in evolution and the vital activity of organisms"

1293. PRESMAN, A. S. (1967) Proc. of Symposium on Physics and Biology, Moscow, pp. 13-, "The interaction of physics and biology in the investigation of the biological effect of electromagnetic fields"

1294. PRESMAN, A. S. (1968) Izd-vo Nauka, Moscow, 287 pages, (English Transl. in: USSR Sci. Abstr., Bio-Medical Sciences 62:49-52 (1968)), (In Russian), Electromagnetic Fields and Animate Nature (See also citation #1295)

1295. PRESMAN, A. S. (1970) (Translated from Russian by Sinclair, F. L.) Brown, F. A., Jr., (ed.), Plenum Publ. Co., New York, 332 pages. Electromagnetic Fields and Life: Effects of Electromagnetic Fields on Living Organisms, (Transl. of citation #1294)

1296. PRESMAN, A. S., & KAMENSKIY, YU. I. (1961) Biofizika 6(2):231-233, (In Russian), "Experimental apparatus for studying the excitability of neuromuscular preparations during irradiation by microwaves"

1297. PRESMAN, A. S., KAMENSKIY, YU. I., & LEVITINA, N. A. (1961) Uspekhi Sovremennoy Biologii 51(1):82-103, (In Russian), (JPRS 9451), (Abstr. in: Biological Effects of Microwaves: Compilation of Abstracts, ATD P-65-68 (1965), pp. 74-76, "Review of the biological effects of microwaves"), "Biological effect of microwaves"

1298. PRESMAN, A. S., & LEVITINA, N. A. (1962) Part I. Biulleten Eksperimental'noi Biologii i Meditsiny 53(1):41-44; Part II., ibid., 53(2):39-43, (1962), (In Russian), (Part I. Bulletin of Experimental Biology & Med. 52:36-39 (1962), Part II., ibid., 53(2):pp.? (1963), "Nonthermal action of microwaves on cardiac rhythm: Communication I. A Study of the action of continuous microwaves; Communication II. The action of pulsed microwaves"); (Part I: AD 288404; FTD-TT-62-278-1, 2, & 4; Part II: AD 283882); (Abstr. in: Biological Effects of Microwaves: Compilation of Abstracts, ATD P-65-68, (1965), Part I, pp. 38-39; Part II, pp. 40-41, "Nonthermal effect of pulsed microwaves on mammalian cardiac rhythm"); (Also abstr. in: The Biological Effects of Electromagnetic Fields - Annotated Bibliography, ATD Rept. P-65-17, Apr. 1965), "The nonthermal effect of microwaves on the systolic rhythm of animals. Report No. I, The effect of non-pulsed microwaves"; Report No. II, "The effect of pulsed microwaves"

1299. PRESMAN, A. S., & LEVITINA, N. A. (1962) Radiobiologiya 2(1):170-171, (In Russian), (AEC TR-5428, pp. 258-; TID-3912, pp. 447-), "Influence of nonthermal microwave radiation on the survivability of gamma irradiated animals"

1300. PRESMAN, A. S., & RAPPEPORT, S. M. (1964) Biologicheskie Nauki (formerly Nauchnye Doklady Vysshei Shkoly Biologicheskie Nauki) USSR, _(1):48-, "New data on the existence of an excitable system in paramecia. I. Reactions of paramecia to direct current pulses"; ibid. _(3):44-, "II. Reactions of paramecia to ac pulses"

1301. PRESMAN, A. S., & RAPPEPORT, S. M. (1965) Biulleten Eksperimental'noi Biologii i Meditsiny (Moskva) 59(4):48-52, (In Russian); (In English, Bulletin of Experimental Biology and Medicine 59(?):pp.? (1965)), "Effect of microwaves on the excitable (sensory) systems of paramecia"

1302. PROKTOVA, T. N. (1956) Vysshei Nervnoi Deyatel'nosti imeni i p Pavlova, USSR, 6(6):846-854, (Also in Psychological Abstracts 32(3), No. 2398 (1958)), "The effect of a continuous UHF electrical field on the higher nervous activity of dogs under normal and pathological conditions"

1303. PUHARICH, H. K. & LAWRENCE, J. L. (1964) Report, 77 pages, (AD 459956; RADC TDR-64-18), "Electro-stimulation techniques of hearing"

1304. PUKHOV, V. A. (1965) Patologicheskaia Fiziologia i Eksterimental'naia Terapiia (Moskva) 9(6):72-73, (JPRS 36,906), "SHF-UHF electromagnetic wave effects on mice cause induced changes of the functional state of the central nervous system"

1305. PUSCHER, H. (1966) Springer-Verlag, New York, 337 pages, Heating with Microwaves - Fundamentals, Components, and Circuit Techniques

1306. QUON, K. C. (1960) U. S. Navy Medical News Letter 36(10):29-34 (18 Nov.), (Originally in: Industrial Med. & Surgery 29: 315-318 (July), "Hazards of microwave radiation"

1307. RAE, J., JR., HERRICK, J. F., WAKIM, K., & KRUSEN, F. (1949) Arch. of Physical Med. 30:199-211, "A comparative study of the temperatures produced by microwave and shortwave diathermy"

1308. RAE, J., JR., MARTIN, G., TREAMOR, W., & KRUSEN, F. (1950) Proc. of Staff Meetings, Mayo Clinic, 25:441-446, "Clinical experience with microwave diathermy"

1309. RAICHILSON, R. R., & EMERY, E. (1951) Lockheed Aircraft Corp., California, Rept. ERM 5217, "Deleterious effects of the radar beam"

1310. RAJEWSKY, V., & SCHWAN, H. (1948) Naturwissenschaften 10:315-, "The dielectric constant and conductivity of the blood at ultra-high frequencies"

1311. RANDALL, B. F., IMIG, C. J., & HINES, M. H. (1952) Arch. of Physical Med. 33:73-81, "Effects of some physical therapies on blood flow"

1312. RASSADIN, A. M. (1965) Trans. Sci. Conf. of the Central Sci. Lab. Tomsk, (2):357-359, "Dependence of morphological changes in the kidneys on their functional load under the action of a low frequency electromagnetic field"

1313. RAWLS, O. B., GRAYSTON, C. M., & McDONALD, B. M. (1959), (AFMTC-TN-59-4 (C)), (Classified) "RF radiation hazards; Air Force Missile Test Center Ordnance - Bio-effects - Fuel"

1314. RAWLS, O. B., STILWELL, R. J., & McDONALD, B. M. (1961) RCA Service Co. report, 103 pages, (WO-047832), (AD 260721; AFMTC TR-61-14), "RF radiation hazards: fuel, ordnance, and bio-effects"

1315. REINBERG, G. L., MOGHISSI, A. A., & PEPPER, E. W. (1969) Proc. of the "Biological Effects and Health Implications of Microwave Radiation" Symposium, (Cleary, S. F., ed.), Medical College of Va., Richmond, 17-19 Sept., Bureau of Radiological Health/Division of Biological Effects, Rept. No. 70-2, pp. 101-103, "Effects of microwaves on optical activity"

1316. REINS, D. A., & WEISS, R. A. (1969) Work Order No. 523-003-10, Navy Clothing and Textile Research Unit, Natick, Mass., "Physiological evaluation of effects on personnel wearing the microwave protective suit and over-garment"

1317. REINER, S. (1967) In: Therapeutic Electricity and Ultraviolet Radiation, Licht, S. H., (ed.) 2nd edition, Licht, E., Publisher, New Haven, Conn., (Vol. 4 of Physical Medicine Library), Chapt. 2, pp. 70-104, "Instrumentation for electrotherapy"

1318. REITER, P. J. (1936) Zentralblatt fur die gesamte Neurologie and Psychiatrie 155:382-404, (In German), "The biological effect of shortwaves on the brain and investigation of a therapy for chronic brain diseases"

1319. REITER, T. (1933) British J. of Physics 8:119-, "Some investigations of short waves"

1320. REVIGLIO, G. M. (1934) Abstr. of the 1st Internat. Congress of Electro-Radio-Biology, Cappelli, L., (ed.), Bologna, Italy, pp. 387-395, (In Italian with English summary), "On the topic of short wave diathermic generators"

1321. REVUTS'KYY, YE. L. (1964) Akademiya nauk UKRSSR. Fiziologichnyy Zh. 10(5):636-640, (JPRS 27982; no6-1505), (Abstr. in: The Biological Effects of Electromagnetic Fields - Annotated Bibliography, ATD Rept. P-65-17, Apr. 1965), "The effect of high-frequency (13.56, 39 to 41, and 2375 Mc) electromagnetic oscillations on the motor function of the human stomach"

1322. REVUTS'KYY, YE. L. (1965) Akademiya nauk UKR SSR, Fiziologichnyy Zh., 11(3):380-384, (Abstr. only in ATD Press, Special Issue, "Biomedical Microwave Research", 4(43), Aug, 1965), "The effect of HF, VHF, and UHF radiation on the secretory and excretory functions of the human stomach"

1323. REVUTS'KYY, YE. L., & EYDEL'MAN, F. M. (1964) Fiziologichnyy Zh. Akademiya nauk UKR SSR, 10(3):379-383, (Abstr. in Biological Effects of Microwaves, ATD P-65-68, Sept. 1965, pp. 14-18, "Effects of meter and centimeter waves on human hemodynamics"), N64-31540; (Also, Biological Abstracts (Biophysics Section) 46:430, (196_), #5407), "Effect of centimeter and meter waves on the content of biologically active substances in human blood"

1324. REYNOLDS, M. R. (1961) Proc. 4th Tri-service Conf. on the Biological Effects of Microwave Radiation, Vol. 1, (Peyton, M. F., ed.) pp. 71-84, 'Development of a garment for protection of personnel working in high-power RF environments"

1325. REYZIN, M. S., & MOTSNYI, P. E. (1939) Dnepropetrovsk, Universitet, Institut Fiziologii Sbornik rabot, 2:21-, (Abstr. in: The Biological Effects of Electromagnetic Fields - Annotated Bibliography, ATD Rept. P-65-17, Apr. 1965), (Title not given), [Deals with induced changes in nerve upon UHF exposure]

1326. REZNIKOVA, L. (1937) Biologicheskoye deystviye UVCh. Simpozium, (Biological effect of ultra-high frequencies. Symposium' Moscow, pp. 373-, (Abstr. in: The Biological Effects of Electromagnetic Fields - Annotated Bibliography, ATD Rept. P-65-17, 1965), (Title not given), [Discusses biochemical analysis of UHF irradiated tissue]

1327. RICCIONI, B. (1934) In: Abstr. of the 1st Internat. Congress of Electro-radio-biology, Cappelli, L., (ed.), Bologna, Italy, pp. 152-229, (In Italian with English summary), "On the increase in grain production by the preliminary electrical exposure of the seed"

1328. RICHARD, W., & LOOMIS, A. (1927) Proc. of the National Academy of Sciences 15:58 .ielectric losses in electrolyte ..ti-tions in high frequency fields"

1329. RICHARDSON, A. J. (1954) J. of Physical Med. 33(2):103-107, "Effect of microwave induced heating on the blood flow through peripheral skeletal muscles"

1330. RICHARDSON, A. W. (1955) British J. of Physical Med. 18(7):143-, "The effectiveness of microwave diathermy therapy as a hyperthermic agent upon vascularized and avascular tissue"

1331. RICHARDSON, A. W. ((197) Proc. 1st Tri-service Conf. on Biological Hazards of Microwave Radiation, (Pattishall, E. G., ed.), 1:109-110, "Abstract of report on pathologic effects of three centimeter microwaves of low magnitude, and demonstration of dosimeters to assay accumulated microwave energy"

1332. RICHARDSON, A. W. (1958) Proc. 2nd Tri-service Conf. on Biological Effects of Microwave Energy, (Pattishall, E. G., & Banghart, F. W., eds.), 2:169-174, "Review of the work conducted at University of St. Louis (USN sponsored)"

1333. RICHARDSON, A. W. (1959) Blood 14(11):1237-, "Blood coagulation changes due to electromagnetic microwave irradiations"

1334. RICHARDSON, A. W. (1959) In: Investigators' Conf. on Biological Effects of Electronic Radiating Equipments, (Knauf, G. H., Chm.), (RADC-TR-59-67, pp. 37-41; AD 214693; Also? AD 131477), "Review of work conducted at St. Louis Univ. School of Medicine"

1335. RICHARDSON, A. W. (1959) Proc. 3rd Tri-service Conf. on Biological Effects of Microwave Radiating Equipments, (Susskind, C., ed.) 3:244-250, (RADC-TR-59-140; AD 234788), "New microwave dosimetry and the physiologic need"

1336. RICHARDSON, A. W. (1966) St. Louis Univ. School of Medicine, (NONR-130402), (AD 484726L), "Studies concerned with the biologic effects of microwave irradiations of different frequencies"

1337. RICHARDSON, A. W. (1968) Scientia (Milan) 103:447-453, (Abstr. in: Nuclear Science Abstracts 23(19):3978, #38860, 1969), "Biologic effects of non-ionizing electromagnetic radiations"

1338. RICHARDSON, A. W., DUANE, T. D., & HINES, H. M. (1948) Arch. of Physical Med. 29(12):765-769, "Experimental lenticular opacities produced by microwave irradiations"

1339. RICHARDSON, A. W., DUANE, T. D., & HINES, H. M. (1951) Amer. Medical Assoc. Arch. of Ophthalmology 45:382-386, "Experimental cataract produced by three c ntimeter pulsed microwave irradiations"

1340. RICHARDSON, A. W., IMIG, C. J., FEUCHT, B. L., & HINES, H. M. (1950) AMA Arch. of Physical Med. 31:19-25, "The relationship between deep tissue temperature and blood flow during electromagnetic irradiation"

1341. RICHARDSON, A. W., LOMAX, D. H., NICHOLS, J., & GREEN, H. D. (1952) Amer. J. of Ophthalmology 35:993-, "The role of energy, pupillary dimeter and alloxan diabetes in the production of ocular damage by microwave irradiations"

1342. RICHARDSON, A. W., et al. (1969?) From: Systems Engineering and Consultant Corp., Tulsa, Oklahoma, "Microwave/radar radiation measuring instrument (advanced information)"

1343. RICHARDSON, P. D., & WHITELAW, J. H. (1967) In: Digest of the 7th Internat. Conf. on Medical and Biological Engineering, (Jacobson, B., ed.), Stockholm, p. 398 only, "The response of human skin to localized heat sources"

1344. RICHTER, W. R. (1964) U. S. Army Medical Research Laboratory Rept. 600, (AD 440272), 12 pages, "Effects of RF energy on tissue cultures"

1345. RIEKE, F. E. (1953) Industrial Medicine & Surgery 23:328-, "Unplanned radio wave diathermy at place of work"

1346. RIVIERE, H. R., PRIORE, A., & BERLUREAU, F. (1964) Comptes Rendus acad. sci. 259:4895-4897, (In French) "Effect of electromagnetic fields on implanted T-8 tumors in the rat"

1347. RIVIERE, H. R., PRIORE, A., & BERLUREAU, F. (1965) Comptes Rendus acad. sci. 260:2099-2102, (Also, Semaine des Hopitaux Informations, Paris, 11:6-,) "Effect of electromagnetic fields on transplantable lymphoblastic sarcoma in the rat", (In French)

1348. RIVIERE, H. R. PRIORE, A., & BERLUREAU, F. (1965) Semaine des Hopitaux Informations Paris, 11:3-, (In French), "Action of electromagnetic fields on skin graft of T-8 tumor in the rat"

1349. RIVIERE, H. R., PRIORE, A., & BERLUREAU, F. (1965) Comptes Rendus acad. sci. 260:2639-2643, (In French), "Regression phenomenon observed on the skin grafts of lymphosarcoma in mice exposed to ultra-high frequency electromagnetic radiation"

1350. ROBERTS, A. M. (1969) Nature (London) 223(5206):639 only, "Effect of electric fields on mice"

1351. ROBERTS, A. M. (1970) J. of Theoretical Biology 27(1):97-106, "Motion of Paramecium in static electric and magnetic fields"

1352. ROBERTS, J. E., & COOK, H. F. (1952) British J. of Applied Physics 3:33-40, "Microwaves in medical and biological research"

1353. ROCK, J. (1969) Medical Aspects of Human Sexuality 3(9):45 only, "Scrotal temperature and fertility"

1354. RODICHEVA, E. K., GITELZON, I. I., & TERSKOV, I. A. (1965) Trans. of Sci. Conf. Central Sci. Lab., TOMSK, (2):319-322, (The Biological Effects of Electromagnetic Fields), "The effect of constant electric and alternating electromagnetic fields on the biosynthesis of chlorella during continuous culture"

1355. ROFFO, A. E., JR. (1934) In: Abstr. of the Internat. Congress of Electro-radio-biology, Cappelli, L., (ed.), Bologna, Italy, pp. 230-242, (In French with English summary), "Modification of electrocardiographic results produced by the application of high frequency electromagnetic fields"; ibid., pp. 396-414, "Relation of high frequency electromagnetic fields on cellular multiplication of in vitro tissue cultures"; and ibid., pp. 415-439, "Action of high frequency electromagnetic fields on photodynamics of colored materials in the heart of bacteria"

1356. ROGERS, S. J. (1969) Proc. of the "Biological Effects and Health Implications of Microwave Radiation" Symposium, (Cleary, S. F., Ed.), Medical College of Virginia, Richmond, 17-19 Sept. 1969, Bureau of Radiological Health/Division of Biological Effects, Rept. No. 70-2, pp. 222-232, "Radio frequency radiation hazards to personnel at frequencies below 30 MHz"

1357. ROGOVAYA, T. Z., TROITSKIY, S. A., & LASHCHENKO, N. S. (1959) In: Summaries of reports, Labor Hygiene and the Biological Effect of Radio Frequency Electromagnetic Waves. Moscow, p. 34 only, "The state of health of workers having long contact with high frequency electromagnetic equipment"

1358. ROHRSCHNEIDER, W. (1955) Munch. Med. Wschr. 97:33-37, "Radiation damage and protection for the eye against radiation"

1359. ROLLWITZ, W. L. (1958) Proc. 2nd Tri- ·vice Conf. on Biological Effects of Microwave Energy, (Pattishall, E. G., & Banghart, F. W., eds.) 2:254-264, "Review o. the work conducted at Southwest Research Institute on the use of electron paramagnetic resonance to evaluate the chemical and/or physical changes in the lenses of eyes irradiated by microwaves (USAF sponsored)"

1360. ROLNICK, H. C. (1935) Arch. of Physical Therapy 16:391-393, "Status of electrosurgical prostatic resection"

1361. ROMAN, J. (1958) Proc. 2nd Tri-service Conf. on Biological Effects of Microwave Energy, (Pattishall, E. G., & Banghart, F. W., eds.), 2:70-78, "Radio frequency hazards aboard naval ships"

1362. ROMAN, J. (1959) The Engineer's Digest, CG-133, No. 118 (Sept.-Oct.), pp. 39-, "Calculating power densities in the vicinity of radar antennas"

1363. ROMANOV, V. I. (1940) Trans. of the 1st Conf. on Problems in the Application of Shortwaves and Ultrashort Waves in Medicine, Medgiz, (Abstr. in: The Biological Effects of Electromagnetic Fields - Annotated Bibliography, ATD Rept. P-65-17, Apr. 1965), "High frequency fields as a method of studying molecular structures"

1364. RONALD, K. (1962) Canadian J. of Zoology 41(2):197-217, "The effects of physical stimuli on the larval stage of Tenanova decipiens. III. Electromagnetic spectum galvanotaxis"

1365. ROSE, D. L., & MEAD, S. (1948) Arch. of Physical Medicine 29:637-642, "Electrical tests of sensation" (Voltage-duration curves of tactile sensation and pain)

1366. ROSENSTEIN, M., BRILL, W. A., & SHOWALTER, C. K. (1969) U. S. Dept. of Health, Education, and Welfare; Public Health Service; Consumer Protection & Environmental Health Services, Environmental Control Admin., Bureau of Radiological Health, Rockville, Md., Rept. No. OCS 69-1, "Radiation exposure overview: Microwave ovens and the public"

1367. ROSENTHAL, S. W., BIRENBAUM, L., GROSOF, G. M., & ZARET, M. M. (1967) Digest of the 7th Internat. Conf. on Medical and Biological Engineering, (Jacobson, B., ed.), p. 399 only, "A study of the cataractogenic effect of microwave radiation"

1368. ROSENTHAL, S. W. (Moderator), FREY, A., LEMASTER, F., BOWMAN, R. R., RECHEN, H., OSEPCHUCK, J., & MICHAELSON, S. (1969) Proc. of the "Biological Effects and Health Implications of Microwave Radiation" Symposium, (Cleary, S. F., ed.), Medical College of Virginia, Richmond, 17-19 Sept., Bureau of Radiological Health/Division of Biological Effects, Rept. No. 70-2, pp. 233-247, "Panel Discussion I: Microwave measurements method and standards for biological research and hazard surveys"

1369. ROTH, E. M. (Ed.) (1968) Compendium of Human Responses to the Aerospace Environment 1(1):1-22, (Document # NASA CR-1205(1); N-69-12435), "Microwave radiation"; (Also, "Magnetic Fields", Section 4, pp. 1-7, N69-12438)

1370. ROTHMEIER, J. (1970) Proc. of the 3rd Annual National Conf. of the Neuro-Electric Society, "The Nervous System and Electric Currents", (Wulfsohn, N. L., & Sances, A., Jr., eds.), 23-25 Mar., Las Vegas, Plenum Press, New York, pp. 57-69, "Effect of microwave radiation on the frog sciatic nerve"

1371. ROYER, R., WAKIM, K., LEVESTEOR, S., & KRUSEN, F. (1950) Arch. of Physical Medicine 31:557-566, "Influence of microwave diathermy on swelling and trismus resulting from odontectomy"

1372. ROZANOVA, O. S. (1939) Fizioterapiya (2):pp.? "Significance of the frequency factor for the bioeffects of a HF-VHF electric field"

1373. ROZENBERG, P. A., & GELFON, I. A. (1966) Gigiena Truda i Professional'nye Zabolevaniia (Moskva) (5):52-53, "The effect of VHF-HH therapy on the silicon content in the lungs and bifurcated lymph nodes during experimental silicosis"

1374. RUBIN, A., & ERDMAN, W. J. (1959) Amer. J. of Phys. Med. 38:219-220, "Microwave exposure of the human female pelvis during early pregnancy and prior to conception"

1375. RUBIN, L., & VOROG'YEV, I. (1936) Kurortologii i Fizioterapii 1:11-, (Abstr. in: The Biological Effects of Electromagnetic Fields - Annotated Bibliography, ATD Rept. P-65-17, 1965), (Title not given), [Deals with temperature rise and suppression of nervous excitation of in vitro frog muscle]

1376. RUDGE, A. W., & KNOX, R. M. (1970) U. S. Dept. of Health, Education, and Welfare, Public Health Service Publication No. BRH/DEP 70-16, 69 pages (limited distribution), "Near-field instrumentation"

1377. RUTKOWSKI, A. & CHRISTIANSON, C. (1965) Progress Rept. 1, Naval Applied Science Lab., Brooklyn, "Development of a radiation hazard protective suit and RF measuring techniques"

1378. SACCHITELLI, G., & SACCHITELLI, F. (1956) Folia Medica, Naples, 39:1037-, (In Italian), "The action of radar microwaves on plasma lipases and serum amylase"

1379. SACCHITELLI, G., & SACCHITELLI, F. (1958) Folia Medica, Naples 41:345-, (In Italian), "On the behavior of blood glutathione following irradiation with radar microwaves"

1380. SACCHITELLI, F., & SACCHITELLI, G. (1960) Folia Medica, Naples, 43:1219-1229, (In Italian), (FTD-TT-65-1497/1+3+4, Jan. 1967), "On the protection of personnel exposed to radar microwaves"

1381. SACCHITELLI, F., & SACCHITELLI, G. (1960) Minerva fizioterap. 5:201-203, (In Italian), "On the analgesic effect of radar microwaves on caisson disease"

1382. SADCHIKOVA, M. N. (1957) In: Summaries of reports, Part 2. Jubilee Scientific Session of the Institute of Labor Hygiene and Occupational Diseases, Dedicated to the 40th Anniv. of the Great October Socialistic Revolution. Moscow. (Title not given)

1383. SADCHIKOVA, M. N. (1960) Trudy Nii Gigiyena Truda i Profzabolevaniya AMN SSR, (1):32-35, (Abstr. in: The Biological Effects of Electromagnetic Fields - Annotated Bibliography, ATD Rept. P-65-17, 1965); (Also, Abstr. in: the Biological Action of UHF, (Letavet, A. A., & Gordon, Z. V., eds.), Moscow, pp. 25-29, JPRS 12471), State of the nervous system under the influence of SHF-UHF fields"

1384. SADCHIKOVA, M. A. (1960) In: Physical Factors of the Environment, (Letavet, A. A., ed.), pp. 177-183, "State of the nervous system under the influence of SHF-UHF fields"

1385. SADCHIKOVA, M. N. (1964) Trudy Nii Gigiyena Truda i Profzabolevaniya AMN SSSR, (2):110-113, (Abstr. in: The Biological Action of Radio-Frequency Electromagnetic Fields, Moscow), "Clinical aspects of changes within the nervous system induced by the action of radio waves of various frequencies"

1386. SADCHIKOVA, M. N., & ORLOVA, A. A. (1958) Gigiena Truda i Professional'nye Zabolevaniya (MOSKVA), 2(1):16-22, (In Russian), (JPRS L1451D; OTS-59-11437), "Clinical picture of the chronic effect of electromagnetic centimeter waves"

1387. SADCHIKOVA, M. N., & ORLOVA, A. A. (1960) Nauchno-issledovatel'skiy institut gigiyeny truda i profzabolevaniy, Trudy _(10): 25-29, (Abstr. in: The Biological Action of UHF, (Letavet, A. A., & Gordon, Z. V., eds., Moscow, JPRS 12471); (Also, Abstr. in: The Biological Effects of Microwaves: Compilation of Abstracts, ATD P-65-68, (1965), p. 9 only, "Effect of UHF on the human nervous system"), "State of the nervous system under the influence of UHF"

1388. SAFONOV, YU. D., PROVOTOROV, V. M., YAKIMENKOV, L. I., & LUBE, V. M. (1967) Biulleten Eksperimental'noy Biologii i Meditsiny 64(9):111-113, (ATD Abstr. 3(6/54)), "Method of recording the magnetic field of a heart-magnetocardiography"

1389. SAITO, M., & SCHWAN, H. P. (1961) Proc. 4th Tri-service Conf. on the Biological Effects of Microwave Radiation, Vol. 1, (Peyton, M. F., ed.) pp. 85-97, "The time constants of pearl-chain formation"

1390. SAITO, M., SCHWAN, H. P., & SCHWARZ, G. (1966) Biophysical J. 6(5):313-327, "Response of nonspherical biological particles to alternating electric fields"

1391. SAITO, M., SHER, L. C., & SCHWAN, H. P. (1961) Digest of Internat. Conf. on Medical Electronics and Medical and Biological Engineering 4:154 only, "RF field-induced forces on microscopic particles"

1392. SALATI, O. M. (1959) In: Investigators Conf. on Biological Effects of Electronic Radiating Equipments, (Knauf, G., Chm.), Patrick Air Force Base, Florida, 14-15 Jan., RADC-TR-59-67, July 1959, pp. 26-30, (AD 214693), "Microwave absorption measurements"

1393. SALATI, O. M., ANNE, A., & SCHWAN, H. P. (1962) Electronic Industries, (Nov.) _(11):96-101,"Radio frequency radiation hazards"

1394. SALATI, O. M., & SCHWAN, H. P. (1959) Proc. 3rd Tri-service Conf. on Biological Effects of Microwave Radiating Equipments (Susskind, C., ed.), 3:107-112, "A technique for relative absorption cross-section determination"

1395. SALEV, A. P. (1964) Voronezh, Izd-vo Voronezh. Univ., pp. 50-58, "The effect of the energy of an electromagnetic field of varying frequency on the secretion of the salivary glands"

1396. SALISBURY, W. W., CLARK, J. W., & HINES, A. M. (1948) Collins Radio Co., (Report #CER-153, Rand - P-58), 14 pages, "Physiological damage due to microwaves"

1397. SALISBURY, W. W., CLARK, J. W., & HINES, H. M. (1949) Electronics 22:66-67, "Exposure to microwaves"

1398. SALOTTI, A., & FIORENZI, ?, (1934) Proc. of the 1st Internat. Congress of Electro-Radio-Biology (Cappelli, L., ed.), Bologna, Italy, pp. 440-444, (In Italian with English summary), "Results of research on the influence of microwaves of wavelength 60-70 cm on plants"

1399. SANCES, A., JR., & LARSON, S. J. (1965) Digest of 6th Internat. Conf. on Medical Electronics and Biological Engineering, (Iwai, Y., ed.) pp. 113-114, "Electrotonic solution of rectangular electrical anesthesia currents applied to model neurons"

1400. SANTHA, A. (1968) Honvedorvos, (Apr-Jun), _(2):198-205, "Investigations on the relations between the biological effects of ionizing radiation and electromagnetism"; "Part 2: Joint effect of ionizing radiation and electromagnetism on the growth of the root of Vicia Faba"

1401. SAREL, M., et al. (1961) Zeitschrift fur die gesamte Hygiene und Ihre Grenzgebiete (Berlin) 7:897-, (In German), "Concerning the effect of electromagnetic radar waves (cm wavelength) on the nervous system of man"

1402. SAWINSKA, A., BIELSKI, J., & WALASZKOWSKI, A. (1967) Przeglad Lekarski, Cracow, 23:742-744, "Health conditions of workers at radio and television stations exposed to the high frequency electromagnetic field"

1403. SAZONOVA, T. YE. (1964) Vestnik Leningradskogo Universiteta, Seriya Biologii, USSR, 19(3):109-116, "Effect of low frequency electromagnetic fields on the motor function of animals (Biol. Ser. No. 1)"; and ibid., 19(15):82-86, "The effect of a high gradient low frequency electromagnetic field on the efficiency of an altered motor structure (Biol. Ser. No. 3)"

1404. SAZONOVA, T. YE. (1964) Author's Abstr. of Candidate's Dissertation, Leningrad, "Functional Changes in an Organism Due to Work in a Hig.-Intensity Electric Field at Industrial Frequencies"

1405. SCELSI, B. (1957) Radioterapia Radiobiologia Fisica Medica 12:135-, (In Italian), "Thermogenesis by ultrasound and ultra-high frequency electromagnetic (radar) waves on organic, not-living tissues"

1406. SCHAEFER, H., & SCHWAN, H. (1943) Annalen Physik 43:99-135, (In German), "Concerning the question of selective heating of small particles in the ultrashort wave condenser field"

1407. SCHAEFER, H., & SCHWAN, H. (1947) Strahlentherapie 77:123-130, "Concerning the question of selective overheating of single cells in biological tissue by means of ultrashort wave currents"

1408. SCHAFFER, M. B. (1962) Report (Rand-P-2558-1), 38 pages, "The thermal response of small animals to microwave radiation"

1409. SCHAIBLE, J. P., & KNUDSEN, A. (1929) Reported at 13th Internat. Physiological Congress., "Chemical changes in the body resulting from exposure to ultra-high frequency fields"

1410. SCHASTNAYA, P. I. (1955) In: Trudy Khar'kovskogo Meditsinskogo Instituta, [Collection of Scientific Works of Kharkov Medical Institute], 13: pp. 170-, "The effect of SHF fields on microorganisms"

1411. SCHASTNAYA, P. I. (1957) In: Trudy Khar'kovskogo Meditsinskogo Instituta, USSR, 15: 9-, "The effect of electromagnetic waves of superhigh frequency on microorganisms"

1412. SCHASTNAYA, P. I. (1958) Trudy Khar'kovskogo Meditsinskogo Instituta, USSR, 16:359-, "The effect of SHF radiowaves on the colon bacillus"

1413. SCHEIE, H. G., & JERONE, B. (1949) Amer. J. of Ophthalmology 32:60-78, (une, pt. 2), "Electrocoagulation of the sclera: reduction in ocular volume and pathologic changes produced"

1414. SCHERESCHEWSKY, J. W. (1926) Public Health Reports 41:1939-, "The physiological effects of currents of very high frequency (135,000,000 to 8,300,000 cps)"

1415. SCHERESCHEWSKY, J. W. (1928) Public Health Reports 43(16):927-939, "The action of currents of very high frequency upon tissue cells, A. Upon a transplantable mouse sarcoma"

1416. SCHLIEPHAKE, E. (1935) Actinic Press, London, (Authorized English transl. of 2nd and enlarged German edition), 238 pages, Short Wave Therapy - The Medical Use of Electrical High Frequencies

1417. SCHLIEPHAKE, E. (1950) British J. of Physical Medicine 13:145-152, "Supersonic and ultrashort waves"

1418. SCHLIEPHAKE, E. (1952) Stuttgart, (In German), Short-Wave Therapy

1419. SCHLIEPHAKE, E. (1960) Zbl. Chir. 85:1063-1066, "Endocrine influence on bleeding and coagulation time"

1420. SCHLINK, F., et al. (1954) British J. of Physical Medicine 17:39-42, "Effect of ultrashort wave diathermy on blood"

1421. SCHULTZ, C. A., GRAY, O. S., SANDERS, H., & FELLOWS, O. N. (1970) Presented before the New York Academy of Sciences at the Symposium entitled "Effect of Controlled Electromagnetic Energy on Biological Systems", (Nov), 5 pages, "The effect of electromagnetic controlled energy on viruses in human blood"

1422. SCHULTZ, F. V., BURGENER, R. C., & KING, S. (1958) Proc. of the Institute of Radio Engineers 46:476-, "Measurement of the radar cross section of a man"

1423. SCHVARTS, J. I. (1945) Frunze, Local Reflex Changes Under the Influence of Local Action of UHF Fields on the Cervico-Thoracic Segments of the Spinal Cord

1424. SCHWAN, H. (1948) Zeitschrift fur Naturforschung (Tubingen) 3B:361-367, (In German), "Temperature dependence of the dielectric constant of blood at low frequencies"

1425. SCHWAN, H. (1950) Ann. Phys. 6:253-, "Resonance method for the determination of complex resistances of substances at decimeter wavelengths"

1426. SCHWAN, H. (1953): Amer. J. of Physical Med. 32:144-, "Electrical properties of blood at ultrahigh frequencies"

1427. SCHWAN, H. (1953) Zeitschrift fur Naturforschung (Tubingen) 8B:3-10, (In German), "Measurement of electrical constants and complex-resistances in biological materials"

1428. SCHWAN, H. (1954) Zeitschrift fur Naturforschung (Tubingen) 9B(8):245-251, (In German), "The electrical characteristics of muscle tissue at low frequencies"

1429. SCHWAN, H. P. (1955) Institute of Radio Engineers, Trans. PGI4:75-83, (Also: Tech. Rept. #15, Univ. of Pennsylvania, to Office of Naval Research, 23 pages), (AD 56691), "Application of UHF impedance measuring techniques in biophysics"

1430. SCHWAN, H. P. (1955) Institute of Radio Engineers, Trans. on Medical Electronics, 3:32-46, "Electrical properties of body tissues and impedance plethysmography"

1431. SCHWAN, H. P. (19__) Electromedical Lab., Moore School of Electrical Engineering, Univ. of Pennsylvania, "Survey of microwave absorption characteristics of body tissue"

1432. SCHWAN, H. (1956) In: Handbook of Biological Data, National Research Council, Washington, D. C., "Electrical properties measured with alternating current: body tissues"

1433. SCHWAN, H. P. (1956) J. of the Amer. Medical Assoc. 160:191-197, "The biophysical basis of physical medicine"

1434. SCHWAN, H. P. (1957) Final Rept. from Univ. of Penna. on ONR Contract (1 July 1954 to 30 June 1957) 11 pages, (AD 149535), "Influence of electromagnetic radiation on biological material"

1435. SCHWAN, H. P. (1957) Proc. 1st Tri-service Conf. on Biological Hazards of Microwave Radiation (Pattishall, E. G., ed.), 1: 59-63, "The physiological basis of RF injury (Abstract)"

1436. SCHWAN, H. P. (1957) In: Advances in Biological and Medical Physics, 5, (Lawrence, J. H., & Tobias, C. A., eds.), Academic Press, Inc., New York, pp. 147-209, (Tech. Rept. #20, Univ. of Penna.), (AD 132533), "Electrical properties of tissues and cell suspensions"

1437. SCHWAN, H. P. (1958) Proc. 2nd Tri-service Conf. on Biological Effects of Microwave Energy (Pattishall, E. G. & Bangbart, F. W., eds.) 2, (Rome Air Dev. Center, ARDC-TR-58-54, pp. 126-145 (AD-131477); (Also: ONR Technical Rept #25), "Survey of microwave absorption characteristics of body tissue"

1438. SCHWAN, H. P. (1958) Annual Progress Rept. on ONR Contract, Univ. of Penna. (AD 207468), "Properties of biological material"

1439. SCHWAN, H. P. (1958) Proc. 2nd Tri-service Conf. on Biological Effects of Microwave Energy (Pattishall, E. G. & Banghart, F. W., eds.) 2:33-48, (Also, ONR Technical Rept. #24 of the Univ. of Penna.; AD 220125), "Molecular response characteristics to ultra-high frequency fields"

1440. SCHWAN, H. P. (1958) In: Therapeutic Heat, Physical Medicine Library, 2, (Licht, S. H., ed.), Licht, E., Publisher, New Haven, Conn., Chapt. 3, pp. 55-115, (Also: Tech. Rept. #21 from Univ. of Penna. to ONR, AD 149534), "Biophysics of Diathermy"

1441. SCHWAN, H. P. (1959) Proc. 3rd Tri-service Conf. on Biological Effects of Microwave Radiation Equipments (Susskind, C., ed.) 1:94-106, (RADC-TR-59140; AD 234788), "Theoretical considerations pertaining to thermal dosimeters"

1442. SCHWAN, H. P. (Conf. Chm.) (1959) Digest of Technical Papers, 12th Ann. Conf. on Electrical Techniques in Med. & Biology, 1st Edition, 10-12 Nov., Sponsored by Institute of Radio Engineers, Amer. Institute of Electrical Engineers, and Instrument Society of Amer., Winner, L., publisher, New York

1443. SCHWAN, H. P. (1959) Proc. of the Institute of Radio Engineers 47:1841-1855, "Alternating current spectroscopy of biological substances"

1444. SCHWAN, H. P. (1960) In: Medical Physics, 3, (Glasser, O., ed.), The Year Book Publishers, Inc., Chicago, pp. 1-7, "Absorption and energy transfer of microwaves and ultrasound in tissues: characteristics"

1445. SCHWAN, H. P. (1963) In: Physical Techniques in Biological Research, (Nastuk, W. L., ed.), Academic Press, New York, from Vol. 6, Part B of "Electrophysiological Methods", pp. 323-407, "Determination of biological impedances"

1446. SCHWAN, H. P. (1964) Final Rept. (from Univ. of Penna. under ONR Contract, (D 600263), 13 pages, "Non-thermal effects of alternating electrical fields on biological structures"

1447. SCHWAN, H. P. (1968) In: Microwave Power Engineering, (Okress, E. C., ed.), Academic Press, N. Y., 2:215-243, "Radiation, biology, medical applications, and radiation hazards"

1448. SCHWAN, H. P. (1969) J. of Non-Ionizing Radiation 1(1):23-, "Effects of Microwave radiation on tissue - a survey of basic mechanisms"

1449. SCHWAN, H. P. (1969) Proc. of the "Biological Effects and Health Implications of Microwave Radiation" Symposium (Cleary, S. F., ed.), Medical College of Virginia, Richmond, 17-19 Sept., Bureau of Radiological Health/Division of Biological Effects, Rept. No. 70-2, pp. 13-21, "Interaction of microwave and radio frequency radiation with biological systems"

1450. SCHWAN, H. P. (1970) Final Rept. on ONR Contract, Mar. 1964 - Dec. 1969, Univ. of Penna., "Non-thermal effects of alternating electrical fields on biological structures"

1451. SCHWAN, H. P., ANNE, A., & SHER, L. (1966) U. S. Naval Air Engineering Center, Philadelphia, Pa., Aerospace Crew Equipment Lab., Rept. # NAEC-ACEL-534;/"Heating of living tissues [by microwave irradiation to determine threshold sensations of warmth]; (AD 479192L; & X66-16685) Final Rept. 1963-1965"

1452. SCHWAN, H. P., & CARSTENSEN, E. L. (195 , (Trans. AIEE preprint Paper 53-137, Winter General Meeting, Electrical Techniques in Med. and Biology), AIEE Trans. 72:106-, "Application of electric and acoustic impedance measuring techniques to problems in diathermy"

1453. SCHWAN, H. P., CARSTENSEN, E. L., & LI, K. (1953), (AIEE Technical Paper 53-206, AIEE Summer General Meeting), Electrical Techniques in Medicine and Biology, AIEE Trans. 72:483-, "Heating of fat - muscle layers by electromagnetic and ultrasonic diathermy"

1454. SCHWAN, H. P., CARSTENSEN, E. L., & LI, K. (1954) Electronics 27:172-175, "Electric and ultrasonic deep heating diathermy"

1455. SCHWAN, H. P., CARSTENSEN, E. L., & LI, K. (1954) Arch. of Physical Med. and Rehabilitation 35:13-19, "Comparative Evaluation of electromagnetic and ultrasonic diathermy"

1456. SCHWAN, H. P., & KAY, C. F. (1957) Annals of the New York Academy of Science 65(6):100 - 3, "The conductivity of living tissues"

1457. SCHWAN, H. P., & LI, K. (1953) Proc. of the Institute of Radio Engineers 41(12):1735-1740, "Capacity and conductivity of body tissues at ultrahigh frequencies"

1458. SCHWAN, H. P., & LI, K. (1955) Trans. of the AIEE (Communications and Electronics) 16:603-607, "Measurements of materials with high dielectric constant and conductivity at ultrahigh frequencies"

1459. SCHWAN, H. P., & LI, K. (1955) Electronic Engineering 74:64-, "Measurement of materials at ultra-high frequencies"

1460. SCHWAN, H. P., & LI, K. (1955) Arch. of Physical Med. & Rehabilitation 36:363-370, "Variations between measured and biologically effective microwave diathermy dosage"

1461. SCHWAN, H. P., & LI, K. (1956) Institute of Radio Engineers Trans. on Medical Electronics PGME-4:45-49, (Also, Tech. Rept. #16, ONR Contract, Univ. of Penna., AD 80164; Also, presented at Symposium on "Physiologic & Pathologic Effects of Microwaves, Mayo Clinic, Sept. 1955), "The mechanism of absorption of ultrahigh frequency electromagnetic energy in tissues, as related to the problem of tolerance dosage"

1462. SCHWAN, H. P., & LI, K. (1956) Proc. of the Institute of Radio Engineers 44(11):1572-1581, (Also Tech. Rept. #19, Univ. of Penna. on ONR Contract, AD 122467), "Hazards due to total body irradiation by radar"

1463. SCHWAN, H. P., & LI, K. (1959) Proc. of the 1st National Biophysics Conf., Columbus, (Quastler, H., & Morowitz, H., eds., Yale Univ. Press, New Haven), pp. 355-356, "Dielectric properties of hemoglobin at ultrahigh frequencies"

1464. SCHWAN, H. P., & MACZUK, J. (1959). Proc. of the 1st National Biophysics Conf., Columbus, (Quastler, H., & Morowitz, H., eds., Yale Univ. Press, New Haven), pp. 348-355, "Electrical relaxation phenomenon of biological cells and colloidal particles at low frequencies"

1465. SCHWAN, H. P., & PAULY, H. (1959) Digest of Technical Papers, Proc. of the 12th Annual Conf. on Electrical Techniques in Medicine and Biology (Schwan, H. P., Chm.), p. 54 only, "Dielectric constant and conductivity of the interior erythrocytes and pearl chain formation in blood"

1466. SCHWAN, H. P., & PAULY, H. (1959) Proc. 3rd Tri-service Conf. on Biological Effects of Microwave Radiating Equipments (Susskind, C., ed.) 3:113-123, "Electrical substitutes for human tissue"

1467. SCHWAN, H. P., PAULY, H., TWISTON, J., & GLAZER, I. (1958) First Annual Progress Rept. to Air Force, Univ. of Penna. "Effects of microwaves on mankind"

1468. SCHWAN, H. P., & PIERSOL, G. M. (1953) Arch. of Physical Med. 33:34-, "Absorption of electromagnetic energy in body tissue; review and critical analysis"

1469. SCHWAN, H. P., & PIERSOL, G. M. (1954) Amer. J. of Physical Med. 33(6):371-404, "The Absorption of Electromagnetic Energy in Body Tissues: A Review and Critical Analysis, Part I, Biophysical Aspects"; Part II. Amer. J. of Physical Med., Internat. Review of Physical Med., 34(3):425-448 (1955), (AD 83453), "Physiological and clinical aspects - physiological effects of microwave diathermy"

1470. SCHWAN, H. P., SAITO, M., & SCHWARZ, G. (1966) Biophysical Journal 6:313-, (Also, Tech. Rept. #49 of Univ. of Pennsylvania), "Response of non-spherical biological particles to alternating electric fields."

1471. SCHWAN, H. P., & SALATI, O. M. (1959) Proc. 3rd Tri-service Conf. on Biological Effects of Microwave Radiating Equipments, (Susskind, C., ed.) 3:107-, (Also: Rept. RADC-TR-59-140), "A technique for relative absorption cross-section determination"

1472. SCHWAN, H. P., SALATI, O. M., ANNE, A., & SAITO, M. (1960) Univ. of Penna. Progress Rept to Air Force, RADC-TN-60-158, (AD 241768), 77 pages, "Effects of microwaves on mankind"

1473. SCHWAN, H. P., SALATI, O., PAULY, H., ANNE, A., FERRIS, C. D., & TWISDON, J. (1958) Univ. of Penna. Rept. to Air Force (RADC-TN-59-199, AD 217619), 42 pages, "Effects of microwaves on mankind"

1474. SCHWAN, H. P., & SHER, L. D. (1967) Univ. of Penna. Progress Rept. to ONR, (AD 656736), 8 pages, "Non thermal effects of alternating electric fields on biological structures"

1475. SCHWAN, H. P., SHER, L. D., & MERJANIAN, S. V. (1967) Proc. of the 20th Annual Conf. on Engineering in Medicine and Biology, (Also, Univ. of Penna. Tech. Rept. 51), "Optimization study of an electrical method for the rapid thawing of frozen blood"

1476. SCHWAN, H. P., & SHER, L. D. (1969) In: Dielectrophoretic and Electrophoretic Deposition, (Pehl, H. A., & Pickard, W. F., eds.), The Electrochemical Society, Inc., New York; pp. 107-126, "Electrostatic field-induced forces and their biological implications"

1477. SCHWAN, H. P., & SHER, L. D. (1969) J. of the Electrochemical Society: Reviews & News 116(1):22C-, "Alternating-current field-induced forces and their biological implications"

1478. SCHWAN, H. P., & SHEN, D. W. C. (1959) Digest of Technical Papers. Proc. of the 12th Annual Conf. on Electrical Techniques in Medicine and Biology, (Schwan, H. P., Chm.), Sponsored by the Institute of Radio Engineers, the Amer. Institute of Electrical Engineers, and the Instrument Soc. of Amer., (Nov.), "Relaxation parameters of a suspension of membrane covered ellipsoids"

1479. SCHWAN, H. P., & VOGELHUT, P. O. (1968) In: Microwave Engineering, 2, Academic Press, pp. 213-244, "Microwave biophysics"

1480. SCHWARTZ, R. F. (1966) Electronic Industries (June), pp. 88-96, "Precision microwave power measurements, a survey"

1481. SCHWARTZKOPFF, J. (1950) Die Vogelwarte 15(3):194-196, (NRC Transl. TT-1161; N65-28815), "On the question of the perception of ultra-shortwaves by migratory birds"

1482. SCHWARZ, G. (1963) J. of Chemical Physics 39(9):2387-2388, "General equation for the mean electrical energy of a dielectric body in an alternating electrical field"

1483. SCHWARZ, G., SAITO, M., & SCHWAN, H. P. (1966) J. of Chemical Physics 43(10):3562-3569, (Univ. of Penna. Rept.), (AD 631617), "On the orientation of nonspherical particles in an alternating electrical field"

1484. SCOTT, J. (1971) Microwaves 10(1):9-14, "Is today's standard for microwave radiation safe for humans"

1485. SEARLE, C., DAHLEN, R. W., IMIG, C. J., WUNDER, C. C., THOMSON, J. D., THOMAS, J. A., & MORESSI, W. J. (1961) Proc. 4th Tri-service Conf. on the Biological Effects of Microwave Radiation, Vol. 1, (Peyton, M. F., ed.), pp. 187-199, "Effects of 2450 mc microwaves in dogs, rats, and larvae of the common fruit fly"

1486. SEARLE, C. W., IMIG, C. J., & DAHLEN, R. W. (1959) Proc. 3rd Tri-service Conf. on Biological Effects of Microwave Radiating Equipments (Susskind, C., ed.) 3:57-81, "Studies with 2450 Mc(cw) exposures to the head of dogs"

1487. SEDLACEK, J., & MACEK, O. (1966) Sbornik Lekarsky, Prague, 68:28-35, "Attempt to analyze the substance responsible for the high frequency impedance of cerebral tissue"

1488. SEDUNOV, B. I., & FRANK-KAMENETSKII, D. A. (1963) Uspekhi Fizicheskikh Nauk, Moscow, 79(3):617-639, (Amer. Institute of Physics Transl. 6(2):279-293 (1963)), "Dielectric constants of biological objects"

1489. de SEGUIN, L. (1947) Comptes Rendus Hebdomadaires des Seances de l'Academie des Sciences 225:76-77, (In French), "Reversibility of lesions observed in small animals exposed to ultra high frequency radiation (wavelengths of 21 cm)"

1490. de SEGUIN, L. (1947) Comptes Rendus Hebdomadaires des Seances de l'Academie des Sciences 228:135-, (In French) "Laws of heat distribution in tissues of organisms irradiated with ultrahigh frequency electromagnetic fields"

1491. de SEGUIN, L. (1949) J. de Radiologie et d'Electrologie 30:458-461, (In French), "Biophysical bases of therapeutic applications of microwaves"

1492. de SEGUIN, L., & COSTELAIN, C. (1947) Comptes Rendus Hebdomadaires des Seances de l'Academie des Sciences 224(23):1662-1663, (In French), "Effect of ultra high frequency waves (wavelengths of 21 cms) on temperature of small laboratory animals"

1493. de SEGUIN, L., & COSTELAIN, C. (1947) Comptes Rendus Hebdomadaires des Seances de l'Academie des Sciences 224(26):1850-1852, (In French), "Anatomic lesions observed in laboratory animals exposed to ultrahigh frequency radiation (wavelength of 21 cms)"

1494. de SEGUIN, L., LEFEBVRE, J., & POLIETIER, H. (1949) J. de Radiologie et d'Electrologie 30:566-568, (In French), "Specific action of microwaves on tissue cultures"

1495. de SEGUIN, L., et al. (1948) Comptes Rendus Hebdomadaires des Seances de l'Academie des Sciences 227:783-, (In French), "Increase in the growth rate of tissue cultures irradiated with ultrahigh frequency electromagnetic radiation (wavelength 21 cm)"

1496. SEIPEL, J. H., & MORROW, R. D. (1960) J. of the Wash. Academy of Sciences 50(6):1-4, "The magnetic field accompanying neuronal activity: a new method for the study of the nervous system"

1497. SEMENOV, A. I. (1962) Izd-vo Moskovskogo Universitets, Moskva, pp. 1-254, (Abstr. in: The Biological Effects of Electromagnetic Fields - Annotated Bibliography, ATD Rept. P-65-17, Apr. 1965), "Theory of electromagnetic waves"

1498. SEMENOV, A. I. (1965) Biulleten Eksperimental'noi Biologii i Meditsiny (Moskva) 60(7):64-66, (Abstr. in: ATD Press, Special Issue "Biomedical Microwave Resesearch" 4(43):6-7 (1965)), "The influence of the SHF-UHF electromagnetic field on the temperature in rabbit femoral tissues"

1499. SEMENOV, N. V. (1965) Biulleten Eksperimental'noi Biologii i Meditsiny (Moskva) 60(4):17-19, (FTD Transl. TT-65-31496; JPRS 30998; N65-28140), "Elimination of hypothermia in dogs by means of high frequency currents"

1500. SENKEVECH, A. I. (Possibly Zenkevich?) (1959) Summaries of reports. Labor Hygiene and the Biological Effect of Radio Frequency Electromagnetic Waves; Moscow, p. 6 only, (Title not given)

1501. SERCL, J., et al. (1961) Sbornik Vedeckych Praci Lekarske Fakulty Karlovy University, Czechoslovakia, 4(4):427-440, (Also Z. ges. Hyg. 7:897-907, (1961), (in German)), "On the effects of cm electromagnetic waves on the nervous system of man; radar" [thermal & nonthermal]

1502. SETH, H. S., & MICHAELSON, S. (196') Aerospace Medicine 35(8):734-739, "Microwave/hazards evaluation"

1503. SETH, H. S., & MICHAELSON, S. M. (1965) J. of Occupational Medicine 7(9):439-442, "Microwave cataractogenesis"

1504. SETTER, L. R., SNAVELY, D. R., SOLEM, D. L., & VAN WYE, R. F. (1969) U. S. Dept. of Health, Education, and Welfare, Public Health Service Publication No. 999-RH-35 (April), 77 pages (limited distribution), (Also in: "Senate Hearings", pp. 1216-1296); "Regulations, standards, and guides for microwaves, ultra-violet radiation, and radiation from lasers and television receivers - an annotated bibliography"

1505. SEVASTYANOV, V. V. (1965) Voyenno Meditsinskii Zh., USSR Military Med. Jour. _(7):21-25, "Measurement of SHF-UHF electromagnetic radiation intensities and the problem of their hygienic appraisal"

1506. SEVASTYANOV, V. V. (1969) Voyenno Meditsinskii Zh., USSR Military Med. Jour., _(1):54-55, "Visual recording technique used in the assessment of SHF-UHF effects on an organism"

1507. SHAPAR, H. K. (1961) Health Physics 5:155-159, "Significance of health physics evidence in the trial of a case of radiation personal injury"

1508. SHARMA, R. C. (1967) Nature 214:83-84, "Mechanism of characteristic behavior of cells in an alternating electric field"

1509. SHAW, T., & WINDLE, J. (1950) J. of Applied Physics 21:956-, "Microwave techniques for measurement of the dielectric constant of fibers and films of high polymers"

1510. SHCHEGLOVA, (1961) Gigiena i Sanitariya, USSR, 28(5):18-22, (JPRS 23898), "On the combined action of a high frequency electromagnetic field and x-ray in industry"

1511. SHCHERBAK, A. YE. (1933) Biulleten Gosudarstvennogo Tsentral'nogo Instituto Sechenova (Bull. of the State Central Institute of sechenova), _(2-3):pp.? "From the history of the scientific life of the Sechenov Institute"

1512. SHENYAKOV, S. I. (1955) Voyenno Meditsinskii Zh., USSR Military Med. Jour., _(5):79-83, "Certain data of medical observations in radio technical stations"

1513. SHEN, D. W. C., & SCHWAN, H. P. (1959) Digest of Technical Papers. Proc. 12th Annual Conf. on Electrical Techniques in Medicine and Biology, (Schwan, H. P., Chm.), Nov., p. 55 only, "Relaxation parameters of a suspension of membrane-covered ellipsoids"

1514. SHER, L. D. (1970) Paper presented at 4th Annual Midyear Topical Symposium, Health Physics Soc., Electronic Product Radiation and the Health Physicist, Jan., Louisville, Ky., Bureau of Radiation Health, Div. of Electronic Products, Rept. No. 70-26, pp. 431-462, "Interaction of microwave and RF energy on biological material"

1515. SHER, L. D. (1970) Medical Research Engineering 9(1):12-16, "Symposium on biological effects and health implications of microwave radiation: a review"

1516. SHER, L. D., KRESCH, E., & SCHWAN, H. P. (1970) Biophysical Journal 10(10):970-979, "On the possiblity of nonthermal biological effects of pulsed electromagnetic radiation"

1517. SHER, L. D., & SCHWAN, H. P. (1963) Ph.D. thesis of L.D.S., and Tech. Rept. #37 to ONR, the Moore School of Electrical Engineering, Univ. of Penna., (Abstr. in IEEE BME-16:1, 1969), "Mechanical Effects of AC Fields on Particles Dispersed in a Liquid; Biological Implications"

1518. SHER, L. D., SCHWAN, H. P., AND MACZUK, J. (1965) Digest of 6th Internat. Conf. on Medical Electronics and Biological Engineering, (Iwai, Y., ed.) Aug., pp. 547-548, "The electrical impedance of frozen blood and applications to electrical methods of thawing"

1519. SHEREŠHEVSKAYA, L. (1966) Vestnik Oftalmol/ _(3):5-9, "Centimeter-band therapy of distrophy of the macula lutea and uveitis" ogii

1520. SHEVCHIK, F., & VETTERL', V. (1965) Biofizika 10(3):441-446, (ATD 66-55) (Abstr. in: ATD Press, Special Issue, "Biomedical Microwave Research" 4(43):1-3, (1965)), "Complex dielectric permitivity of solutions in the centimeter wave band"

1521. SHEVELOVA, A. B. (1939) Sbornik trudov Instituta Fiziologii Dnepropetrovsk. Universitet., 1937-1940, (Subseries of the University's "Nauchnye Zapiski", monograph), 2:31-, "Influence of UHF fields on heart action in the frog"

1522. SHEYVAS, V. E., & ZUFAROV, K. A. (1968) Med. Zh. Uzbek, _(6):12-15, "Biological effects of electromagnetic fields; electron microscopic research"

1523. SHEYVEKHMAN, B. YE. (1949) Problemy Fiziologicheskoy Akustiki, USSR, 1:122-127, (Abstr. in: The Biological Effects of Electromagnetic Fields - Annotated Bibliography, ATD Rept. P-65-17, Apr. 1965); (AD 281129; FTD-TT-62-491/1+2), "Effect of the action of a VHF-HF field on the aural sensitivity during application of electrodes in the zone of projection of the aural zone of the cortex (lamella of temporal bone)"

1524. SHIMKOVICH, I. S., & SHILYAYEV, V. G. (1959) Vestnik Oftalmol/, Moscow, 72(4):12-16, (Abstr. in Mammalian Eye, A Literature Survey, by Lazarus, H. S., & Levedahl, B. H., TID-3912, DTIE-, U. S. Atomic Energy Commission, Oak Ridge, Tenn., 1962, pp. 447-), "Development of cataract of both eyes as a result of brief exposures to high density SHF-UHF electromagnetic fields"

1525. SHINDRYAYEV, A. A. (1969) Voyenno-Meditsinski Zh.,(USSR Military Med. J.), _(5):87-88, "Nomogram for determining radii of radar set danger zones"

1526. SHINN, D. H. (1958) Nature 182(4652):1792-1793, "Health hazards from powerful radio transmissions"

1527. SHINOWARA, G. YE., & HORAVA, A. (1962) Inst. of Contemporary Russian Studies 4(3):7-8, "The biological action of ultra-high frequencies"

1528. SHIPP, L. M. (1965) J. of Occupational Medicine 7:423-430, "Electronics and medicine"

1529. SHLYAFER, T. P., & YAKOVLEVA, M. I. (1969) Fiziologicheskiy Zh., SSSR, 55(1):16-21, (In Russian with English summary), "The effect of SHF-UHF electromagnetic fields on the pulsed activity of cerebro-cortical neurons"

1530. SHMELEV, V. P. (1964) In: Some Questions of Physiology and Biophysics, Voronezh, pp. 89-, "The effect of an electromagnetic field of the audio- and radio-frequency ranges on the reflex activity of the spinal cord"; and ibid., pp. 98-, "The state of electric activity of the brain due to action of electromagnetic vibrations of the audio- and radio-frequency range on the organism"

1531. SHNEYVAS, V. B., & ZUFAROV, K. A. (1968) ATD Press, Aerospace Technology Division, Library of Congress 7(10):4-5, (Summary in: USSR Science Abstracts _(62):48-, (1968)), "The biological effect of electromagnetic fields (electron-microscopic study)"

1532. SHORE, M., & LEACH, W. (1969) In: Conf. on Federal-State Implementation of Public Law 90-602, (Miller, J. W., & Gerusky, T. M., Co-Chm.), Bureau of Rad. Health Rept. ORD 69-4 [LD_{50} Studies on rats & hamsters; changes in protein synthesis; chromosomal studies following exposure to electromagnetic radiation]

1533. SHTOL'TSER, V. R. (1958) Problemy Gematologii i Perelivaniia Krovi, Moskva, 3(3):178-183, "Changes in the activity of hemostatic blood preparations caused by the electromagnetic field"

1534. SHVARTS, YA. I. (1945) Frunze, Local and Reflected Changes Due to Localized Action of HF-VHF Field Upon Cervicothoracic Segments of the Spinal Cord

1535. SIDDONS, H., & SOWTON, E. (1967) Chas. C. Thomas, Publ., Springfield, Ill., pp. 99-102, [see especially p. 100 for a discussion of experimental effects on cardiac pacemakers of various types of RF/microwave/diathermy, etc. equipment], Cardiac Pacemakers

1536. SIEMS, L. L., KOSMAN, A. J., & OSBORNE, S. L. (1948) Arch. of Physical Medicine 29(12):759-764, "A comparative study of short wave and microwave diathermy on blood flow"

1537. SIGEL, M. M., & BURNSTEIN, T. (1959) In: Annual Rept. of Microwave Radiation Research, Univ. of Miami, (AD 232925), "Effect of microwaves on mammalian cells grown in vitro"

1538. SIGLER, A. T., LILIENFELD, A. M., COHEN, B. H., & WESTLAKE, J. E. (1965) Bull. of Johns Hopkins Hospital 117(6):374-400, "Radiation exposure in parents of children with Mongolism (Downs Syndrome)"

1539. SILVER, S. (1959) Proc. 3rd Tri-service Conf. on Biological Effects of Microwave Radiating Equipments, (Susskind, C., ed.), 3:22-32, (RADC-TR-59-140; AD 234788), "Physical aspects of microwave radiation"

1540. SILVERS, L. J. G. (1935) Arch. of Physical Therapy 16:671-673, "Control of pain and hemorrhage in electrosurgical tonsillectomy"

1541. SIMMONS, A., & EMERSON, W. (1953) Tele-Tech and Electronic Industries _(7):pp.?, "Anechoic chambers for microwaves"

1542. SIMON, C. W., & ANDERSON, L. E. (1956) Presented at 8th Annual Meeting of Flight Safety Foundation (Hughes Aircraft Co.), (AD 144744), "Potential ground hazards of high performance radar"

1543. SIMONELLI, M., & RIZZINI, V. (1951) Giornale Italiano di Oftalmologia 4(1):3-[illegible] (In Italian), "Action of microwaves on the eye (preliminary note)" (Abstr. in: Zentralbl. f.d. ges. Ophth. 59(7):344 (July 1953))

1544. SINGATULLINA, R. G. (1961) Biulleten Eksperimental'noi Biologii i Meditsiny (Moskva) 52(7):69-72, (In Russian), "The effect of ultrahigh frequency currents on blood serum protein fractions"

1545. SINGATULLINA, R. G. (1961) Biulleten Eksperimental'noi Biologii i Meditsiny (Moskva) 52(7):812-815, (Also, Biological Abstracts 38(5636), (1962)), "The effect of UHF currents on proteins in blood serum fractions"

1546. SINISI, L. (1954) Electroencephalogy & Clinical Neurophysiology 6:535-, "EEG [human] after radar application"

1547. SKAGGS, G. A. (1971) Naval Research Laboratory Memorandum Report 2218, 11 pages, "High frequency exposure chamber for radiobiological research"

1548. SKURIKHINA, L. A. (1961) Voprosy Kurortologii, Fizioterapii i Lechebnoy Fizicheskoy Kul'tury (Problems in Health Resort Science, Physiotherapy & Medical Physical Culture), Moscow, _(4):338-, "The therapeutic application of microwaves (SHF electromagnetic fields)"

1549. SKURIKHINA, L. A. (1962) Novosti Meditsinskoy Tekhniki, Moskva, _(3):9-, "Clinical and physiological bases of microwave therapy"

1550. SLABOSPITSKIY, A. A. (1964) In: Biological Action of Ultrasound and SHF-UHF Electromagnetic Oscillations,(Gorodetskiy, A. A., ed.), Academy of Sciences, Institute of Physiology, imeni A. A. Bogomolets, Kiev, UKR SSR, (JPRS 36060; N65-28707), pp. 92-107, "The problem of microwave lesions of the skin"

1551. SLABOSPITSKIY, A. A. (1964) In: Problems of the Biophysics and Mode of Action of Radiation, Zdorovya Publ. House, Kiev, pp. 89-94, (Transl. of abstr., Zh. Biol. (19), (Oct. 1965), Abstr. 19-P-373; JPRS 34963), "Morphological changes in the skin of white rats when exposed to centimeter range radio waves"

1552. SLABOSPITSKIY, A. A. (1965) Fiziologicheskiy Zh. SSSR, 11(2):225-231, "The mechanism of action of microwaves on the skin"

1553. SLAVISKIY, G. M. (1937) Sevastopol, (Abstr. in: The Biological Effects of Electromagnetic Fields - Annotated Bibliography, ATD Rept. P-65-17, Apr. 1965), The Experimental Foundation of Short Wave Therapy

1554. SLAVSKIY, G. M., & BURNAN, L. S. (1935) Bull. Gosudarstvennogo Tsentral'nogo Nauchno-issledovatel'skogo Inst. imeni Sechenova (6-7): "The problem concerning pathological anatomical changes occurring in the organs and tissues under total exposure to short waves"

1555. SLEPICKA, J., SLIVOVA, A., ZPPOCHMON, O., & ZAPLETALOVA, E. (1967) Pracovni Lekarstvi, Prague 19:5-11, "The effect of electromagnetic radiation in the meter wavelength on operators of short-wave radio transmitters"

1556. SLINEY, D. H., & PALMISANO, W. A. (1967); (AD 652708; N67-32384), 37 pages, "Microwave hazards bibliography"

1557. SMIRNOVA, M. I., & SADCHIKOVA, M. N. (1960) Nauchno-issledovatel'skiy Institut Gigiyena Truda i Profzabolevaniya Trudy (1):50-51, (Also in: The Biological Action of Radio-Frequency (UHF) Electromagnetic Fields, (Letavet, A. A., & Gordon, Z. V., eds.), (JPRS 12471, (1962), pp. 47-49); (Abstr. in: Biological Effects of Microwaves: Compilation of Abstracts, ATD P-65-68, Sept. 1965, pp. 18-19, "Effect of UHF on thyroid gland functions"); (Abstr. in: The Biological Effects of Electromagnetic Fields - Annotated Bibliography, ATD Rept. P-65-17, Apr. 1965), "Determination of the functional activity of the thyroid gland by means of radioactive iodine in workers exposed to UHF fields"

1558. SMIRNOVA, M. I., & SADCHIKOVA, M. N. (1962) Summaries of reports. Questions of the Biological Effect of a SHF-UHF Electromagnetic Field. Kirov Order of Lenin Military Medical Academy, Leningrad, (Title not given)

1559. SMITH, E. E. (1928) U. S. Navy Medical Bulletin 26:479-502, "Heat stroke, a thermoregulatory incompetency"

1560. SMITH, G. C. (1950) British Medical J., No. 4668, (July 13-21), pp. 1466-1467, "Effects of diathermy currents on metal implants in the body wall"

1561. SMITH, G. C. (1958) Medical J. of Australia 45:313-315, "Radiation hazards in industry"

1562. SMOLYANOV, A. A. (1957) Sci. Work 1st Leningrad Military Naval Hospital, pp. 56-65, "The effect of high frequency pulsed field on the vegetative nervous system"

1563. SMUROVA, YE. I. (1959) Summaries of reports. Labor Hygiene and the Biological Effect of Radio Frequency Electromagnetic Waves, Moscow, "Occupational hygiene problems in areas where MF-LF currents are used"

1564. SMUROVA, YE. I. (1966) Gigiena Truda i Professional'nye Zabolevaniya (Moskva) 10(1):17-, (JPRS 35648; TT-66-32083), "Health characteristics of conditions for medical personnel working with sources of radio frequency range electromagnetic fields"

1565. SMUROVA, YE. I. (1967) Gigiena i Sanitariya, USSR, 32(6):37-41, (TT-67-51409-2); (Also Abstr. in: Soviet Radiobiology, ATD 68-105-108-9, pp. 84-85) (AD 671436), "Changes in the phagocytic and bactericidal functions of the blood in animals exposed to radio frequency electromagnetic fields"

1566. SMUROVA, YE. I., ROGOVAYA, T. Z., TROITSKIY, A. S., LASHCHENKO, N. S., & MELNIKOVA, N. D. (1962) Gigiena Truda i Professional'nye Zabolevaniya (Moskva) 6(5):22-28, (In Russian), (JPRS 14925, N62-14907), "Problems of occupational hygiene and health status of operators exposed to the effects of high frequency currents"

1567. SMUROVA, YE. I., ROGOVAYA, T. Z., YAKUB, I. L., & TROITSKIY, S. A. (1964) Gigiena i Sanitariya, USSR, (12):27-30, (Abstr. in: Biological Effects of Microwaves, ATD-P-65-68, pp. 11-12 (1965)), "Industrial hygiene and the health of technicians servicing 60 - 90 kc generators"

1568. SMUROVA, YE. I., ROGOVAYA, T. Z., YAKUB, I. L., & TROITSKIY, S. A. (1966) Kazanskiy Meditsinskiy Zh. 47(2):82-84, "General health ons working with HF, UHF, and VHF generators in physiotherapy machines"

1569. SNYDER, S. H. (1970) Annual Summary Report, Johns Hopkins Univ. (AD 710005), June 1960 to May 1970, 18 pages, "The effect of microwave irradiation on the turnover rate of serotonin and norepinephrine in rat brain"

1570. SOBAKIN, M. A. (1965) Digest of the 6th Internat. Conf. on Medical Electronics and Biological Engineering, (Iwai, Y., ed.) p. 654 only, "Infra-red radiation from the body surface (radio epigastrica) as an index of the state of the stomach function"

1571. SOKOLNIKOV, O. I. (1937) Tr. III Vses. syezda fizioterap.(Trans. of the Third All-Union Conf. of Physical Therapists), Kiev, pp. 206-, (Abstr. in: The Biological Effects of Electromagnetic Fields - Annotated Bibliography, ATD Rept. P-65-17, Apr. 1965), "The character of biochemical dislocations in the organism under the effect of HF and UHF waves"

1572. SOKOLOV, S. D. (1967) Patologicheskaya fiziologiya i eksperimental'naya terapiya 11(3):69-70, (Abstr. in: Soviet Radiobiology, ATD 68-105-108-9, pp. 85-86, (AD 671436), "Anti-inflammatory effect of a constant magnetic field"

1573. SOKOLOV, V. V., & ARIYEVICH, M. N. (1960) Trudy Nii Gigiyena Truda i Profzabolevaniya AMN SSSR (1):43-45, (Abstr. in: "The Biological Action of UHF, Letavet, A. A., & Gordon, Z. V., eds.), pp. 39-41, (JPRS 12471); "Changes in the blood under the influence of SHF-UHF on the organism"

1574. SOKOLOV, V. V. & CHELINA, N. A. (1964) Trudy Nii Gigiyena Truda i Profzabolevaniya AMN SSSR (2):122-125, (Abstr. in: The Biological Action of Radio Frequency Electromagnetic Fields, (Letavet, A. A., & Gordon, Z. V., eds.), JPRS 12471 (1962); (JPRS 34963); "Peripheral blood count under the action of radio waves of various wavelengths on the organism"

1575. SOKOLOV, V. V., et al. (1962) Summaries of reports. Questions of the Biological Effect of a SHF-UHF Electromagnetic Field. Kirov Order of Lenin Military Medical Academy, Leningrad, p. 48 only, "The effect of centimeter waves of varying intensity on blood"

1576. SOLEM, D. L., REMARK, D. G., MOORE, R. L., CRAWFORD, R. E., RECHEN, H. J. L. (1968) U. S. Dept. of Health, Education, and Welfare, Public Health Service, Environmental Control Admin., Technical Service Branch Staff Rept., TSB No. 5, "Report of preliminary measurements of electromagnetic radiation fields near microwave ovens" (Also: Non-Ionizing Rad. 1(2):88-94 (1969))

1577. SOLOV'EV, N. A. (1962) In: Proc. of the 2nd All-Union Conf. on the Use of Radioelectronics in Biology and Medicine, Moscow, pp. 29-, "Differentiation of the action of alternating magnetic field and the emfs and currents induced by it in living organisms"

1578. SOLOV'EV, N. A. (1963) Trudy Vsesoyuznogo Nauchno-Issledovatel'skogo Instituta Meditsinskikh Instrumentov i Oborudovanii, USSR, 3:120-, "Responses of the entire living organism to an electromagnetic field"

1579. SOLOV'EV, N. A. (1963) Doklady Akademii Nauk SSSR 149:438-, "Mechanism of the biological action of a pulsed electromagnetic field"

1580. SOLOVTSOVA, K. M. (1965) Fiziologicheskii Zh. Akad. Nauk UKR SSSR 11(4):489-503, "Effect of electromagnetic high-frequency oscillations on the functioning of the liver in persons with a normal or moderately pathological functional state of this organ"

1581. SOMMER, H. C., & Von GIERKE, H. E. (1964) Aerospace Med. 35(9):834-839, "Hearing sensations in electric fields"

1582. SOROKINA, YE. I. (1965) Voprosy Kurortologii i Fizioterapii i Lechebnoy Fizicheskoy Kul'tury (Problems in Health Resort Sci., Physiotherapy & Medical Physical Culture) [illegible]:40-45, (JPRS 29914, pp. 1-8; TT 65-30903 (1965)), "Experience in the use of microwave therapy in patients suffering from sympathetic ganglionitis and radiculitis of the thoraco-cervical segment with a cardiac pain syndrome"

1583. SOUTHWORTH, G. (1937) J. of Applied Physics 8:660-664, "New experimental methods applicable to ultrashort waves"

1584. SOWTON, E., GRAY, K., & PRESTON, T. (1970) British Heart J. 32:626-632, "Electrical interference in non-competitive pacemakers"

1585. SPALA, M. (1961) Sbornik lekarsky 63:349-370, "Dosimetry of thermogenic effects of an rf field and its tolerable dose" in the rabbit" (In Czech.)

1586. SPALA, M., RIEDEL, O., & KACL, J. (1962) Casopis Lekaru Ceskych 101:791-795, (In Czech) "Effect of the rf field on the metabolism of bone tissue in the rabbit: Incorporation of ostheotropic radioisotopes"

1587. SPARKS, R. A. (1961) Digest of the Internat. Conf. on Medical Electronics, Biological Effects of Microwaves I (Athermal Aspects), (Frommer, P. L., ed.) Plenum Press, New York, pp. 230-, "X-radiation hazards from high power traveling wave tubes"

1588. SPASSKIY, V. A. (1956) Voyenno Meditsinskii Zh. (USSR Military Med. J.) (9):25-28, (Abstr. in: The Biological Effects of Electromagnetic Fields - Annotated Bibliography, ATD Rept. P-65-17, 1965), "The objectives of the study of work conditions and hygienic facilities for the personnel of radar stations"

1589. SPECTOR, H. (1969) Medical College of Virginia Quarterly 5(1):20-, "Thermodes and theories"

1590. SPEICHER, H. W. (1958) AMA Arch. of Industrial Health 17:546-555, "Some factors to be considered in a protection program for use of radiation sources"

1591. SPENCER, J. L., & KNAUF, G. H. (1957) Proc. 1st Tri-service Conf. on Biological Hazards of Microwave Radiation, (Pattishall, E. G., ed.) 1:52-59, "Exposure of Air Force personnel to ionizing radiation produced by radio frequency generators - summary"

1592. STARIKOVA, M. N. (1959) Sovetskaya Meditsina (3):66-68, "The use of a new physical factor - The pulsed VHF-HF electric field in cases of acute inflammatory infiltrates and lymphadenites"

1593. STARMER, C. F., WHALEN, R. E., & McINTOSH, H. D. (1964) Amer. J. of Cardiology 14:537-546, "Hazards of electric shock in cardiology"

1594. STEPHENS, F. H., JR. (1959) In[illegible]estigators' Conf. on Biological Effects of Electronic Radiating Equipments, (Knauf, G. H., Chm.) pp. 42-45, (AD 214693), "Equipment and methods employed in the exposure of experimental animals to microwaves at 24,000 megacycles"

1595. STEPHENS, F. H., JR. (1961) Industrial Med. & Surgery 30:221-228, "Microwave radiation of 10 mw/cm and factors that influence biological effects at various power densities"

1596. STEPHENS, F., & LANDEEN, K. (1953) J. of Occupational Med. 5:418-425, "Effects on dogs of chronic exposure to microwave radiation"

1597. STEPIN, L. D. (1965) M.I.T. Press, Quantum Radio Frequency Physics

1598. STIEBOCK, L. H. (1935) Arch. of Physical Therapy 16:657-661, "The fundamentals and indications of short wave therapy, fulguration and coagulation"

1599. STILLWELL, G. K. (1967) In: Vol. 4, Therapeutic Electricity and Ultraviolet Radiation, Physical Medicine Library, (Licht, S. H., ed.), Licht, E., Pub., New Haven, Conn., "Clinical electric stimulation"

1600. STOCKMAN, H. E. (1969) Electronics (Nov. 24), :110-, "Seeing in the dark is aim of r-f holography"

1601. STODOLNIK-BARANSKA, W. (1967) Nature 214:102-103, "Lymphoblastoid transformation of lymphocytes in vitro after microwave irradiation"

1602. STOLWIJK, J. A. J., & HARDY, J. D. (1965) Rept. No. DASA-1566, "Skin and subcutaneous temperature changes during exposure to intense thermal radiation"

1603. STOPCZYK, M., & PIENIAK, M. (1968) Polish Arch. Med. Wewn 41:773-782, (In Polish), "Diagnosis of the cause of stimulation disorders in patients with implanted heart stimulators with constant rhythm"

1604. STOWELL, R. E., ARNOLD, E. A., GOLDBLATT, P. J., TAKASHIMA, S., TRUMP, B. F., & YOUNG, D. E. (1960) Armed Forces Institute of Pathology Annual Progress Rept, (AD 241314), (Also 1964 Progress Report), "Biological and biochemical effects of microwaves"

1605. STOWELL, R. E., ARNOLD, E. A., FAITH, C. C., GRIFFIN, J. L., & YOUNG, D. E. (1965) Armed Forces Institute of Pathology Annual Progress Rept., pp. 98-117, (AD 470416; RCS-MEDDH-288), "Biological and biochemical effects of microwaves and other physical agents"

1606. STRASSBURGER, A., & SCHLIEPHAKE, E. (1935) Archiv fur Experimentelle Pathologie u. Pharmakol. 177:1-17, (In German) "The influence of ultrashort waves on the heat regulation of rabbits"

1607. STRAUB, K. D., & LYNN, W. S., JR. (1963) Federation Proc. 22, Abstr. No. 2763, p. 623 only, "Effects of oxidizing and reducing agents and A-C current on frog skin potential"

(USSR Military Medical J.)

1608. STYKAN, O. A. (1967) Voyenno Meditsinskiy Zh./ (7):36-38, (ATD Abstr. 8(6/51)), "Problem of radiation-genetic effects of the electronic-vacuum apparatus in radar stations"

1609. SUBBOTA, A. G. (1957) Trudy Voyenno Meditskinskii Akademii i Kirov, USSR, 73:35-37 (Abstr. from Zh. Biol. No. 46203, 1959), "The effect of SHF-UHF electromagnetic fields upon the higher nervous activity of dogs"; ibid., pp. 78-83, (Abstr. from Zh. Biol. No. 59927, 1959), "Changes in respiration, pulse rate and general blood pressure during irradiation of animals with SHF-UHF ibid., pp. 111-115, (Abstr. from Zh. Biol. No. 59926, 1959), "The effect of a SHF-UHF field on heart function and the lumen of vessels"; ibid., pp. 127-132, (Abstr. from Zh. Biol. No. 59922, 1959), "Effect on the blood of animals of exposure to a strong SHF-UHF field"; ibid., pp. 165-, "Some tissue reactions due to local exposure to a SHF field"

1610. SUBBOTA, A. G. (1958) Biulleten Eksperimental'noi Biologii i Meditsiny 46(10):55-61, "The effect of pulsed SHF-UHF electromagnetic fields on the higher nervous activity of dogs"

1611. SUBBOTA, A. G. (1959) In: Summaries of reports. Labor Hygiene and the Biological Effect of Radio Frequency Electromagnetic Waves, Moscow, (Title not given)

1612. SUBBOTA, A. G. (1962) In: Summaries of reports. Questions of the Biological Effect of a SHF-UHF Electromagnetic Field. Kirov Order of Lenin Military Medical Academy, Leningrad, pp. 49-51, "Some problems of adjustment and accumulation under multiple exposures to microwaves"

1613. SUBBOTA, A. G., & GREBESHECHNIKOVA, A. M. (1967) In: Medical and Biological Problems of SHF Radiation. (Petrov, I. R., ed.) (Title not given)

1614. SUPONITSKAYA, F. M. (1933) Byull. Tsentr. Nii Fiz. Metodov Lecheniya Im Sechenov (6-7):244-, (Abstr. in: The Biological Effects of Electromagnetic Fields - Annotated Bibliography, ATD Rept. P-65-17, 1965), (Title not given)

1615. SUROVIEC, H. J. (1967) Arch. of Environmental Health 14:469-472, (Also in Senate Hearings, pp. 1359-1362), "Microwave oven radiation hazards in food vending establishments"

1616. SUSSKIND, C. (1958) Annual Scientific Rept. (1957-1958); (RADC TR-59-298; AD 226735) Institute of Engineering Research, Univ. of Calif. (Berkeley), Ser. No. 60, No. 2[illegible], "Biological effects of microwave radiation"

1617. SUSSKIND, C. (1959) Annual Scientific Rept. (1958-1959); (RADC TR-59-181; AD 227847), 45 pages, Inst. of Engineering Research, Univ. of Calif. (Berkeley), Ser. No. 60, No. 241, "Cellular and longevity effects of microwave radiation"

1618. SUSSKIND, C. (1959) In: Investigators' Conf. on Biological Effects of Electronic Radiating Equipments (Knauf, G. M., Chm.) (RADC TR-59-67, p. 18 only; AD 214693), "Summary of the microwave research performed at the Univ. of Calif."

1619. SUSSKIND, C., (ed.) (1959); (RADC TR-59-140, Univ. of Calif., Berkeley, AD 234788) 335 pages, "Proc. of 3rd Annual Tri-service Conf. on Biological Effects of Microwave Radiating Equipments"

1620. SUSSKIND, C., et al. (1960) Institute of Engineering Research, Univ. of Calif., Berkeley, Series No. 60, No. 285, (RADC TR-60-122; AD 245534) 39 pages, "Microwave radiation as biological hazard and tool"

1621. SUSSKIND, C. (& Staff) (1961) Annual Scientific Rept. (1960-1961); (RADC-TR-61-205; AD 269385), Inst. of Engineering Research, Univ. of Calif., Berkeley, Series No. 60, No. 382, 28 pages, "Longevity study of the effects of 3-cm microwave radiation on mice"

1622. SUSSKIND, C., (& Staff) (1962); (RADC-TR-62-624) Univ. of Calif., Berkeley, Series No. 60, No. 489, "Nonthermal effect of microwave radiation"

1623. SUSSKIND, C., & PRAUSNITZ, S. (1959) Proc. of the 3rd Tri-service Conf. on Biological Effects of Microwave Radiating Equipments, (Susskind, C., ed.) 3:33-, (RADC-TR-59-140), "Temperature regulation in laboratory animals irradiated with 3-cm microwaves"

1624. SUSSKIND, C., & VOGELHUT, P. O. (1959) Proc. of the 3rd Tri-service Conf. on the Biological Effects of Microwave Radiating Equipments, (Susskind, C., ed.) 3:46-53, "Analytical and experimental investigation of unicellular organisms with 3-cm microwaves"

1625. SUSSKIND, C., & VOGELHUT, P. O. (1959) Digest of Technical Papers, Proc. of the 12th Annual Conf. on Electrical Techniques in Medicine and Biology (Schwan, H. P., Chm.), p. 53 only, "Analytical and experimental investigation of unicellular organisms under microwave irradiation"

1626. SUSSKIND, C., & VOGELHUT, P. O. (1961) Presented at the Conf. on Microwave Measurement Techniques held by the Inst. of Electrical Engineers in London, Sept., (Institute of Engineering Research, Univ. of Calif., Berkeley, Series No. 60, No. 439, 1962, p. 19-); (Also in: Proc. of the Institute of Electrical Engineers 109B, Suppl. 23:668-669, and 682-685 (1961)), "Cavity perturbation measurement of the effects of microwave radiation on proteins"

1627. SUSSKIND, C., & VOGELHUT, P. O. (1963) Annual Scientific Rept. No. 63-27 (1962-1963) Univ. of Calif., Berkeley, (AD 433659) "Biological uses of non-ionizing radiation"

1628. SUVOROVSKAYA, N. A. (1961) Patologicheskaia Fiziologiia i Eksperimental'naia Terapiia 5(1):38-40, (JPRS 9314), "Investigation of the effect of electromagnetic energy of centimeter waves on hemopoiesis pathology"

1629. SVETLOVA, Z. P. (1962) In: Summaries of reports. Questions of the Biological Effect of a SHF-UHF Electromagnetic Field. Kirov Order of Lenin Military Medical Academy, Leningrad, pp. 43-44, "Changes in the symmetrical conditioned and unconditioned reflexes in dogs under the influence of a SHF-UHF field in the decimeter range"

1630. SWANSON, J. R., ROSE, V. E., & POWER, C. H. (1970) Paper presented at 4th Annual Midyear Topical Symposium, Health Physics Soc., Electronic Product Radiation and the Health Physicist, Louisville, Ky., 28-30 Jan.; Bureau of Radiation Health, Div. of Electronic Products Rept. No. 70-26, pp. 95-110, (Also: Amer. Industrial Hygiene Assoc. J. 31:623-629, (1970)), "A review of international microwave exposure guides"

1631. SYCH, G. YA. (1940) Dnepropetrovsk. Universitet. Institut fiziologii. Sbornik rabot, 3:103-, (Abstr. in: The Biological Effects of Electromagnetic Fields - Annotated Bibliography, ATD Rept. P-65-17, 1965), [Title not given - Discusses alteration of reflex times in frogs exposed to ultrahigh frequency electromagnetic fields]

1632. SYNGAYEVSKAYA, V. A. (1962) In: Summaries of reports. Questions of the Biological Effect of a SHF-UHF Electromagnetic Field. Kirov Order of Lenin Military Medical Academy, Leningrad, pp. 52-53, "Some metabolic indices in the blood and urine of individuals following their exposure to SHF-UHF electromagnetic fields"

1633. SYNGAYEVSKAYA, V. A., & IGNATYEVA, O. S. (1962) In: Summaries of reports. Questions of the Biological Effect of a SHF-UHF Electromagnetic Field. Kirov Order of Lenin Military Medical Academy, Leningrad, p. 52 only, [Title not given]

1634. SYNGAYEVSKAYA, V. A., IGNATYEVA, O. S., & PLESKENA-SINENKO, G. F. (1962) In: Summaries of reports. Questions of the Biological Effect of a SHF-UHF Electromagnetic Field. Kirov Order of Lenin Military Medical Academy, Leningrad [Title not given]

1635. SYNGAYEVSKAYA, V. A. & PLESKENA-SINENKO, G. F. (1959) In: Summaries of reports. Labor Hygiene and the Biological Effect of Radio Frequency Electromagnetic Waves, Moscow [Title not given]

1636. SYNGAYEVSKAYA, V. A., PLESKENA-SINENKO, G. F., & IGNATYEVA, O. S. (1962) In: Summaries of reports. Questions of the Biological Effect of SHF-UHF Electromagnetic Field. Kirov Order of Lenin Military Medical Academy, Leningrad, pp. 51-52, "The effect of microwave radiation in the meter and decimeter waveranges on the endocrine regulation of carbohydrate metabolism and the functional state of adrenal cortex in rabbits and dogs"

1637. SZACHNOWICZ, L. A. (1967) Pediatria Polska 42:679-684, "Use of physical therapy in sequelae and late complications of infectious hepatitis (Botkin's Disease) in children"

1638. SZCZUREK, H. (1963) Przeglad Woiskladowych, Warsaw, (3):5-15, "Effect of microwaves on living organisms"

1639. SZYMANOWSKI, W. T., & HICKS, R. A. (1932) J. of Infectious Diseases 50(1):1-25, (Title?)

1640. TACCARI, E., CRESPI, M., & DDAINOTTO, F. (1967) Rassegna di medicina sperimentale 14(4):158-167, "Experimental contribution to the study of the effects of microwaves on the mesenteric mast cells of the albino rat"

1641. TAKASHIMA, S. (1966) IEEE Trans. on Bio-Medical Engineering, MBE-13(1):28-31, "Studies on the effect of radio-frequency waves on biological macromolecules"

1642. TAKATA, H., & MURASUGI, T. (1941) Bioklimatische Beiblatter 8:17-26, "Disturbance of the flocculation index in health human blood serum: Cosmo-terrestrial sympathy"

1643. TALLARICO, L. B., & KETCHEL, J. (1959) Annual Report to Air Force of Microwave Radiation Research at the Univ. of [illegible], (AD 232925), pp. 57-78, "Effects of exposure to microwave and infrared energy upon behavior of rats"

1644. TALLARICO, R. B., & KETCHEL, J. (1959) Proc. 3rd Tri-service Conf. on Biological Effects of Microwave Radiating Equipments, (Susskind, C., ed.) 3, pp.? "Effect of microwaves on certain behavior patterns of the rat"

1645. TALLMAN, O. G. (1961) Proc. 4th Tri-service Conf. on the Biological Effects of Microwave Radiation, Vol. 1, (Peyton, W. F., ed.), pp. 3-8, "Radio frequency environment"

1646. TANNER, J. A. (1966) Nature 210:636 only, (May 7), "Effect of microwave radiation on birds"

1647. TANNER, J. A., & ROMERO-SIERRA, C. (1968) 2nd Canadian Medicine and Biology in Engineering Conf., Toronto, (9-11 Sept.) "Microwaves vs. birds: A new approach to the bird problem in aviation"

1648. TANNER, J. A., & ROMERO-SIERRA, C. (1969) Proc. of the "Biological Effects and Health Implications of Microwave Radiation" Symposium, (Cleary, S. F., ed.), Medical College of Va., Richmond, Va., 17-19 Sept.; (Bureau of Radiological Health/Division of Biological Effects, Rept. No. 70-2, pp. 185-187), "Bird feathers as sensory detectors of microwave fields"

1649. TANNER, J. A., ROMERO-SIERRA, C., & DAVIE, S. J. (1967) Nature 216:1139 only, (16 Dec.), "Non-thermal effects of microwave radiation on birds"

1650. TANNER, J. A., ROMERO-SIERRA, C., & DAVIE, S. J. (1969) J. of Microwave Power 4(2):122-128, "The effects of microwaves on birds: preliminary experiments"

1651. TANNER, J. A., ROMERO-SIERRA, C., & VILLA, F. (1969) Proc. of 8th Internat. Conf. on Medicine and Biology in Engineering; and 22nd Annual Conf. on Engineering in Medicine and Biology, held in Chicago, Ill., 21 July, "Changes of muscle action in birds exposed to a microwave field"

1652. TARCHEVSKIY, I. A. (1964) In: Proc. of Concluding Scientific Conf. of Kazan State University, Kazan, pp. 30-, "Change in photosynthetic carbon metabolism as a nonspecific response to the action of electromagnetic factors"

1653. TARJAN, P. P., & MURPHY, W. P., JR. (1970) J. Amer. Medical Assoc. 214(7):1328 only, "Cardiac pacemakers and microwave ovens"

1654. TARUSOV, B. N. (1938) Arkhiv Biologicheskikh Nauk Moscow (Archives des Sciences Biologique) (2):pp.? (Abstr. in: The Biological Effects of Electromagnetic Fields - Annotated Bibliography, ATD Rept P-65-17, Apr. 1965), "Electroconductivity as a method of determining the viability of tissues"

1655. TATARINOV, V. V., & FRENKEL', G. L. (1939) Medgiz, Leningrad, An Introduction to the Study of Ultrahigh Frequency Biological Effects

1656. TAUSSIG, H. B. (1969) Amer. Scientist 57(3):306-316, "Death from lightning and the possibility of living again"

1657. TAYLOR, F. J. D., FLOYD, C. F., & RAWLINSON, W. A. (1960) Proc. of the Internat. Conf. on Medical Electronics and Biological Engineering, 3:393-398, "Some aspects of the measurement of potentially hazardous electromagnetic fields"

1658. TEIXEIRA-PINTO, A. A., CUTLER, J. L., & HELLER, J. H. (1959) Investigators Conf. on Biological Effects of Electronic Radiating Equipments, held at Patrick AFB, Fla. 14-15 Jan. (Knauf, G. M. Chm.) RADC-TR-59-67, pp. 31-32, (AD 214693), "Review of work accomplished at the New England Institute for Medical Research"

1659. TEIXEIRA-PINTO, A. A., NEJELSKI, L. L., CUTLER, J. L., & HELLER, J. H. (1960) Experimental Cell Research 20:548-564, "The behavior of unicellular organisms in an electromagnetic field"

1660. TEPLYAKOVA, N. L. (1965) Trans. of the Science Conf., Central Science Laboratory, Tomsk, (2):363-364, "Clinical and morphological changes in the visual organ in guinea pigs under short term exposure to alternating and constant magnetic fields"

1661. TERENT'YEVA, YE. V. (1945) Nauchno-issledovatel'skiye ratoty biologicheskikh nauk za 1945 g. Referaty. (Research of the division of biological sciences for 1945. Abstracts), (Izd-vo AN SSSR pp. 347- (1947), (Abstr. in: The Biological Effects of Electromagnetic Fields - Annotated Bibliography, ATD Rept. P-65-17, 1965), [Title not given; Discusses exposure of the head of dogs to UHF fields (50 MHz) at thermal levels. Changes in conditioned reflex feeding effects were observed]

1662. TERRIE, M., & LOMBARDINI, P. (1951) Bollettino Dell'Istituto Sieroterapico Milanese, Italy, 30:134-150, "Effect of microwaves on bacteria: electromagnetic waves of 3, 10, and 142 cm. wavelength on Escherichia coli"

1663. THERIOT, F. P. (1953) Unpublished summary of the "Conference on the Biological Effects of Microwaves" held at the Naval Medical Research Institute, Bethesda, Md., 29 April

1664. THOMAS, J. A., & THOMSON, J. D. (1961) Federation Proceedings 20(1):401-, (Also, Dissertations Abstr. 22(5):1696 (1961)) "The effect of microwave irradiation on spermatogenesis and on accessory sex organs in the male Albino rat"

1665. THOMPSON, R. L. (1970) Presented at 4th Annual Midyear Topical Symposium, Health Physics Soc., Electronic Product Radiation and the Health Physicist, Louisville, Ky., 28-30 Jan., Bureau of Radiation Health, Div. of Electronic Products Rept. No. 70-26, pp. 463-464, "Microwave hazards surveillance and control"

1666. THOMPSON, W. D., & BOURGEOIS, A. E. (1965) Primate Behavior Lab., Aeromedical Research Lab. Report, (Wright-Patterson AFB, Ohio), (ARL-TR-65-20; AD 489245;/ 77 pages, "Effects of microwave exposure on behavior and related phenomena" [i.e., physiological processes] & N67-11057)

1667. THOMSON, P. (1910) Proceedings, Royal Soc. (London) 82:396-, "A physiological effect of an alternating magnetic field"

1668. THOMSON, R. A. E., MICHAELSON, S. M., & HOWLAND, J. W. (1960) Federation Proceedings 19(1):71-, "Leucocyte changes in normal dogs exposed to microwaves"

1669. THOMSON, R. A. E., MICHAELSON, S. M., & HOWLAND, J. W. (1963) Report, 10 pages, (RADC-TDR-63-352, AD 424411), "Microwave modification of x-ray lethality in mice"

1670. THOMSON, R. A. E., MICHAELSON, S. M., & HOWLAND, J. W. (1965) Radiation Research 24:631-635, "Modification of x-irradiation lethality in mice by microwaves (Radar)"

1671. THOMSON, R. A. E., MICHAELSON, S. M., & HOWLAND, J. W. (1966) Blood 28(2):157-162, "Leukocyte response following simultaneous ionizing and microwave (Radar) irradiation"

1672. THOMSON, R. A. E., MICHAELSON, S. M., & HOWLAND, J. W. (1967) Aerospace Medicine 38(3):252-255, "Microwave radiation and its effect on response to x-radiation"

1673. THORPE, H. (1952) Trans. of the American Academy of Ophthalmology 56:596-599, "Microwave diathermy in ophthalmology. The various diathermy currents used in ophthalmology"

1674. TIAGIN, N. V. (1958) Biulleten Eksperimental'noi Biologii i Meditsiny (Moskva) 46(8):963-966, "The thermal effects of UHF electromagnetic fields" (A duplicate of TYAGIN (1958) #1718)

1675. TIKHONOVA, M. A. (1948) Problems of Experimental Physiotherapy, Collection, Tashkent, pp. 113-119, "The problem of the action of an electromagnetic (UHF) field on the growth of young animals"

1676. TITEL, J. M., & EL-ETR, A. A. (1968) Anesthesiology 29:845-846, "Fibrillation resulting from pacemaker electrodes and electrocautery during surgery"

1677. TKACHENKO, YE. G., & PALALKA, Y. S. (1965) Trans. of Science Conf., Central Science Lab. Tomsk, pp. 338-341, "Changes in the reactivity of leukocytes in the peripheral blood of Albino mice simultaneously vaccinated against anthrax under the action of an alternating electromagnetic field"

1678. TKAN, V. K., & PRIKHOZHII, I. I. (1953) Inst. Biofiz. Akad. Nauk SSSR Sci. Session Celebrating Achievements of Soviet Biophysics in Agriculture, pp. 61-, "Peculiarities of the kinetics of electrical properties of the blood under the action of UHF, infrared rays, and high frequency fields on the organism"

1679. TOLGSKAYA, M. S. (1957) Biulleten Eksperimental'noi Biologii i Meditsiny (Moskva) 43(1):104-107, "Changes in the synaptic formations during intoxication with occupational poisons"

1680. TOLGSKAYA, M. S. (1959) Voprosy Kurortologii Fizioterapii i Lechebnoy Fizicheskoy Kul'tury (Problems in Health Resort Sci., Physiotherapy, & Medical Physical Culture) _(1):21-24, (Abstr. in: Biological Effects of Microwaves: Compilation of Abstracts, Sept. 1965, pp. 28-29; ATD-P-65-68), "Morphological changes in animals exposed to 10 cm microwaves"

1681. TOLGSKAYA, M. S., & FUKALOVA, P. P. (1968) Gigiena Truda i Professional'nye Zabolevaniya (Moskva) _(9):37-40, "Morphological changes in experimental animals under the action of electromagnetic fields in the HF and VHF ranges"

1682. TOLGSKAYA, M. S., & GORDON, Z. V. (1959) In: Summaries of reports. Labor Hygiene and the Biological Effect of Radio Frequency Electromagnetic Waves. Moscow, pp. 55-, [Title not given]

1683. TOLGSKAYA, M. S., & GORDON, Z. V. (1960) Trudy Nii Gigiyena Truda i Profzaboleaniya AMN SSSR _(1):99-103, (In Russian); (In: The Biological Action of UHF, Letavet, A. A., & Gordon, Z. V., (eds.), Moscow, Academy of Medical Sciences USSR, 1960, pp. 104-108 (OTS 62-19175-R; JPRS 12471); (Abstr. in: The Biological Effects of Electromagnetic Fields - Annotated Bibliography, 1965); (Also, Abstr. in: Biological Effects of Microwaves: Compilation of Abstracts, Effect of UHF on receptor and interoceptor mechanisms", Sept. 1965, pp. 37-38; ATD-P-65-68), "Changes in the receptor and interoceptor apparatus under the influence of SHF-UHF radiation"

1684. TOLGSKAYA, M. S., & GORDON, Z. V. (1964) Trudy Nii Gigiyena Truda i Profzaboleaniy AMN SSR _(2):80-88, (Biological Effects of Radio Frequency Electromagnetic Fields, Inst. of Industrial Hygiene & Occupational Diseases, Acad. of Med. Sciences, Moscow), "Comparative morphological characteristics of the effect of microwaves of various wavelengths"

1685. TOLGSKAYA, M. S., GORDON, Z. V., & LOBANOVA, YE. A. (1957) In: Summaries of reports. Part 2. Jubilee Scientific Session of the Institute of Labor Hygiene & Occupational Diseases Dedicated to the 40th Anniv. of the Great October Socialistic Revolution, Moscow, [Title not given]

1686. TOLGSKAYA, M. S., GORDON, Z. V., & LOBANOVA, YE. A. (1959) Voprosy Kurortologii Fizioterapii i Lechebnoy Fizicheskoy Kul'tur y (Problems in Health Resort Sci., Physiotherapy, & Medical Physical Culture) _(1):21-24, (Abstr. in: Biological Effects of Microwaves: Compilation of Abstracts (1965), ATD-P-65-68), "Morphological changes in experimental animals under the action of ten centimeter electromagnetic waves"

1687. TOLGSKAYA, M. S., GORDON, Z. V., & LOBANOVA, YE. A. (1960) In: Physical Factors of the Environment, Letavet, A. A. (ed.) [Title not given]

1688. TOLGSKAYA, M. S., GORDON, Z. V., & LOBANOVA, YE. A. (1960) Trudy Nii Gigiyena Truda i Profzaboleaniya AMN SSSR _(1):90-98, (In Russian); (Abstr. in: The Biological Action of UHF, Letavet, A. A., & Gordon, Z. V., (eds.), Moscow: Academy of Medical Sciences USSR (1960), pp. 94-103; OTS 62-19175; JPRS 12471); (Also abstr. in: Biological Effects of Microwaves: Compilation of Abstracts, "Effect of pulsed and nonpulsed UHF on the organism", Sept. 1965, pp. 34-37; ATD-P-65-68), "Morphological changes in experimental animals under the influence of pulsed and continuous wave SHF-UHF radiation"

1689. TOLGSKAYA, M. S., & NIKONOVA, K. V. (1964) Trudy Nii Gigiyena Truda i Profzaboleaniya AMN SSSR _(2):89-93, "Histologic changes in the organs of white rats under continuous exposure to MF-LF electromagnetic fields"

1690. TOLGSKAYA, M. S., et al (1957) Tezisy Dokladov Yubileynoy Sessii Institut Gig. Tr. Prof. Zabol. _(2):73-74, "Morphological changes in animals exposed to SHF and UHF fields"

1691. TOLLES, W. E., & HORVATH, W. J. (1956) Trans. of Institute of Radio Engineers on Medical Electronics, PGME-4:13-15, (See also Erratum in Trans. of Inst. of Radio Engineers PGME-7:pp? 1956)); (Presented at Symposium on Physiologic and Pathologic Effects of Microwaves, Krusen, F. H., (Chm.), Mayo Clinic, 23-24 Sept., 1955), "Energy densities of microwave radiating systems"

1692. TOMBERG, V. T. (1934) Abstracts of the 1st Internat. Congress on Electro-Radio-Biology, (Cappelli, L., ed.) Bologna, Italy, pp. 445-451, (In German with English summary) "The specific biological effects of short wavelength electrical energy"

1693. TOMBERG, V. T. (1959) Digest of Technical Papers, Proc. 12th Annual Conf. on Electrical Techniques in Medicine and Biology, (Schwan, H. P., Chm.), pp. 58-59, "Bionegative actions of microwaves"

1694. TOMBERG, V. T. (1960) Proc. 2nd Internat. Conf. on Medical Electronics, Paris, (1959), Chas. C. Thomas (Publisher), Springfield, Ill., pp. 401-407, "Ultrasonic effects compared with microwave biological effects"

1695. TOMBERG, V. T. (1960) In: Institute of Radio Engineers Internat. Convention Record, Part 9: Instrumentation, Medical Electronics and Nuclear Science Session, "Varied Views of Medical Electronics", pp. 94-97, "Biological microwave hazards"

1696. TOMBERG, V. T. (1960) Proc. 4th Tri-service Conf. on the Biological Effects of Microwave Radiation, Vol. 1, (Peyton, A. F., ed.) pp. 221-228, "Specific thermal effects of high frequency fields"

1697. TOMBERG, V. T. (1961) Digest of Internat. Conf. on Medical Electronics, Biological Effects of Microwaves, 1 (Athermal Aspects) (Frommer, P. L., ed.) Plenum Press, New York, p. 231-, "Specific electrical effects of radiowaves and their biomedical importance"

1698. TONKIKH, A. V. (1940) In: Questions on the Use of Short Waves and Ultrashort Waves in Medicine, Moscow, "The effect of HF/VHF electromagnetic fields on basal metabolism"

1699. TONKIKH, A. V. (1941) Sborn. Physiol. Vegat. Nerv. System, Leningrad, 13, (Abstr. in: The Biological Effects of Electromagnetic Fields - Annotated Bibliography, ATD P-65-17, 1965), "Influence of UHF electromagnetic fields on basal metabolism"

1700. TOROPTSEV, I. V., & GARGANEYEV, G. P. (1962) In: Materials of the All Union Sci. Conf., Exp. Kurortology and Physiol. Moscow, "Some morphological changes in experimental animals subject to exposures of alternating electromagnetic fields of industrial importance"

1701. TOSHEV, G., NINOV, V., & TOMOV, V. (1964) Voprosy Kurortologii Fizioterapii i Lechebnoy Fizicheskoy Kul'tury (Problems in Health Resort Sci., Physiotherapy, & Medical Physical Culture) 29(2):154-155, (JPRS 25121, pp. 17-19 (1964); OTS-64-31500), "Experience in the treatment of puerperal mastitis with decimeter waves"

1702. TRESKUNOVA, A. S., & SLIZSKIY, G. N. (1962) In: Summaries of reports. Questions of the Biological Effect of a SHF-UHF Electromagnetic Field. Kirov Order of Lenin Military Medical Academy, Leningrad, pp. 53-54, "Data on the dispensary service offered to individuals exposed in their work to microwave fields"

1703. TRIFONOV, YU. A., & UTINA, I. A. (1966) Biofizika 11(4):646-652, (Biophysics 11:740-748 (1966), (in English)), "Investigation of the mechanism of action of current on the L type cells of the retina"

1704. TROYANSKIY, N. P., KRUGLIKOV, R. I., KORNILOV, R. N., PETROVA-GOLUVENKO, L. B., & KALASHNIKOVA, Z. S. (1967) Voyenno-Meditsinskiy Zh. USSR (Military Med. Jour.), _(7):30-35, (Abstr. in Soviet Radiobiology, 68-105-108-9, ATD Press, (June 1968), p. 87 only), "Some results of an investigation of the state of health of specialists working with SHF-UHF generators"

1705. TSOU, H., et al. (1962) National Medical Journal of China _(7-12):531-533, "Observations on the clinical effectiveness of microwave therapy"

1706. TUMARKINA, L. N., & DUBROVSKIY, ? (1966) Biofizika 11(4):653-658 (Biophysics 11:750-756 (1966), (in English), "Certain aspects of the perception by man of amplitude-modulated signals"

1707. TURLYGIN, S. YA. (1937) Comptes Rendus (Doklady) de l'Acad. des Sci. de l'USSS, 17(1):19-22, (in English), (Abstr. in: ATD Rept. P-65-68, Sept. 1965, Biological Effects of Microwaves, pp. 1-2, "Effect of centimeter waves on the human central nervous system"); (Also, Abstr. in: The Biological Effects of Electromagnetic Fields - Annotated Bibliography, ATD Rept. P-65-17, 1965), "Effect of electromagnetic centimeter waves on the central nervous system"

1708. TURLYGIN, S. YA. (1942) Biulleten Eksperimental'noi Biologii i Meditsiny (Moskva) _(4):63-, "Irradiation of the human organism with 2-cm microwaves"

1709. TURNER, J. J. (1962) Based on a translation of The Biological Action of Ultrahigh Frequencies, Letavet, A. A., & Gordon, Z. V., Moscow (1960); U. S. Army Materiel Command, ZEUS Liaison Office, Bell Telephone Labs., Whippany, N. J., 16 July, 64 pages, (AD 278172), "The effects of radar on the human body (results of Russian studies on the subject)"

1710. TURNER, J. J. (1962) Rept. No. EM-TR-[illegible]-1 (AD 273787), U. S. Army Ordnance Missile Command, (Bell Telephone Labs.), 21 Mar., 89 pages, "The effects of radar on the human body" **(Based on a transl. of citation #879, this Bibliography)**

1711. TURRILL, W. J. (1935) Arch. of Physical Therapy 16:278-281, "Short wave therapy"

1712. TUTTLE, W. W., & JANNEY, C. D. (1948) Arch. of Physical Med. 29:416-421, "The construction, calibration, and use of thermocouples for measuring body temperature"

1713. TUVL, H. A., & WHITMAN, W. G. (1930) "Unpublished super-high frequency data"

1714. TYAGIN, N. V. (1957) Trudy Voyenno-Meditsinskaya Akademiya i Kirov (Leningrad) USSR, 73:9-19, (Abstr. in: The Biological Effects of Electromagnetic Fields - Annotated Bibliography, ATD Rept P-65-17, Apr. 1965), "Study of the thermal effect of SHF-UHF electromagnetic fields on various animals using the thermometric method"

1715. TYAGIN, N. V. (1957) Trudy Voyenno-Meditsinskaya Akademiya i Kirov (Leningrad) USSR, 73:84-101, "Electrocardiogram changes in dogs affected by SHF-UHF electromagnetic fields"

1716. TYAGIN, N. V. (1957) Trudy Voyenno-Meditsinskaya Akademiya i Kirov (Leningrad) USSR, 73:116-126, (Abstr. from Zh. Biol. No. 59923 (1959)), "Changes in the blood of animals subjected to a SHF-UHF field"

1717. TYAGIN, N. V. (1957) In: Summaries of reports. Part 2, Jubilee Scientific Session of the Institute of Labor Hygiene & Occupational Diseases Dedicated to the 40th Anniv. of the Great October Socialistic Revolution, Moscow, [Title not given] **963-966 (57-),**

1718. TYAGIN, N. V. (1958) Biulleten Eksperimental'noi Biologii i Meditsiny (Moskva) 46(8):/ "The thermal action of a SHF electromagnetic field"

1719. TYAGIN, N. V. (1959) In: Summaries of reports. Labor Hygiene and the Biological Effect of Radio Frequency Electromagnetic Waves, Moscow, "Some problems of occupational hazard caused by microwave electromagnetic fields"

1720. TYAGIN, N. V. (1960) Voyenno Med. Zh., (USSR Military Med. J.), _(9):14 only, [Title not given]

1721. TYAGIN, N. V. (1962) In: Summaries of reports. Questions of the Biological Effect of a SHF-UHF Electromagnetic Field. Kirov Order of Lenin Military Medical Academy, Leningrad, pp. 54-55, "The syndrome of the chronic effect of a microwave field" **(A67-80162)**

1722. TYAGIN, N. V., & USPENSKAYA, N. V. (1966) Zh. Nervnopatologii i Psikhiatrii i Korsakova 66(8):1132-1136/ "Functional changes in the nervous system and some other systems of the organism under chronic exposure to SHF-UHF radiation"

See also TYAGIN

1723. UIC, M., & SVACINA, J. (1966) Ceskoslovenska Neurologie 29(6):402-406, "EEG shifts in personnel working around centimeter wave sources"

1724. ULRICH, L., & FEPIN, J. (1959) Pracovni Lekarstvi, Prague, 11:500-503, (In Czech.) "The effect of working in high-power transmitting stations upon certain functions of the organism"

1725. USPENSKAYA, N. V. (1959) In: Works of the Scientific Session Devoted to Results of Work in 1957 by the Inst. of Industrial Hygiene and Occupational Diseases, Leningrad, pp. [illegible]-67, "Clinical aspects of the continuous action of SHF/UHF currents"

1726. USPENSKAYA, N. V. (1959) In: Summaries of reports. Labor Hygiene and the Biological Effect of Radio Frequency Electromagnetic Waves, Moscow, p. 23 only, [Title not given]

1727. USPENSKAYA, N. V. (1961) In: Materials of the Scientific Session Concerned with the Results of Work Conducted by the Leningrad Institute of Industrial Hygiene & Occupational Diseases for 1959-1960, Leningrad, pp. 116-117, "Results of the observation of workers exposed to electromagnetic waves in the centimeter range"