



Mark Dean
Attorney

March 16, 2012

Amanda O. Noonan
Director, Consumer Affairs
New Hampshire Public Utilities Commission
21 S. Fruit Street
Concord, NH 03301-24229

RE: Nelson v. NHEC

Dear Amanda:

Enclosed you will find documents concerning the “smart meter” litigation in Grafton County Superior Court.

Please note that the provision of these materials is not intended as, nor should it be construed as constituting, a consent pursuant to RSA 301:60.

If you have any questions concerning this matter please do not hesitate to contact me.

Sincerely,



Mark W. Dean

13 Samuel Drive
Concord, New Hampshire 03301
(603) 230-9955 • (603) 494-1032 (cell) • (603) 230-9669 (fax)
mdean@mdeanlaw.net



Mark Dean
Attorney

February 22, 2012

Grafton County Superior Court
David P. Carlson, Clerk
3785 Dartmouth College Highway
North Haverhill, NH 03774

Re: Erik R. Nelson, et al vs.
New Hampshire Electric Cooperative, Inc.
Docket No. 215-2012-CV-46

Dear Mr. Carlson:

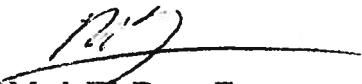
Enclosed for filing in the above-captioned matter please find the following:

- 1) My Appearance on behalf of New Hampshire Electric Cooperative, Inc. ("NHEC"),
- 2) NHEC's Demurrer, with accompanying Memorandum of Law,
- 3) NHEC's Objection to Request for Injunction, with accompanying Memorandum of Law, and
- 4) The Affidavit of Dena DeLuca, which is provided in support of these filings.

Please note that this matter is currently scheduled for a hearing regarding Plaintiffs' request for a temporary injunction on February 23, 2012.

Please contact me with any questions concerning these filings.

Very truly yours,


Mark W. Dean, Esq.

13 Samuel Drive
Concord, New Hampshire 03301
(603) 230-9955 • (603) 494-1032 (cell) • (603) 230-9669 (fax)
mdean@mdeanlaw.net

THE STATE OF NEW HAMPSHIRE

GRAFTON, SS.

SUPERIOR COURT

Docket No. 215-2012-CV-00046

Erik R. Nelson, et al

v.

New Hampshire Electric Cooperative, Inc.

APPEARANCE

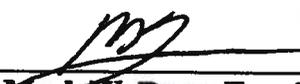
To the Clerk of the GRAFTON COUNTY SUPERIOR COURT:

In the above action, please enter my Appearance as counsel for

New Hampshire Electric Cooperative, Inc.

Mailing Address: 579 Tenney Mountain Highway
Plymouth, NH 03264

MARK DEAN, PLLC

BY: 

Mark W. Dean, Esquire (NH Bar No.609)

13 Samuel Drive
Concord, NH 03301
Tel: 603.230.9955

Duplicate appearance cards hand-delivered and/or mailed to:

Charles Carpenter, 594 Hundred Acre Woods Road, Bristol, NH,
Herb Blish, 586 Hundred Acre Woods Road, Bristol, NH,
Daniel Arseneau, 495 Hundred Acre Woods Road, Bristol, NH,
Erik R. Nelson, 445 Hundred Acre Woods Road, Bristol, NH,
Daniel Rivanis, 366 Hundred Acre Woods Road, Bristol, NH,
Joan Wirth, 348 Hundred Acre Woods Road, Bristol, NH,
Kenneth Rossi, 303 Hundred Acre Woods Road, Bristol, NH, and
John Elkins, 570 Hundred Acre Woods Road, Bristol, NH.

DATED: 2/22/12

STATE OF NEW HAMPSHIRE

GRAFTON, SS

SUPERIOR COURT

Case No. 215-2012-CV-00046

Erik R. Nelson, et al

v.

New Hampshire Electric Cooperative, Inc.

DEMURRER OF NEW HAMPSHIRE ELECTRIC COOPERATIVE, INC.

NOW COMES New Hampshire Electric Cooperative, Inc. ("NHEC") by and through its attorney, Mark Dean, PLLC, and pursuant to New Hampshire Superior Court Rule 134 respectfully states that the plaintiffs are not entitled upon their petition to the relief prayed for. In support of this demurrer NHEC states the following:

Factual Background

1. NHEC is a not-for-profit rural electric cooperative organized and operating under New Hampshire law. NHEC provides electric utility distribution service to approximately 80,000 members located within its franchise service territory spread throughout New Hampshire.
2. The Plaintiffs are eight NHEC members and receive electric service from NHEC at their residences on Hundred Acre Woods Road in Bristol, New Hampshire.
3. NHEC provides electric service to its members by purchasing electricity at wholesale in a New England-wide wholesale marketplace.
4. NHEC's wholesale electricity purchases are received at various wholesale delivery points and are distributed throughout NHEC's service territory through a system of electric distribution lines, substations, transformers, service drops and other electric utility facilities ("NHEC's Distribution System").

5. NHEC's members are connected to NHEC's Distribution System through electric meters mounted in metal socket boxes, generally attached to the outside of members' homes or businesses. These meters serve both as the "plugs" which connect the Distribution System to the members' premises and as means for measuring how much electricity NHEC delivers to the consumers' premises.

6. These electric meters are integral parts of NHEC's Distribution System and are owned by NHEC.

7. The terms and conditions under which NHEC provides electric service to its members require that NHEC and its agents be allowed access to NHEC's equipment located on members' premises for a variety of purposes, including the reading, testing, repairing, removal or replacement of electric meters. As a condition of service, when necessary, members provide NHEC with easements which permit NHEC to access members' properties in order to perform these functions.

8. Electric utility meters operate much like an automobile odometer. They continuously measure, in kilowatt hours ("kWh"), the cumulative amount of electricity which has passed through the meter. Historically, NHEC's electric meters have operated on an analogue basis, with the familiar rotating disk indicating the rate of electricity flow and its rotations recording the cumulative total which has been delivered to the premises.

9. Periodically (generally and approximately once a month), an NHEC employee or agent visits each meter and visually notes the then-current cumulative total kWh recorded by the meter. The current meter reading is then compared to the most recent previous reading in order to determine the total monthly kWh delivered.

10. Over the past several decades, as new technologies became available, gas, water and electric utilities, like most other businesses, have adopted digital technology for collecting, processing and storing business information, including the amount of utility commodities delivered to consumers' premises. Many utilities have long ago switched to digital meters. Others, like NHEC, have continued to rely primarily upon old analogue meters for the initial measurement of usage. These meters must still be visually inspected at periodic in-person meter-reading visits, but the analogue information is now entered into hand-held digital recording devices at the meter location and these hand-held devices transmit the now-digital meter readings to the utility via the internet or other communications systems.

11. Over the past decade, various federal, state and industry initiatives have recognized the desirability of further automating utility meter services in order to improve utility efficiencies, system reliability, outage response time and to provide consumers with more sophisticated usage information and tools to help manage their resource consumption and utility bills.

12. As a result of these initiatives and developing technologies, a number of New Hampshire water, gas and electric utilities have deployed automated meters which operate digitally and which will eliminate the need for in-person meter reading visits by automatically transmitting meter readings to the utilities via periodic wireless or wired transmissions.

13. Over the past ten years, NHEC has been engaged in the process of evaluating, planning, and now implementing a major upgrade of its communications, systems management, and metering infrastructure. NHEC refers to this effort as the Communications Systems Infrastructure and Advanced Metering Infrastructure Plan ("CSI/AMI Project").

14. During this same time, a number of major policy initiatives, including the Energy Independence and Security Act of 2007 and the American Recovery and Reinvestment Act of 2009, have encouraged utilities to deploy new technologies which are intended to make utility systems increasingly clean, efficient, reliable and safe, while offering the potential for lower overall consumer costs. These initiatives and related technologies are often referred to as the “Smart Grid.” Utility systems upgrades of the type which NHEC has been developing as part of its CSI/AMI Project are considered essential to these Smart Grid initiatives.

15. In 2010, NHEC received a grant from the United States Department of Energy (“DOE”) pursuant to the American Recovery and Reinvestment Act of 2009, in the amount of \$15.9 million. The DOE grant covers approximately 45% of the projected \$35 million cost of NHEC’s CSI/AMI Project, all to the benefit of NHEC’s membership.

16. Under the terms of NHEC’s DOE grant, the funded systems must be installed and grant funds expended by March, 2013 at the latest. Delays in the installation and implementation process risk higher deployment expenses and loss of DOE funding, all to the detriment of NHEC’s membership.

17. An essential component of NHEC’s CSI/AMI Project is the replacement of all old analogue electric meters with meters which record electric usage in a digital format and are capable of periodically transmitting meter reading information back to NHEC by means of short-range wireless transmissions. These low-power, short-range transmissions are relayed from one meter to the next until they reach NHEC’s backbone communication system. Once on NHEC’s backbone communication system, the meter readings are communicated back to NHEC’s headquarters via wireless and/or fiber optic transmissions.

18. NHEC's new advanced wireless meters are the so-called "Smart Meters" which are the subject of the Plaintiffs' petition.

19. To date, NHEC has installed and is currently operating approximately 36,000 of these new meters. Approximately 44,000 old meters remain to be replaced.

Smart Meters

20. It is important to recognize that "smart meter" is a generic term which is both widely and loosely applied to a wide variety of advanced meters which may share some common characteristics, but which also vary substantially, from one meter type to the next, in their function, design, properties and capabilities. In short, not all "smart meters" are the same.

21. Despite the wide array of devices which might fall under the "smart meter" umbrella, there are certain characteristics common to most "smart meters" which help to define that term and which serve to generally divide all "smart meters" into one of two distinct groups.

22. Although based upon differing technologies, most devices commonly referred to as "smart meters" have the ability to record electric usage in a digital format. They are capable of reading the total cumulative energy delivered without the necessity of an in-person visit to the meter site, and at intervals not limited to the traditional monthly basis. These meters can communicate their meter readings to the utility via wired or wireless transmissions or some combination thereof. These meters can also automatically alert the utility in the case of power outages. Meters which share this basic set of capabilities could be characterized as "basic" smart meters.

23. There is a second broad subset of smart meters which share a substantial set of additional capabilities. These "advanced" smart meters contain a second, separate communications device which is capable of communicating (generally through wireless

transmitter/receivers which are sometimes referred to as “smart meter gateway devices”) with devices located within consumers’ premises and which allow the smart meter to record and/or control electric usage associated with these “smart meter-enabled” devices. These smart meter-enabled devices have their own transmitter/receivers and may be separate plug-in controllers or may be built into appliances or other electric consumer devices. Under either scenario, communications with devices inside consumers’ premises can only be accomplished when both an “advanced” smart meter and smart meter-enabled consumer devices are present.

NHEC’s “Smart Meter”

24. The specific meter type which NHEC is currently deploying throughout its service territory, and which is the subject of Plaintiffs’ petition, is an Elster REX meter (“the REX Meter”). The REX Meter is a “basic” smart meter. It is capable of recording the cumulative total of energy which passes through the meter, on a kWh basis, in a digital format. It is programmed to read the total cumulative energy delivered on an hourly basis. It is programmed to transmit its meter readings approximately ten times per day. These readings are wirelessly transmitted back to NHEC through its network of REX Meters and NHEC’s backbone communication infrastructure. NHEC’s REX Meters are not “advanced” smart meters. They do not contain a second transmitter/receiver, smart meter gateway device, or any other device which would allow them to communicate with, monitor, or control any smart meter-enabled devices which members may have within their premises.

Radio Frequency

25. NHEC’s REX Meter transmits its meter readings via a ¼ watt transmitter which operates within the 900MHz area band, which is approximately the same frequency range utilized by many cell phones. At ¼ watt, NHEC’s REX Meter signal strength is less than half

that of a typical cell phone. Unlike a cell phone, NHEC's REX Meter's signal need not be strong enough to reach distant cell towers. The REX Meter's signal need only reach its nearest REX Meter neighbor so that its meter reading can be transmitted by hops through the chain or "mesh" of REX Meters back to NHEC's communications system. Unlike a cell phone and many other common household radio transmitters (cordless phones, baby monitors, wireless computer networks, etc.), NHEC's REX Meters are generally installed on the exterior of members' premises. NHEC's REX Meters are also installed in metal socket boxes which have the effect of redirecting the transmitter's already weak signal away from the premises. Unlike a cell phone or other common household transmitters, the transmissions from NHEC's REX Meters are of short duration (on average 0.025 to 1.5 seconds) and are programmed to occur only 10 times per day.

26. The Federal Communications Commission ("FCC") regulates the safety of all devices which emit radio energy. The FCC has established maximum permissible exposure ("MPE") standards for all radio devices and has determined that all devices which meet those standards are safe. In order to meet the FCC's requirements, all radio devices must be incapable of exceeding the FCC's MPE requirements under "worst case" testing conditions, which presume continuous transmission at maximum signal strength and measured at slightly less than 2 feet from, and directly in front of, the transmitter face.

27. The transmitters in NHEC's REX Meters are FCC approved and test substantially below the FCC limits, even in the required "worst case" testing conditions.

28. The manufacturer of NHEC's REX Meters has indicated that there is no possible scenario in which its FCC approved transmitter, as deployed in a REX Meter, can transmit at the power and for the continuous durations incorporated in the FCC's "worst case" standards. Accordingly, in real world operation, the power of the REX Meter's transmission is in the order

of 1/100 of the FCC limits. Likewise, the FCC has recently noted that when smart meters like the REX Meter are installed and operated in the same manner as described in paragraph 25 above, “the actual exposures are typically thousands of times less than this ‘worst case’ measurement condition.”

Plaintiffs’ Refusal to Allow Meter Change

29. Recently, the NHEC meters located at the premises of NHEC members on Hundred Acre Woods Road in Bristol, New Hampshire were scheduled to be replaced with NHEC’s REX Meters as part of the ongoing implementation of NHEC’s CSI/AMI Project. Some of these members objected to the planned meter change and requested that they be allowed to “opt-out” of the CSI/AMI Project’s implementation, citing health and privacy risks which they perceived to be associated with “smart meters.”

30. NHEC attempted to dispel the expressed concerns, which appeared not to be based upon the specific facts relating to NHEC’s REX Meter deployment, but rather appeared to be based primarily upon generalized information and opinions generically concerning “smart meters” posted on various websites.

31. NHEC also informed the objecting members that the effective and reliable operation of NHEC’s Distribution System, as upgraded according to the CSI/AMI Project, required that all meters be changed, and that “opt-outs” would undermine the functionality of all meters by creating gaps in the “mesh” network which would prevent meters located at other members’ premises from properly functioning.

32. NHEC reiterated that the REX Meters meet all applicable FCC requirements and that all of NHEC’s meters, both old and new, are NHEC property, which NHEC needs to, and

may, install, maintain, repair and replace as it deems appropriate for the operation of its Distribution System.

33. Plaintiffs filed their Ex Parte Petition (“the Petition”).

The Petition Must Be Dismissed As It Fails To Allege A Legal Basis For The Relief Requested.

34. The Petition fails to allege that NHEC’s proposed replacement of its existing utility meters with REX Meters is contrary to any federal, state or local law, or that it violates any contractual obligations owed to Plaintiffs by NHEC, or that it runs counter to any recognized common law right. Indeed, the Petition’s requested relief is that NHEC be enjoined from further installation of “smart meters” until such time as this court conducts some form of quasi-legislative hearing to “thoroughly review the hazards and concerns of NHEC’s customers regarding the installation of smart meters on their homes, to consider unknown consequences of using this technology, and to consider an “op-out” option for NHEC’s customers.” The Petition simply fails to assert or support any cognizable legal basis for the extraordinary equitable relief it requests. The Petition must be dismissed.

The Petition Must Be Dismissed Because The Relief Sought Is Preempted By FCC Regulation.

35. The essence of The Petition is the claim that, although NHEC’s REX Meters comply with the relevant FCC safety standards, those standards are not adequate. Federal law charges the FCC with the regulation of wireless communications devices, including the adoption and enforcement of appropriate technical standards for such devices to insure the safety of workers and the public. On its face, The Petition acknowledges that NHEC’s REX Meters

comply with the FCC's standards. It is clearly-established law that the FCC's RF regulations preempt state-law actions which seek to second guess the FCC's expert regulatory assessment that wireless communications devices which conform to its standards are safe. Accordingly, the Petition must be dismissed.

WHEREFORE, for the reasons set forth herein and for those set forth in NHEC's Memorandum of Law in Support of NHEC's Demurrer, NHEC respectfully requests the following relief:

- a. That the court dismiss the Petition, with prejudice; and,
- b. That the court grant such further and other relief as the law and equity require.

Respectfully submitted,

NEW HAMPSHIRE ELECTRIC
COOPERATIVE, INC.

By its attorney,

MARK DEAN, PLLC

Date: 2/22/12

By:


Mark W. Dean, Esquire (NH Bar No. 609)
13 Samuel Drive
Concord, NH 03301
230-9955

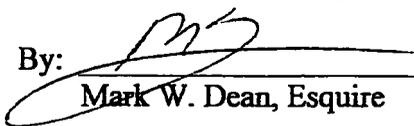
CERTIFICATE OF SERVICE

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Date: 2/22/12

By:


Mark W. Dean, Esquire

STATE OF NEW HAMPSHIRE

GRAFTON, SS

SUPERIOR COURT

Case No. 215-2012-CV-00046

Erik R. Nelson, et al

v.

New Hampshire Electric Cooperative, Inc.

MEMORANDUM OF LAW IN SUPPORT OF THE DEMURRER OF NEW HAMPSHIRE ELECTRIC COOPERATIVE, INC.

NOW COMES New Hampshire Electric Cooperative, Inc. ("NHEC") by and through its attorney, Mark Dean, PLLC, and respectfully states the following in support of its Demurrer:

1. The Petition must be dismissed as it fails to allege a legal basis for the relief requested.

A petition seeking temporary or permanent injunctive relief is a call upon the court to exercise, "one of the peculiar and extraordinary powers of equity." Johnson v. Shaw, 101 N.H. 182, 188 (1957). Although the availability of injunctive relief is a matter within the sound discretion of the court, that discretion must be exercised, "on a consideration of all the circumstances of each case and controlled by established principles of equity." Timberlane Regional School Dist. v. Timberlane Regional Ed. Ass'n, 114 N.H. 245, 250 (1974). See also, Varney v. Fletcher, 106 N.H. 464, 467-468 (1965). Neither the circumstances alleged in Plaintiffs' Ex Parte Petition ("the Petition") nor the principles of equity clearly established under New Hampshire law provide any basis for the court to grant the extraordinary injunctive relief requested.

The Petition generally alleges that NHEC is in the process of replacing its electric utility meters with new so-called “smart meters” and that, despite the fact that there are “FCC ‘safety’ standards **which these meters comply with,**” (Pet., emphasis added), NHEC should be enjoined from further meter installations until the court conducts a public hearing to review Plaintiffs’ concerns about the “unknown consequences of using this technology.” (Pet.) Although the Petition presents a laundry list of the Plaintiffs’ perceived concerns relative to radio frequency (“RF”) transmissions generally, the alleged inadequacies Federal Communications Commission (“FCC”) regulation and a distrust of devices falling within a generic category of “smart meters,” the Petition is most notable for what it so clearly does not allege.

The Petition makes no allegations concerning the specific meters which NHEC is actually in the process of installing.

The Petition does not, and cannot, allege that NHEC’s work, which it seeks to enjoin, violates or threatens to violate any federal, state, or local statute, regulation or ordinance.

The Petition does not, and cannot, allege that NHEC’s work, which it seeks to enjoin, violates or threatens to violate any contractual obligations between NHEC and the Plaintiffs.

The Petition does not, and cannot, allege that NHEC’s work, which it seeks to enjoin, violates or threatens to violate any property right.

The Petition does not, and cannot, allege that NHEC’s work, which it seeks to enjoin, violates or threatens to violate any established common law right.

The Petition does not, and cannot, allege that Plaintiffs’ have no adequate remedy at law.

The Petition does not, and cannot, allege that Plaintiffs will suffer irreparable harm.

While the Petition does make reference to the Plaintiffs' "civil rights to safety and privacy in our homes" and the "spirit of 'free choice'" (Pet.), it contains no allegation as to how NHEC's otherwise lawful acts could somehow be transformed into civil rights violations.

In short, the Petition fails to allege a single element of the established principles of equity which might justify the extraordinary relief it requests.

It has long been settled that injunctive relief is an extraordinary remedy which is only warranted by "imminent danger of great and irreparable damage," Johnson v. Shaw, 101 N.H. 182, 188-189 (1957), and where the plaintiff has no remedy at law. Timberlane Regional School Dist. v. Timberlane Regional Ed. Ass'n, 114 N.H. 245, 250 (1974). The Petition alleges none of these essential claims nor any equitable principles. Accordingly, the Petition must be dismissed.

2. The Petition must be dismissed because it is barred by the doctrine of preemption.

As the Petition correctly avers, devices which are capable of wireless transmissions, like the meters which NHEC is installing, are subject to safety standards issued and enforced by the FCC. Farina v. Nokia, 625 F.3d 97, 106-107 (3rd Cir. 2010). The FCC has regulated human exposure to RF emissions since 1985. See, In Re Responsibility of the F.C.C. to Consider Biological Effects of Radiofrequency Radiation, 100 F.C.C. 2d 543, 544 (1985).

After receiving input from other federal agencies, including the Food and Drug Administration, the Environmental Protection Agency, the Occupational Safety and Health Administration, the National Institute for Occupational Safety and Health, the National Telecommunications and Information Administration, and the Department of Defense, the

FCC adopted as its own standard the then-current American National Standards Institute Committee (“ANSI”) standard governing RF emissions. Farina, at 106.

Following the enactment of the Telecommunications Act of 1996 (“TCA”), the FCC adopted new RF standards based upon a hybrid of the ANSI standards and those of the National Council on Radiation Protection and Measurements (“NCRP”). These FCC standards reflect the “consensus view of the federal agencies responsible for matters relating to public safety and health.” Farina, at 107. While relying upon this consensus view, the FCC recognizes that issues concerning RF radiation safety will continue to be the subject of ongoing research and has pledged to monitor the science, “in order to ensure that our guidelines continue to be appropriate and scientifically valid.” Farina, at 107 (quoting, 11 F.C.C.R. at 15125 (1996)).

In Farina, the United States Court of Appeals for the Third Circuit affirmed the dismissal of a plaintiff’s suit which, under a variety of legal theories, claimed that cell phones used without headsets (which would allow usage further from the speakers head) were unsafe. *Id.* at 104. The Farina court held that FCC regulation of RF emissions standards for wireless devices preempted any state law suit the essence of which was to challenge the safety of such devices based upon their, “emission of RF radiation - despite the fact that their emission levels were in compliance with FCC standards.” *Id.* at 122. Summing up its exhaustive preemption analysis, the Farina court concluded:

Accordingly, we conclude that Farina's claims are preempted by the FCC's RF regulations. The inexorable effect of allowing suits like Farina's to continue is to permit juries to second-guess the FCC's balance of its competing objectives. The FCC is in a better position to monitor and assess the science behind RF radiation than juries in individual cases. Regulatory assessments and rulemaking call upon a myriad of empirical and scientific data and medical and scientific opinion, especially in a case, such as RF radiation, where the science remains inconclusive.

....

... Allowing juries to determine instead whether those regulations are adequate to protect the public would “stand[] as an obstacle to the accomplishment and execution of the full purposes and objectives of Congress.” Hillsborough Cnty., 471 U.S. at 713 (internal quotation marks omitted).

Id. at 133-134.

The Farina decision is in full accord with that of Cellular Phone Taskforce AT v. FCC and USA, 205 F.3d 82 (2nd Cir. 2000). Cellular Phone Taskforce, was a direct appeal of the FCC’s rulemaking decisions which established the FCC guidelines and standards for RF emitting devices. The Cellular Phone Taskforce, appellants challenged the FCC RF safety standards using many of the same claims which are now hinted at in the Petition, including the assertion that the FCC standards somehow overlook or exclude the “non-thermal” health effects of RF. *Id.* at 90-92. The court squarely rejected appellants’ claims, including those concerning “non-thermal effects.”

In promulgating their standards, both the ANSI and the NCRP considered non-thermal effects. The ANSI found that “no reliable scientific data exist indicating that [n]onthermal exposure may be meaningfully related to human health” and concluded that its exposure standard “should be safe for all.” The NCRP found that the existence of non-thermal effects “is clouded by a host of conflicting reports and opinions.” In the face of conflicting evidence at the frontiers of science, courts’ deference to expert determinations should be at its greatest. See, Baltimore Gas & Elec. Co. v. Natural Resources Defense Council, Inc., 462 U.S. 87, 103 (1983). All of the expert agencies consulted were aware of the FCC’s reliance on the ANSI and NCRP standards. Each had been advised of such evidence of non-thermal health effects as may have existed and still found the FCC’s approach to be satisfactory.

Under those circumstances it was reasonable for the FCC to continue to rely on the ANSI and NCRP standards absent new evidence indicating that the fundamental scientific understanding underlying the ANSI and NCRP standards was no longer valid. At most, the newly submitted evidence established that the existence of non-thermal effects is “controversial,” and that room for disagreement exists among experts in the field. After examining the evidence, the FCC was justified in continuing to rely on the ANSI and NCRP standards.

Id. at 90.

The Cellular Phone Taskforce, court likewise reaffirmed the preemptive authority of the FCC

RF safety standards:

As noted earlier, while the rulemaking process was underway, Congress passed the Telecommunications Act of 1996, providing, inter alia, that

No State or local government or instrumentality thereof may regulate the placement, construction, and modification of personal wireless service facilities on the basis of the environmental effects of radio frequency emissions to the extent that such facilities comply with the Commission's regulations concerning such emissions.

47 U.S.C. § 332(c)(7)(B)(iv).

The FCC, as part of its rulemaking, issued a comparable interpretive ruling preempting state and local governments from regulating, based on RF emissions, the operation of personal wireless service facilities that are in compliance with the FCC regulations concerning such emissions.

...
The FCC's interpretation is therefore entitled to deference and, because the FCC's interpretation is reasonable, we are bound to accept it.

Id. at 95-96. Thus, both the adequacy and preemptive authority of the FCC RF safety standards have been uniformly reaffirmed by the federal courts.

Consistent with long-standing supremacy clause precedent, New Hampshire recognizes the preemptive authority of federal law. Appeal of A & J Beverage Distribution, Inc., 2010-527 (N.H.S.C., Slip Opinion, January 27, 2012); Koor v. City of Lebanon, 148 N.H. 618 (2002). Indeed, New Hampshire has expressly acknowledged the preemptive power of FCC regulations in the telecommunications field. Koor, at 625.

Thus, because the Petition does not, and cannot, allege that the electric meters which NHEC is currently installing do not meet FCC RF safety standards, the Petition must be dismissed as it is preempted by federal statute and FCC regulations which preclude state law actions challenging the safety of RF emitting devices which meet FCC standards.

WHEREFORE, for the reasons set forth herein and for those set forth in NHEC's Demurrer, NHEC respectfully requests the following relief:

- a. That the court dismiss the Petition, with prejudice; and,
- b. That the court grant such further and other reliefs as the law and equity require.

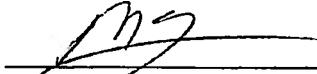
Respectfully submitted,

NEW HAMPSHIRE ELECTRIC
COOPERATIVE, INC.

By its attorney,

MARK DEAN, PLLC

Date: 2/22/12

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STATE OF NEW HAMPSHIRE

GRAFTON, SS

SUPERIOR COURT

Case No. 215-2012-CV-00046

Erik R. Nelson, et al

v.

New Hampshire Electric Cooperative, Inc.

**NEW HAMPSHIRE ELECTRIC COOPERATIVE, INC.'S
OBJECTION TO REQUEST FOR TEMPORARY INJUNCTION**

NOW COMES New Hampshire Electric Cooperative, Inc. ("NHEC") by and through its attorney, Mark Dean, PLLC, and respectfully objects to the granting of a temporary/preliminary injunction. NHEC states the following:

1. The Petition fails to state a claim upon which equitable relief may be granted.
2. The Petition is preempted under controlling federal statutes and regulations and the Supremacy Clause of the United States Constitution.
3. The Petition does not allege, and Plaintiffs cannot establish, that there exists any imminent danger of irreparable harm.
4. The Petition does not allege, and Plaintiffs cannot establish, that there is no adequate remedy at law.
5. The Plaintiffs cannot establish that they are likely to prevail on the merits.
6. An injunction would impose undue, and irreparable, hardship on NHEC, its membership and the public.
7. When all circumstances of the case are considered it would be inequitable to impose an injunction.

8. Pursuant to Superior Court Rule 161(c), any injunctive relief should be conditioned upon Plaintiffs' posting of an injunction bond in an amount adequate to compensate NHEC for such costs and damages as it may incur or suffer if it is found to have been wrongfully enjoined.

WHEREFORE, NHEC respectfully requests the following relief:

- a. That the court not issue any form of injunction relating to NHEC; and,
- b. That the court grant such further and other relief as the law and equity require.

Respectfully submitted,

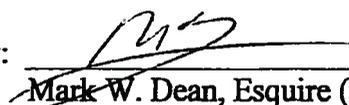
NEW HAMPSHIRE ELECTRIC
COOPERATIVE, INC.

By its attorney,

MARK DEAN, PLLC

Date: 2/22/12

By:

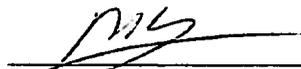

Mark W. Dean, Esquire (NH Bar No. 609)
13 Samuel Drive
Concord, NH 03301
230-9955

CERTIFICATE OF SERVICE

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and/or first-class mail to:

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John Elkins, 570 Hundred Acre Woods Road, Bristol, NH.

Date: 2/22/12

By: 
Mark W. Dean, Esquire

STATE OF NEW HAMPSHIRE

GRAFTON, SS

SUPERIOR COURT

Case No. 215-2012-CV-00046

Erik R. Nelson, et al

v.

New Hampshire Electric Cooperative, Inc.

**NEW HAMPSHIRE COOPERATIVE, INC.'S MEMORANDUM OF LAW IN
OPPOSITION TO PLAINTIFFS'
REQUEST FOR TEMPORARY INJUNCTION**

NOW COMES New Hampshire Electric Cooperative, Inc. ("NHEC") by and through its attorney, Mark Dean, PLLC, and states the following in opposition the issuance of a temporary/preliminary injunction:

Plaintiffs Have Not Met the Standard for Issuance of Temporary/Preliminary Injunctions.

Requests for preliminary or temporary injunctions hinge upon the application of a four-part test. Plaintiffs have the burden of proof to satisfy that: 1) the Plaintiffs are likely to succeed on the merits; 2) the Plaintiffs will suffer irreparable harm if the injunction is not granted; 3) any threatened injury to the Plaintiffs outweighs any harm which granting the injunction would cause to NHEC; and 4) the public interest will not be adversely affected by the granting of the injunction. See, Air Line Pilots Ass'n. v. Guilford Transportation, 399 F.3d 89 (1st Cir. 2005). In the instant case, Plaintiffs cannot satisfy their burden as to any one of the four prerequisites to injunctive relief.

1) Plaintiffs are not likely to succeed on the merits.

As is evident from NHEC's arguments in its Demurrer and its Memorandum of Law in support thereof, Plaintiffs' Petition is fatally flawed. Without repeating NHEC's Demurrer arguments here, but incorporating those arguments herein by reference, it is self-evident that a

Petition which fails to allege any cognizable legal claim which would entitle Plaintiffs to the relief requested, and which is barred by the preemptive authority of federal statute and regulation, is singularly unlikely to succeed on the merits. The facial deficiencies of Plaintiffs' Petition require that any request for a temporary/preliminary injunction be denied.

2) The Plaintiffs are not in imminent danger of irreparable damage.

As highlighted in NHEC's Demurrer, Plaintiffs have not alleged a threat of imminent irreparable harm. While this omission is itself dispositive of Plaintiffs' request for injunctive relief, a closer look at the underlying nature of the "concerns" listed in the Petition shows that the Plaintiffs simply cannot meet their burden of proving an imminent threat of irreparable damage. See, Johnson v. Shaw, 101 NH 182, 188-189 (1957). Setting aside for a moment their questionable factual basis, the Plaintiffs' concerns with "smart meters", as expressed in the Petition, stem not from claims that these new meters pose an immediate and identifiable health or privacy threat. Rather, they involve claims that there are uncertainties, "unknown consequences," "there are no conclusive studies," and that it would be "prudent" to follow "precautionary principles" in using the technology, or that personal usage information, "may at some point" be collected and be subject hacking. (Pet.).

While NHEC disputes the validating and reasonableness of Plaintiffs' stated concerns, the court need not judge their accuracy or rationality to determine that they simply do not support a claim of imminent and irreparable injury. Irreparable harm is "a substantial injury that is not accurately measurable or adequately compensable by money damages." Adams v. Stanley, 237 F.Supp.2d 136, 146 (D.N.H 2003). See also, Ross-Simons of Warwick, Inc. v. Baccarat, Inc., 102 F.3d 12, 18-19 (1st Cir. 1996). "To establish irreparable harm there must be an actual,

viable, presently existing threat of serious harm." Adams, at 146. Plaintiffs' "concerns" do not approach, much less cross, the necessary threshold of imminent irreparable harm.

In this vein, it worthy of note that the Petition does not allege that anyone has ever been injured, or that any home or business has ever been damaged, or that any private consumer information has ever been disclosed as a result of NHEC's actions or the operations of the specific meters which NHEC is installing. Whatever the basis of Plaintiffs' concerns, they do not rise to the level of "imminent irreparable" injury. Johnson, at 188-189.

3. Plaintiffs' "concerns" are outweighed by the harm which an injunction would inflict on NHEC.

Balanced against the theoretical risks alleged by the Plaintiffs is the certain injury which NHEC and its membership will suffer if NHEC is enjoined from the orderly and timely completion of its CSI/AMI Project. Project implementation delays, by definition, deprive NHEC and its membership of timely realization of the intended benefits of the long-planned for systems improvements. As detailed in NHEC's Demurrer and the Affidavit of Dena DeLucca, NHEC is in the midst of a \$35 Million systems upgrade which involves the coordination of multiple contractors, subcontractors and many NHEC personnel. (DeLucca, Para. 7). Any delay in this work threatens to disrupt its orderly and timely completion and imposes additional costs on NHEC. (DeLucca, Para. 7). The potential costs to NHEC extend into the millions of dollars. (DeLucca, Para. 7-9). Delays occasioned by an injunction threaten the substantial DOE grant which allows NHEC to implement its CSI/AMI Project at almost half the cost to NHEC members than would otherwise be possible. (Demurrer, Para. 15-17, DeLucca, Para. 7-8). Given the magnitude of NHEC's estimated risk of injunction-caused damages (DeLucca, Para. 6-9), it would appear unlikely that an adequate injunction bond will be readily available from

Plaintiffs. In the absence of an adequate injunction bond, NHEC's injury is likely to be irreparable.

"Hardship upon the defendant may be sufficient ground for withholding specific relief."

John v. Shaw, 101 N.H. 182, 189 (1957).

4. Granting an injunction would be counter to the public interest.

The Plaintiffs' fourth burden to overcome in their request for a temporary/preliminary injunction is to show that the granting of an injunction will not adversely affect the public interest. Air Line Pilots Ass'n. v. Guilford Transportation, 399 F.3d 89 (1st Cir. 2005).

Plaintiffs cannot meet this burden because the timely and cost effective completion of NHEC's CSI/AMI Project is in the public interest. Deployment of new utility metering systems, such as NHEC's CSI/AMI Project, which promote cleaner, more efficient, more reliable, and safer electric distribution infrastructure has been adopted as national public policy. (Demurrer, Para. 11-14, DeLucca, Para. 4). Indeed, NHEC's activities, which Plaintiffs seek to enjoin, are in furtherance of the Energy Independence and Security Act of 2007 and are funded to a significant degree by virtue of the American Recovery and Reinvestment Act of 2009. (Demurrer, Para. 14-15, DeLucca, Para. 4).

It cannot be that, when all the circumstances of this particular case are taken into account, the disruption of NHEC's DOE grant-funded CSI/AMI Project, the implementation of which is in full compliance with federal, state and local laws, serves the public interest.

Plaintiffs fail on every part of the four-point standard for injunctive relief.

Any Injunction Should be Conditioned Upon an Adequate Injunction Bond.

Superior Court Rules 161(c) and 163 require that, unless good cause is shown, “no restraining order or preliminary injunction shall issues except upon the giving of an injunction bond by the applicant.” The purpose of an injunction bond is to protect the party who may be wrongfully enjoined by ensuring that there is a mechanism by which the enjoined party may recover from the applicants any costs and damages caused to it by a wrongful injunction.

Merrimack Valley Wood Products v. Near, 152 N.H. 192, 204 (2005). In setting the amount of any injunction bond it is essential that the court require an amount to safely cover any reasonable estimate of costs and damages because the bond will generally serve as cap on both the applicant’s liability and the enjoined party’s right to recovery, even if the actual costs and damages suffered exceed the bond amount. *Id.*

As detailed in the Affidavit of Dena DeLucca which accompanied this filing, NHEC’s estimated damages (excluding costs) from any injunction range from the tens of thousands of dollars to approximately \$18 million. (DeLucca, Para. 6-9). Any injunction should be conditioned upon Plaintiffs’ posting of an injunction bond adequate to safely cover NHEC’s estimated damages and costs, as such may be impacted by the scope, length and other parameters of any injunction.

WHEREFORE, for the reasons set forth herein and those set forth in NHEC’s Objection, NHEC respectfully requests the court take the following action:

- a. That the court deny Plaintiffs’ request for a temporary/preliminary injunction;
- b. That the court condition any injunction upon the posting of an adequate injunction bond; and,

c. That the court grant such other relief as the law and equity require.

Respectfully submitted,

NEW HAMPSHIRE ELECTRIC
COOPERATIVE, INC.

By its attorney,

MARK DEAN, PLLC

Date: 2/22/12

By: 

Mark W. Dean, Esquire (Bar No. 609)
13 Samuel Drive
Concord, NH 03301
230-9955

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Date: 2/22/12

By: 

Mark W. Dean, Esquire

STATE OF NEW HAMPSHIRE

GRAFTON, SS.

SUPERIOR COURT

Docket No. 215-2012-CV-00046

Erik R. Nelson, et al

v.

New Hampshire Electric Cooperative, Inc.

AFFIDAVIT OF DENA DELUCCA

I, Dena DeLucca of 579 Tenney Mountain Highway, Plymouth NH in the County of Grafton, New Hampshire, being duly sworn, do hereby depose and state as follows:

1. I am employed by New Hampshire Electric Cooperative, Inc. ("NHEC") as Vice President of Corporate & Member Services and as Chief Financial Officer.
2. In the course of my employment at NHEC I have been closely involved on a first-hand basis in the development and implementation of NHEC's Communications System Infrastructure and Advanced Metering Infrastructure Plan ("CSI/AMI Project").
3. The CSI/AMI Project involves a number of separate, but interdependent, system improvements. It involves numerous contracts for equipment, construction, equipment installation, software and IT services, etc. The CSI/AMI Project has a projected budget of approximately \$35 million.
4. As a result of my duties relating to the CSI/AMI Project, I am familiar with the overall design and implementation of that project and I am familiar with many of its details. While the scope and technical requirements of such a comprehensive system improvement program makes it impossible for me to have expert knowledge concerning each of its details, from my first-hand knowledge and that supplemented by others

working on the project, I can attest to truth and accuracy of all the statements made in this affidavit and in other filings made by NHEC in this case which may make reference to this affidavit.

5. I have assisted in the preparation of and am familiar with the factual statements made by NHEC in its Demurrer filed in this case and dated February 21, 2012. I attest that, to my best knowledge and belief, each of those statements is true and accurate.

6. I have been asked by counsel to calculate the costs and damages which NHEC may incur if it were to be enjoined from the continued implementation of its CSI/AMI Project to the extent that that implementation involves the installation of new REX Meters in replacement of NHEC's existing analog meters, and it is later determined that NHEC was wrongfully enjoined or restrained. While such a calculation involves a number of significant variables, most notably the scope and length of an injunction, it is possible to make reasonable projections of those costs and damages.

7. NHEC has contracts with third party vendors for the purchase and installation of approximately 80,000 REX Meters and for purchase and installation of a wide variety of other equipment and facilities which are necessary to support and integrate the new meters within NHEC's delivery system and business operations. The deployment of these new meters involves multiple contractors and many NHEC personnel whose efforts must be sequentially coordinated. Because of these important timing requirements and the need to meet project completion deadlines imposed as conditions of the \$15.9 million DOE grant which substantially reduces the member-funded cost of this project, NHEC's vendor contracts are largely "time is of the essence" agreements which impose tight performance deadlines. These deadlines, in turn, have required vendors to make firm

commitments concerning the availability and performance of their employees and subcontractors. Consequently, any injunction which disrupts the current implementation schedule would have significant "ripple effect" impacts on the overall schedule and could increase costs to NHEC. Such delays might also cause contractors to reallocate their personnel and subcontractors so that those resources would not necessarily be available on a timely basis once work was permitted to be resumed. If the length of an injunction, or the "ripple effect" delays caused by an injunction, prevented NHEC from completing its project within DOE grant deadlines NHEC would incur substantial damages as a result of lost DOE funding.

8. Taking all of the above factors into consideration, I estimate that NHEC is likely to incur costs and suffer damages in the amount of \$1.8 million for each month its meter deployment is enjoined, without taking into account the potential for non-compliance with DOE grant deadline. I believe an injunction lasting more than 30 days would begin to threaten full compliance with the DOE grant deadline. If an injunction caused non-compliance with DOE grant deadline NHEC would suffer additional damages ranging from \$10 million to \$17.8 million. I calculate NHEC's reasonable risk of exposure to costs and damages from a wrongfully issued injunction of its overall REX Meter installation activities to be \$17.8 million. These figures do not include any estimate for legal costs associated with any injunction.

9. ^{REMOVED AS PER D.W.} If NHEC were enjoined only from installation of its REX Meters at the premises ^{of the Plaintiffs it is difficult to} calculate the full costs and damages given the unknowns at this time. It is unclear if the removal of these meters, for any period of time, from the overall installation would render other nearby meters as inoperable (unable to

communicate meter reads). Assuming that any inoperability of nearby meters could be adequately solved with the installation of a limited amount of additional equipment and other system reconfigurations and also recognizing that additional operations costs would vary over time as NHEC's new systems are deployed, I conservatively estimate that NHEC would likely incur initial one-time damages in the amount of \$25,000 and recurring damages of approximately \$2,220 for each month its deployment of these specific meters is enjoined. This figure does not include any estimate for legal costs associated with any injunction.

Dated this 22nd day of February, 2012.

Dena DeLucca
Dena DeLucca

STATE OF NEW HAMPSHIRE
COUNTY OF Grafton

Sworn to and subscribed before me this 22 day of February, 2012.

Angela M. Berger
Notary Public/Justice of the Peace
My Commission Expires:

ANGELA M. BORGER
NOTARY PUBLIC
State of New Hampshire
My Commission Expires
October 26, 2016

Preamble

Ex Parte Petition

New Hampshire Electric Co-op, Inc. is changing the electric meter system to "Smart Meters". Smart Meters operate with high frequency microwave radiation. These devices along with their infrastructures, increase the level of radiation in our homes, neighborhoods, and environment. There has not been sufficient testing on these devices. The FCC "safety" standards that these meters comply with are irrelevant to the meter emissions, and were not designed to protect the public from health problems under the circumstances in which the meters are being used. The FCC standards are strictly for thermal effects of radiation and exclude non-thermal effects. Because the Smart Meter system is a mesh network, it is impossible to predict individual levels of exposure with any consistency or certainty. The Smart Meter program creates a pervasive electromagnetic field, and there are no conclusive studies yet published indicating that the levels of EMF emitted collectively in a community are safe. Smart meters emit microwave frequency radiation throughout the day and night. Thousands of scientific studies have strong evidence that chronic RF/MF radiation from such devices cause numerous health effects, and children are affected faster. Our detailed data of personal electric usage habits may at some point be collected and tracked continuously; this is intrusive. Our information is vulnerable to security problems and to being hacked. Smart Meters are not UL certified for safety and have caused house fires on numerous homes. These concerns are a breach of our civil rights to safety and privacy in our homes. Electric customers do not wish to pay for a meter that they will not own and do not want. The meters we presently have work just fine. The FCC lacks safety standards for chronic long term exposure to high frequency micro waves. It would be prudent, and it should be a first priority, to comply with those precautionary principles expressed about smart meter emissions by global scientists, environmental agencies, and doctors.

In light of the foregoing, and in the spirit of "free choice", we the undersigned NHEC customers hereby Petition the Grafton County Superior Court of New Hampshire to:

1. Issue an immediate injunction against New Hampshire Electric Co-Op, Inc., (NHEC), requiring NHEC employees, contractors, and or any subcontractors engaged in the installation of "Smart Meters", be ordered to "cease and desist" any further such installations of "smart meters" until a public court hearing may be scheduled.
2. Schedule a public court hearing to thoroughly review the hazards and concerns of NHEC's customers regarding the installation of smart meters on their homes, to consider unknown consequences of using this technology, and to consider an "opt-out" option for NHEC's customers.

Name	Address	Signature
Charles Carpenter	594 Hundred Acre Woods Rd. Bristol, NH	
Herb Blish	586 Hundred Acre Woods Rd. Bristol, NH	<i>Herb Blish - Matthew Blish</i>
Daniel Arseneau	495 Hundred Acre Woods Rd. Bristol, NH	<i>Daniel Arseneau</i>
Erik R. Nelson	445 Hundred Acre Woods Rd. Bristol, NH	<i>Erik R. Nelson</i>
Daniel Rivanis	366 Hundred Acre Woods Rd. Bristol, NH	<i>Daniel Rivanis</i>
Joan Wirth	348 Hundred Acre Woods Rd. Bristol, NH	<i>Joan E. Wirth</i>
Kenneth Rossi	303 Hundred Acre Woods Rd. Bristol, NH	
John Elkins 570	570 Hundred Acre Woods Rd. Bristol, NH	

There is a growing concern in the industry, especially on the part of energy consumers, over the potential health impact of smart meter radio communications. This paper is to assist Elster's EnergyAxis users in understanding matters related to radio frequency (RF) safety with regard to the EnergyAxis mesh local area network (LAN) radio used in EnergyAxis smart meter endpoints, specifically REX2™ and A3 ALPHA³ meters.

The use of RF in consumer facing products has increased considerably over the past decade, and continues to increase. Prominent examples of this are the prolific use of cellular phones, wireless routers, and even microwave ovens.

A lack of education on smart metering technology has led to rising public concern over their use and associated health risks. Although smart meters utilize RF technology, they represent significantly lower RF exposure for consumers than nearly all other products, such as cellular phones, that are used daily without concern.

The bottom line is that smart meters represent no known health hazard and have, as noted above, significantly lower exposure levels than most other typical devices that emit radio waves. Two additional contributing factors to the negligible RF exposure from EnergyAxis smart meters are:

- the distance consumers are typically from smart meters and the minimal amount of time smart meter radios are actually transmitting
- the EnergyAxis smart meter radio achieves equivalent performance with a much lower power than most other smart meter designs. This is an intentional characteristic of the Elster design to avoid potential equipment interference and to lower the technical losses on utility distribution grids, while also lowering RF emissions.



For example, a typical EnergyAxis *smart meter transmits (that is, emits power) with an approximate duty cycle of only 1%. In addition, these meters are typically placed outdoors, with a wall and a metal socket separating the meter from the living space thereby attenuating the signal from the occupants of the living space.*

All electronic devices have some RF emissions. The measure of the strength of these signals is called the power density, which is the amount of RF power (measured in milliwatts) hitting a particular surface area (measured in square centimeters). The power density of a signal can be calculated using the output power level (for example 0.25 watts), and the distance from the transmitter. Higher power density numbers equate to stronger signals, a closer proximity to the signal, or a combination of these two factors.

Power density is calculated using the following formula:

$$\text{Power density} = \text{TxPwr} \times \text{AntGain} \div (4 \times \pi \times \text{Distance}^2) \text{ mW/cm}^2$$

Where:

- TxPwr = The radio frequency power input to the antenna in milliwatts
- AntGain = The power gain of the antenna (unitless)
- π = Constant: Pi (3.14)
- Distance = Distance from the transmitter, in cm

EnergyAxis LAN radios operate in the 900 MHz ISM band using FHSS (Frequency Hopping Spread Spectrum) and have a maximum transmit power (TxPwr) of 250 mW. The radiation pattern of a device depends on the antenna and on surrounding objects. When installed in an electrical socket, the energy radiated backwards through the socket into the home would be significantly reduced due to the metal socket. The metal socket reduces the energy transmitted into the residence but redirects the energy out the front of the meter. As measured as part of the FCC certification process, the maximum antenna gain for a meter in a metal socket was 5.64 dBi, which equates to a gain of 3.66. For calculation purposes, a distance of 2 feet (61 cm) will be used, but typically the distance between an electricity meter and a person would be significantly greater than 2 feet.

The numbers in the previous paragraph can be used to calculate a *worst case theoretical* power density for an EnergyAxis smart meter:

$$\text{Power density} = 250 \times 3.66 \div (4 \times \pi \times (61\text{F})^2) = 0.02 \text{ mW/cm}^2$$

More typical numbers, especially for someone in the residence of the meter in question, would be an antenna gain of 0.5 and a distance of more than 10 feet. Using these numbers, a more realistic power density value would be:

$$\text{Power density} = 250 \times 0.5 \div (4 \times \pi \times (305\text{F})^2) = 0.0001 \text{ mW/cm}^2$$

It is helpful to compare this typical power density of a smart electricity meter to other types of devices that are commonly found in a residence:

	Transmitter power*	Antenna gain	Typical distance	Power density	Typical exposure times
Cellular phone	600 mW	1	1 cm	48 mW/cm ²	Continuously when in use
Cordless phone (handset)	20 mW	1	1 cm	1.6 mW/cm ²	Continuously when in use
EnergyAxis meters (close proximity)	250 mW	1	61 cm (2 ft)	0.02 mW/cm ²	1.5 seconds every 4 hours
WiFi access point or NIC	100 mW	1	30.5 cm (1 ft)	0.008 mW/cm ²	Nearly continuously when in use
EnergyAxis meters (typical proximity)	250 mW	0.5	305 cm (10 ft)	0.0001 mW/cm ²	1.5 seconds every 4 hours

*May be higher depending on the specific device

A substantial number of studies have been performed by various organizations to evaluate the impact of RF emissions on the human body. Taking input from these studies, the FCC set exposure limits that “incorporate prudent margins of safety” (according to the [1]).

Devices which emit radio energy must be certified by the FCC to meet maximum permissible exposure (MPE) requirements, as specified in FCC 1.1310. The limits specified by the FCC vary based on frequency and the power density limits are specified as an average value over a 6 minute time period. The power density limit for the 915 MHz band is 0.6 mW/cm². The FCC validates a device using a calculation distance of 20 cm.

In the MPE report submitted to the FCC for the communications device used on the REX2 meter, the transmitter power was measured as 232 mW, with an antenna gain of 3.66 and at a distance of 20 cm. This results in a calculated power density of 0.169 mW/cm² which is 0.431 mW/cm² below the limit. It is important to note these calculations assumed the device was transmitting 100% of the time during the 6 minute averaging period, whereas there is no possible scenario existing where an EnergyAxis device can transmit at a 100% duty cycle for even a short period of time, let alone for six minutes.

As highlighted above, raw power density calculations do not take into account how often a device is transmitting. The consumer electronic devices listed above are transmitting nearly continuously when they are in use. In comparison, an electricity meter typically transmits very infrequently. A typical EnergyAxis smart meter has a transmit duty cycle of less than 1%. The average power density would therefore be 1/100 of the maximum calculated power density.

In summary, EnergyAxis smart meters:

- Pose no known health risks to humans through RF emissions
- Are proven to have lower RF emissions than other readily accepted consumer devices in use today
- Comply with all applicable FCC exposure limits by a wide margin
- Emit much lower RF energy than most competing smart meters, many of which use radios with 1W or 2W of transmit power

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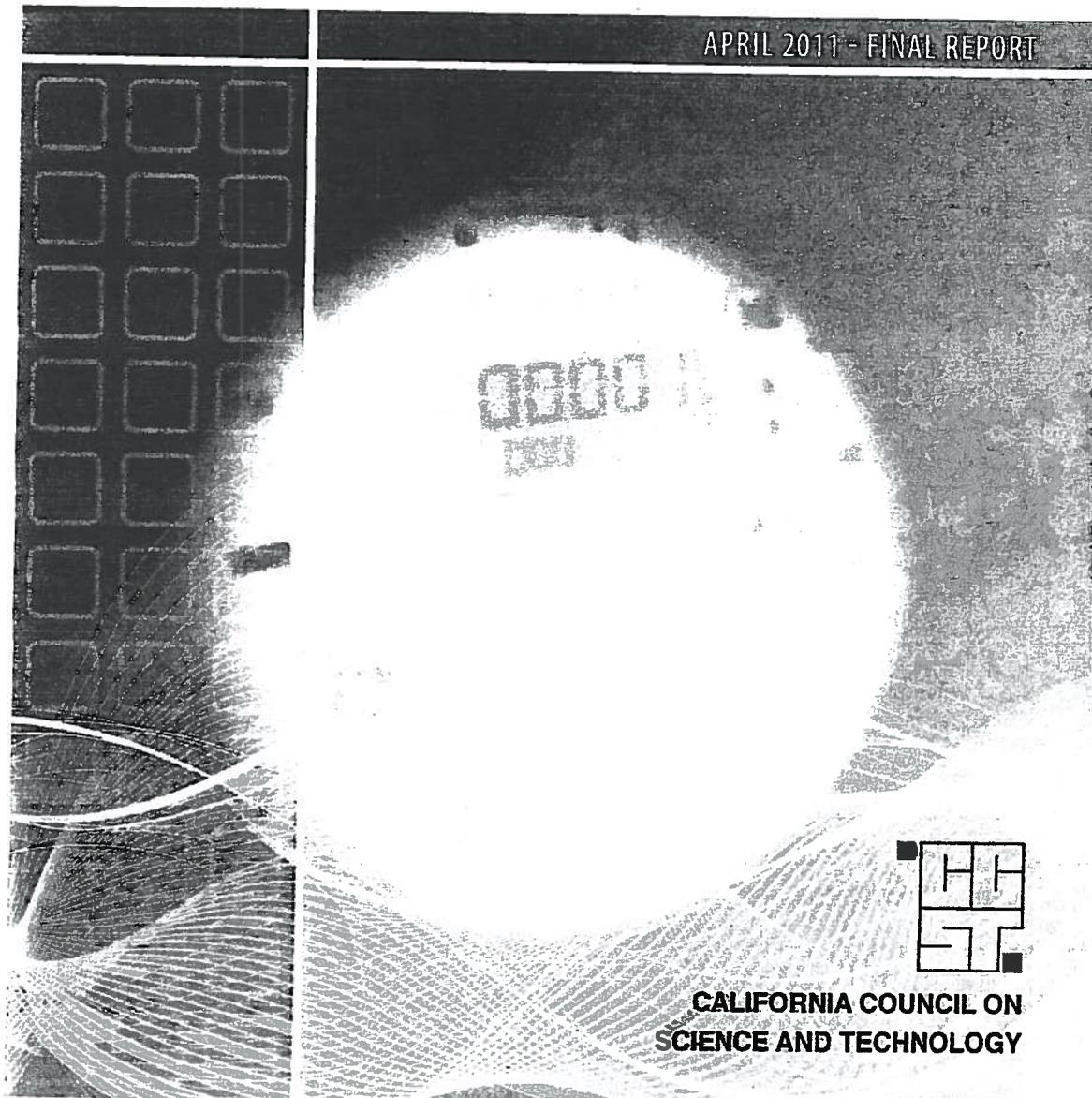
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HEALTH
IMPACTS OF

FROM

SUMMARY EXCERPTS



Full report available at:

<http://www.ccst.us/publications/2011/2011smart-final.pdf>

ACKNOWLEDGMENTS

We would like to thank the many people who provided input and feedback towards the completion of this report. Without the insightful feedback that these individuals generously provided, this report could not have been completed. We would like to give special thanks to the California Smart Grid Center, College of Engineering and Computer Science at the California State University, Sacramento and to the University of California's Center for Information Technology Research in the Interest of Society (CITRIS).

This report was conducted with the oversight of a CCST Smart Meter Project Team, whose members include: Rollin Richmond (Chair), Emir Macari, Patrick Mantey, Paul Wright, Ryan McCarthy, Jane Long, David Winickoff, and Larry Papay. We also thank J.D. Stack for his technical contributions and Lora Lee Martin for the overall coordination of this report response. We express gratitude to CCST's members and colleagues for their many contributions to the report. Comments on the January 2011 draft of this report were solicited from the public. Many very thoughtful and informed comments were received. All public comments were reviewed and taken into consideration as this final report was completed.

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CCST is a non-profit organization established in 1988 at the request of the California State Government and sponsored by the major public and private postsecondary institutions of California and affiliate federal laboratories in conjunction with leading private-sector firms. CCST's mission is to improve science and technology policy and application in California by proposing programs, conducting analyses, and recommending public policies and initiatives that will maintain California's technological leadership and a vigorous economy.

Note: The California Council on Science and Technology (CCST) has made every reasonable effort to assure the accuracy of the information in this publication. However, the contents of this publication are subject to changes, omissions, and errors, and CCST does not accept responsibility for any inaccuracies that may occur.

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Letter from CCST

With rapidly emerging and evolving technologies, lawmakers at times find themselves pressed to make policy decisions on complex technologies. Smart meters are one such technology.

Smart meters are being deployed in many places in the world in an effort to create a new generation of utility service based on the concepts of a smart grid, one that is agile, efficient and cost effective.

The electricity crisis of 2000 and 2001 helped force the issue here in California, lending significant urgency to the need for better management of power generation and distribution. In 2006, the California Public Utilities Commission authorized the Pacific Gas and Electric Company to implement a relatively new technology, smart meters, to gather much more precise information about power usage throughout the state. The process of installing the meters throughout the state is still underway.

As with any new technology, there are unknowns involved. Smart meters generally work by transmitting information wirelessly. Some people have expressed concerns about the health effects of wireless signals, particularly as they become virtually ubiquitous. These concerns have recently been brought to the attention of state legislators, with some local municipalities opting to ban further installation of the meters in their communities.

We are pleased that Assembly Members Huffman and Monning have turned to CCST for input on this issue. It is CCST's charge to offer independent expert advice to the state government and to recommend solutions to science and technology-related policy issues. In this case, we have assembled a succinct but comprehensive overview of what is known about human exposure to wireless signals and the efficacy of the FCC safety standards for these signals. To do so, we assembled a project team that consulted with over two dozen experts and sifted through over a hundred articles and reports, providing a thorough, unbiased overview in a relatively rapid manner.

In situations where public sentiment urges policy makers to make policy decisions with potentially long-term consequences, access to the best information possible is critical. This is the role that CCST was created to fulfill.



Susan Hackwood
Executive Director, CCST

Rollin Richmond
Project Team Chair, CCST

**Health Impacts of Radio Frequency from Smart Meters
Response to Assembly Members Huffman and Monning**

California Council on Science and Technology
April 2011

KEY REPORT FINDINGS

1. Wireless smart meters, when installed and properly maintained, result in much smaller levels of radio frequency (RF) exposure than many existing common household electronic devices, particularly cell phones and microwave ovens.
2. The current FCC standard provides an adequate factor of safety against *known thermally* induced health impacts of existing common household electronic devices and smart meters.
3. To date, scientific studies have not identified or confirmed negative health effects from *potential non-thermal* impacts of RF emissions such as those produced by existing common household electronic devices and smart meters.
4. Not enough is currently known about potential non-thermal impacts of radio frequency emissions to identify or recommend additional standards for such impacts

OTHER CONSIDERATIONS

Smart electricity meters are a key enabling technology for a "smart grid" that is expected to become increasingly clean, efficient, reliable, and safe at a potentially lower cost to the consumer. The CCST Smart Meter Project Team offers the following for further consideration by policy makers, regulators and the utilities. We appreciate that each of these considerations would likely require a cost/benefit analysis. However, we feel they should be considered as the overall cumulative exposure to RF emissions in our environment continues to expand.

1. As wireless technologies of all types increase in usage, it will be important to: (a) continue to quantitatively assess the levels of RF emissions from common household devices and smart meters to which the public may be exposed; and (b) continue to investigate potential thermal and non-thermal impacts of such RF emissions on human health.
2. Consumers should be provided with clearly understood information about the radiofrequency emissions of all devices that emit RF including smart meters. Such information should include intensity of output, duration and frequency of output, and, in the cases of the smart meter, pattern of sending and receiving transmissions to and from all sources.
3. The California Public Utilities Commission should consider doing an independent review of the deployment of smart meters to determine if they are installed and operating consistent with the information provided to the consumer.
4. Consideration could be given to alternative smart meter configurations (such as wired) in those cases where wireless meters continue to be concern to consumers.

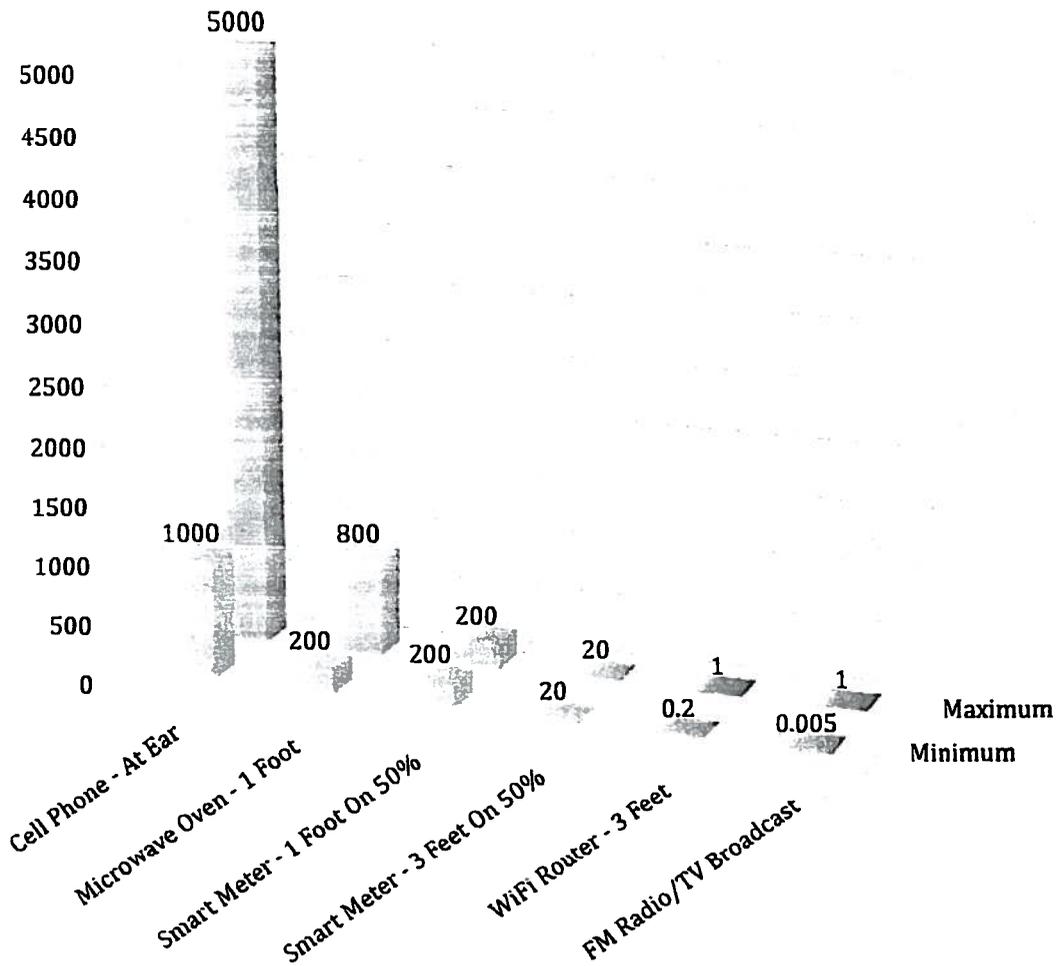


Figure 1. Instantaneous Radio Frequency Power Density Levels of Common Devices (in microWatts/cm²)
 About this figure: This figure was developed by the CCST project team. Quantities for different distances calculated using Inverse Square Law. Assumes distances in far-field, where power density reduces as the square of the distance from the source. Smart meter power scaled to obtain output for 50% duty cycle. The source for the various starting measurements came from Electric Power Research Institute (EPRI), Radio-Frequency Exposure Levels from Smart Meters: A Case Study of One Model (February 2011)

Legislative Request

On July 30, 2010, California Assembly Member Jared Huffman wrote to the California Council on Science and Technology (CCST) to request that the Council perform an “independent, science-based study...[that] would help policy makers and the general public resolve the debate over whether smart meters present a significant risk of adverse health effects.” California Assembly Member Bill Monning signed onto the request with his own letter to CCST on September 15, 2010. The City of Mill Valley also sent a letter on September 20th supporting Assembly Member Huffman’s request for the study.

Approach

Reflecting the requests of the Assembly Members, CCST agreed to compile and assess the evidence available to address:

- 1. Whether Federal Communications Commission (FCC) standards for smart meters are sufficiently protective of public health, taking into account current exposure levels to radiofrequency and electromagnetic fields.**
- 2. Whether additional technology-specific standards are needed for smart meters and other devices that are commonly found in and around homes, to ensure adequate protection from adverse health effects.**

CCST convened a Smart Meter Project Team composed of CCST Council and Board members supplemented with additional experts in relevant fields (see Appendix A for Project Team members). The Project Team identified and reviewed over 100 publications and postings about smart meters and other devices in the same range of emissions, including research related to cell phone RF emissions, and contacted over two dozen experts in radio and electromagnetic emissions and related fields to seek their opinion on the two identified issues.

It is important to note that CCST has not undertaken primary research of its own to address these issues. This response is limited to soliciting input from technical experts and to reviewing and evaluating available information from past and current research about health impacts of RF emitted from electric appliances generally, and smart meters specifically. This report has been extensively reviewed by the Project Team, experts in related fields, and has been subject to the CCST peer review process (see Appendix B). It has also been made available to the public for comment.

Two Types of Radio Frequency Effects: Thermal and Non-thermal

Household electronic devices, such as cellular and cordless telephones, microwave ovens, wireless routers, and wireless smart meters produce RF emissions. Exposure to RF emissions may lead to thermal and non-thermal effects. Thermal effects on humans have been extensively studied and appear to be well understood. The Federal Communications Commission (FCC) has established guidelines to protect public health from known hazards associated with the thermal impacts of RF: tissue heating from absorbing energy associated with radiofrequency emissions. Non-thermal effects, however, including cumulative or prolonged exposure to lower levels of RF emissions, are not well understood. Some studies have suggested non-thermal effects may include fatigue, headache, irritability, or even cancer. *But these findings have not been scientifically established, and the mechanisms that might lead to non-thermal effects remain uncertain.* Additional research and monitoring is needed to better identify and understand potential non-thermal effects.

Findings

Given the body of existing, *generally accepted scientific knowledge* regarding smart meters and similar electronic devices, CCST finds that:

1. **The FCC standard provides an adequate factor of safety against known RF induced health impacts of smart meters and other electronic devices in the same range of RF emissions.**

The potential for behavioral disruption from increased body tissue temperatures is the only biological health impact that has been consistently demonstrated and scientifically proven to result from absorbing RF within the band of the electromagnetic spectrum (EMF) that smart meters use. The Federal Communications Commission (FCC) has set a limit on the Standard Absorption Rate (SAR) from electronic devices, which is well below the level that has been demonstrated to affect behavior in laboratory animals. Smart meters, including those being installed by Pacific Gas and Electric Company (PG&E) in the Assembly Members' districts, if installed according to the manufacturers instructions and consistent with the FCC certification, emit RF that is a very small fraction of the exposure level established as safe by the FCC guidelines.

FCC staff has recently confirmed that it "relied on the expert opinions of EPA, NCRP, and others to conclude that the RF exposure limits it adopted were adequately protective of human health from all known adverse effects, regardless of whether these effects were thermal or athermal in origin".¹

The FCC guidelines provide a significant factor of safety against known RF impacts that occur at the power levels and within the RF band used by smart meters. Given current

¹ Statement provide by Robert Weller regarding FCC regulations on February 3, 2011. Robert Weller, Chief, Technical Analysis Branch, Office of Engineering and Technology, Federal Communications Commission.

scientific knowledge, the FCC guideline provides a more than adequate margin of safety against known RF effects.

2. At this time there is no clear evidence that additional standards are needed to protect the public from smart meters or other common household electronic devices.

Neither the relevant scientific literature nor our expert consultations support that there is a causal relationship between RF emissions and non-thermal human health impacts. Nor does the relevant evidence convincingly describe mechanisms for such impacts, although more research is needed to better understand and verify these potential mechanisms. Given the absence of evidence supporting a real hazard, the benefits of elevating existing standards are highly speculative. Further, there is not an existing basis from which to understand what types of standards could be helpful or appropriate. Without a clearer understanding of the biological mechanisms involved identifying additional standards or evaluating the relative costs and benefits of those standards cannot be determined at this time.

Given the existing significant scientific uncertainty around non-thermal effects, there is currently no generally accepted definitive, evidence-based indication that additional standards are needed. Because of the lack of generally accepted evidence, there is also not an existing basis from which to understand what types of standards could be helpful or appropriate. Without a clearer understanding of the biological mechanisms involved identifying additional standards or evaluating the relative costs and benefits of those standards cannot be determined at this time.

CCST notes that in some of the studies reviewed, contributors have raised emerging questions from some in the medical and biological fields about the potential for biological impacts other than the thermal impact that the FCC guidelines address. A report of the National Academies identifies research needs and gaps and recommended areas of research to be undertaken to further understanding of long-term exposure to RF emissions from communication devices, particularly from non-thermal mechanisms.² In our increasingly wireless society, smart meters account for a very small portion of RF emissions to which we are exposed. Concerns about human health impacts of RF emissions from smart meters should be considered in this broader context.

² National Research Council (2008) *Identification of Research Needs Relating to Potential Biological or Adverse Health Effects of Wireless Communication*, The National Academies Press, Washington, D.C.

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Radio Frequency Safety



Office of Engineering and
Technology (OET)

Frequently asked questions about the safety of radiofrequency (RF) and microwave emissions from transmitters and facilities regulated by the FCC

For further information on these (and other) topics please refer to [OET Bulletin 56](#). You may also contact the FCC's RF Safety Program at rfsafety@fcc.gov or

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- How safe are radio antennas used for paging and "two-way" communications? What about "push-to-talk" radios such as "walkie talkies?"
- How safe are microwave and satellite antennas?
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- What is the FCC's policy on radiofrequency warning signs? For example, when should signs be posted, where should they be located and what should they say?
- Can implanted electronic cardiac pacemakers be affected by nearby RF devices such as microwave ovens or cellular telephones?
- Does the FCC regulate exposure to radiation from microwave ovens, television sets and computer monitors?
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- Which other federal agencies have responsibilities related to potential RF health effects?
- Can local and state governmental bodies establish limits for RF exposure?
- Where can I obtain more information on potential health effects of radiofrequency energy?

WHAT ARE "RADIOFREQUENCY" AND MICROWAVE RADIATION?

Electromagnetic radiation consists of waves of electric and magnetic energy moving together (*i.e.*, radiating) through space at the speed of light. Taken together, all forms of electromagnetic energy are referred to as the electromagnetic "spectrum." Radio waves and microwaves emitted by transmitting antennas are one form of electromagnetic energy. They are collectively referred to as "radiofrequency" or "RF" energy or radiation. Note that the term "radiation" does not mean "radioactive." Often, the terms "electromagnetic field" or "radiofrequency field" may be used to indicate the presence of electromagnetic or RF energy.

The RF waves emanating from an antenna are generated by the movement of electrical charges in the antenna. Electromagnetic waves can be characterized by a wavelength and a frequency. The wavelength is the distance covered by one complete cycle of the electromagnetic wave, while the frequency is the number of electromagnetic waves passing a given point in one second. The frequency of an RF signal is usually expressed in terms of a unit called the "hertz" (abbreviated "Hz"). One Hz equals one cycle per second. One megahertz ("MHz") equals one million cycles per second.

Different forms of electromagnetic energy are categorized by their wavelengths and frequencies. The RF part of the electromagnetic spectrum is generally defined as that part of the spectrum where electromagnetic waves have frequencies in the range of about 3 kilohertz (3 kHz) to 300 gigahertz (300 GHz). Microwaves are a specific category of radio waves that can be loosely defined as radiofrequency energy at frequencies ranging from about 1 GHz upward. ([Back to Index](#))

WHAT IS NON-IONIZING RADIATION?

"Ionization" is a process by which electrons are stripped from atoms and molecules. This process can produce molecular changes that can lead to damage in biological tissue, including effects on DNA, the genetic material of

living organisms. This process requires interaction with high levels of electromagnetic energy. Those types of electromagnetic radiation with enough energy to ionize biological material include X-radiation and gamma radiation. Therefore, X-rays and gamma rays are examples of ionizing radiation.

The energy levels associated with RF and microwave radiation, on the other hand, are not great enough to cause the ionization of atoms and molecules, and RF energy is, therefore, is a type of non-ionizing radiation. Other types of non-ionizing radiation include visible and infrared light. Often the term "radiation" is used, colloquially, to imply that ionizing radiation (radioactivity), such as that associated with nuclear power plants, is present. Ionizing radiation should not be confused with the lower-energy, non-ionizing radiation with respect to possible biological effects, since the mechanisms of action are quite different. ([Back to Index](#))

HOW IS RADIOFREQUENCY ENERGY USED?

Probably the most important use for RF energy is in providing telecommunications services. Radio and television broadcasting, cellular telephones, personal communications services (PCS), pagers, cordless telephones, business radio, radio communications for police and fire departments, amateur radio, microwave point-to-point links and satellite communications are just a few of the many telecommunications applications of RF energy. Microwave ovens are an example of a non-communication use of RF energy. Radiofrequency radiation, especially at microwave frequencies, can transfer energy to water molecules. High levels of microwave energy will generate heat in water-rich materials such as most foods. This efficient absorption of microwave energy via water molecules results in rapid heating throughout an object, thus allowing food to be cooked more quickly in a microwave oven than in a conventional oven.

Other important non-communication uses of RF energy include radar and industrial heating and sealing. Radar is a valuable tool used in many applications range from traffic speed enforcement to air traffic control and military surveillance. Industrial heaters and sealers generate intense levels of RF radiation that rapidly heats the material being processed in the same way that a microwave oven cooks food. These devices have many uses in industry, including molding plastic materials, gluing wood products, sealing items such as shoes and pocketbooks, and processing food products. There are also a number of medical applications of RF energy, such as diathermy and magnetic resonance imaging (MRI). ([Back to Index](#))

HOW IS RADIOFREQUENCY RADIATION MEASURED?

An RF electromagnetic wave has both an electric and a magnetic component (electric field and magnetic field), and it is often convenient to express the intensity of the RF environment at a given location in terms of units specific to each component. For example, the unit "volts per meter" (V/m) is used to express the strength of the electric field (electric "field strength"), and the unit "amperes per meter" (A/m) is used to express the strength of the magnetic field (magnetic "field strength"). Another commonly used unit for characterizing the total electromagnetic field is "power density." Power density is most appropriately used when the point of measurement is far enough away from an antenna to be located in the "far-field" zone of the antenna.

Power density is defined as power per unit area. For example, power density is commonly expressed in terms of watts per square meter (W/m²), milliwatts per square centimeter (mW/cm²), or microwatts per square centimeter (μW/cm²). One mW/cm² equals 10 W/m², and 100 μW/cm²

equal one W/m². With respect to frequencies in the microwave range, power density is usually used to express intensity of exposure.

The quantity used to measure the rate at which RF energy is actually absorbed in a body is called the "Specific Absorption Rate" or "SAR." It is usually expressed in units of watts per kilogram (W/kg) or milliwatts per gram (mW/g). In the case of exposure of the whole body, a standing ungrounded human adult absorbs RF energy at a maximum rate when the frequency of the RF radiation is in the range of about 70 MHz. This means that the "whole-body" SAR is at a maximum under these conditions.

Because of this "resonance" phenomenon and consideration of children and grounded adults, RF safety standards are generally most restrictive in the frequency range of about 30 to 300 MHz. For exposure of parts of the body, such as the exposure from hand-held mobile phones, "partial-body" SAR limits are used in the safety standards to control absorption of RF energy (see later questions on mobile phones). ([Back to Index](#))

WHAT BIOLOGICAL EFFECTS CAN BE CAUSED BY RF ENERGY?

Biological effects can result from exposure to RF energy. Biological effects that result from heating of tissue by RF energy are often referred to as "thermal" effects. It has been known for many years that exposure to very high levels of RF radiation can be harmful due to the ability of RF energy to heat biological tissue rapidly. This is the principle by which microwave ovens cook food. Exposure to very high RF intensities can result in heating of biological tissue and an increase in body temperature. Tissue damage in humans could occur during exposure to high RF levels because of the body's inability to cope with or dissipate the excessive heat that could be generated. Two areas of the body, the eyes and the testes, are particularly vulnerable to RF heating because of the relative lack of available blood flow to dissipate the excess heat load.

At relatively low levels of exposure to RF radiation, *i.e.*, levels lower than those that would produce significant heating; the evidence for production of harmful biological effects is ambiguous and unproven. Such effects, if they exist, have been referred to as "non-thermal" effects. A number of reports have appeared in the scientific literature describing the observation of a range of biological effects resulting from exposure to low-levels of RF energy. However, in most cases, further experimental research has been unable to reproduce these effects. Furthermore, since much of the research is not done on whole bodies (*in vivo*), there has been no determination that such effects constitute a human health hazard. It is generally agreed that further research is needed to determine the generality of such effects and their possible relevance, if any, to human health. In the meantime, standards-setting organizations and government agencies continue to monitor the latest experimental findings to confirm their validity and determine whether changes in safety limits are needed to protect human health. ([Back to Index](#))

CAN PEOPLE BE EXPOSED TO LEVELS OF RADIOFREQUENCY RADIATION THAT COULD BE HARMFUL?

Studies have shown that environmental levels of RF energy routinely encountered by the general public are typically far below levels necessary to produce significant heating and increased body temperature. However, there may be situations, particularly in workplace environments near high-powered RF sources, where the recommended limits for safe exposure of human beings to RF energy could be exceeded. In such cases, restrictive measures or mitigation actions may be necessary to ensure the safe use of RF energy. ([Back to Index](#))

CAN RADIOFREQUENCY RADIATION CAUSE CANCER?

Some studies have also examined the possibility of a link between RF exposure and cancer. Results to date have been inconclusive. While some experimental data have suggested a possible link between exposure and tumor formation in animals exposed under certain specific conditions, the results have not been independently replicated. Many other studies have failed to find evidence for a link to cancer or any related condition. The Food and Drug Administration has further information on this topic with respect to RF exposure from mobile phones at the following Web site: www.fda.gov/cellphones/ . ([Back to Index](#))

WHAT RESEARCH IS BEING DONE ON RF BIOLOGICAL EFFECTS?

For many years, research into the possible biological effects of RF energy has been carried out in laboratories around the world, and such research is continuing. Past research has resulted in a large number of peer-reviewed scientific publications on this topic. For many years the U.S. Government has sponsored research into the biological effects of RF energy. The majority of this work has been funded by the Department of Defense, due in part, to the extensive military interest in using RF equipment such as radar and other relatively high-powered radio transmitters for routine military operations. In addition, some U.S. civilian federal agencies responsible for health and safety, such as the Environmental Protection Agency (EPA) and the U.S. Food and Drug Administration (FDA), have sponsored and conducted research in this area. At the present time, most of the non-military research on biological effects of RF energy in the U.S. is being funded by industry organizations, although relatively more research by government agencies is being carried out overseas, particularly in Europe.

In 1996, the World Health Organization (WHO) established a program called the International EMF Project, which is designed to review the scientific literature concerning biological effects of electromagnetic fields, identify gaps in knowledge about such effects, recommend research needs, and work towards international resolution of health concerns over the use of RF technology. The WHO maintains a Web site that provides extensive information on this project and about RF biological effects and research (www.who.ch/peh-emf).

The FDA, the EPA and other federal agencies responsible for public health and safety have worked together and in connection with the WHO to monitor developments and identify research needs related to RF biological effects. More information about this can be obtained at the FDA Web site: www.fda.gov/cellphones/. ([Back to Index](#))

WHAT LEVELS ARE SAFE FOR EXPOSURE TO RF ENERGY?

Exposure standards for radiofrequency energy have been developed by various organizations and countries. These standards recommend safe levels of exposure for both the general public and for workers. In the United States, the FCC has adopted and used recognized safety guidelines for evaluating RF environmental exposure since 1985. Federal health and safety agencies, such as the EPA, FDA, the National Institute for Occupational Safety and Health (NIOSH) and the Occupational Safety and Health Administration (OSHA) have also been involved in monitoring and investigating issues related to RF exposure.

The FCC guidelines for human exposure to RF electromagnetic fields were derived from the recommendations of two expert organizations, the National Council on Radiation Protection and Measurements (NCRP) and the Institute of Electrical and Electronics Engineers (IEEE). Both the NCRP exposure

criteria and the IEEE standard were developed by expert scientists and engineers after extensive reviews of the scientific literature related to RF biological effects. The exposure guidelines are based on thresholds for known adverse effects, and they incorporate prudent margins of safety. In adopting the most recent RF exposure guidelines, the FCC consulted with the EPA, FDA, OSHA and NIOSH, and obtained their support for the guidelines that the FCC is using.

Many countries in Europe and elsewhere use exposure guidelines developed by the International Commission on Non-Ionizing Radiation Protection (ICNIRP). The ICNIRP safety limits are generally similar to those of the NCRP and IEEE, with a few exceptions. For example, ICNIRP recommends somewhat different exposure levels in the lower and upper frequency ranges and for localized exposure due to such devices as hand-held cellular telephones. One of the goals of the WHO EMF Project (see above) is to provide a framework for international harmonization of RF safety standards. The NCRP, IEEE and ICNIRP exposure guidelines identify the same threshold level at which harmful biological effects may occur, and the values for Maximum Permissible Exposure (MPE) recommended for electric and magnetic field strength and power density in both documents are based on this level. The threshold level is a Specific Absorption Rate (SAR) value for the whole body of 4 watts per kilogram (4 W/kg).

In addition, the NCRP, IEEE and ICNIRP guidelines for maximum permissible exposure are different for different transmitting frequencies. This is due to the finding (discussed above) that whole-body human absorption of RF energy varies with the frequency of the RF signal. The most restrictive limits on whole-body exposure are in the frequency range of 30-300 MHz where the human body absorbs RF energy most efficiently when the whole body is exposed. For devices that only expose part of the body, such as mobile phones, different exposure limits are specified (see below).

The exposure limits used by the FCC are expressed in terms of SAR, electric and magnetic field strength and power density for transmitters operating at frequencies from 300 kHz to 100 GHz. The actual values can be found in either of two informational bulletins available at this Web site ([OET Bulletin 56](#) or [OET Bulletin 65](#)), see listing for "OET Safety Bulletins." ([Back to Index](#))

WHY HAS THE FCC ADOPTED GUIDELINES FOR RF EXPOSURE?

The FCC authorizes and licenses devices, transmitters and facilities that generate RF radiation. It has jurisdiction over all transmitting services in the U.S. except those specifically operated by the Federal Government.

However, the FCC's primary jurisdiction does not lie in the health and safety area, and it must rely on other agencies and organizations for guidance in these matters.

Under the National Environmental Policy Act of 1969 (NEPA), all Federal agencies are required to implement procedures to make environmental consideration a necessary part of an agency's decision-making process.

Therefore, FCC approval and licensing of transmitters and facilities must be evaluated for significant impact on the environment. Human exposure to RF radiation emitted by FCC-regulated transmitters is one of several factors that must be considered in such environmental evaluations. In 1996, the FCC revised its guidelines for RF exposure as a result of a multi-year proceeding and as required by the Telecommunications Act of 1996.

Facilities under the jurisdiction of the FCC having a high potential for creating significant RF exposure to humans, such as radio and television broadcast stations, satellite-earth stations, experimental radio stations and

certain cellular, PCS and paging facilities are required to undergo routine evaluation for compliance with RF exposure guidelines whenever an application is submitted to the FCC for construction or modification of a transmitting facility or renewal of a license. Failure to show compliance with the FCC's RF exposure guidelines in the application process could lead to the preparation of a formal Environmental Assessment, possible Environmental Impact Statement and eventual rejection of an application. Technical guidelines for evaluating compliance with the FCC RF safety requirements can be found in the FCC's OET Bulletin 65 (see "OET Safety Bulletins" listing elsewhere at this Web site).

Low-powered, intermittent, or inaccessible RF transmitters and facilities are normally "categorically excluded" from the requirement of routine evaluation for RF exposure. These exclusions are based on calculations and measurement data indicating that such transmitting stations or devices are unlikely to cause exposures in excess of the guidelines under normal conditions of use. The FCC's policies on RF exposure and categorical exclusion can be found in Section 1.1307(b) of the FCC's Rules and Regulations [47 CFR 1.1307(b)]. It should be emphasized, however, that these exclusions are not exclusions from compliance, but, rather, only exclusions from routine evaluation. Transmitters or facilities that are otherwise categorically excluded from evaluation may be required, on a case-by-case basis, to demonstrate compliance when evidence of potential non-compliance of the transmitter or facility is brought to the Commission's attention [see 47 CFR 1.1307(c) and (d)]. ([Back to Index](#))

HOW SAFE ARE MOBILE AND PORTABLE PHONES?

In recent years, publicity, speculation, and concern over claims of possible health effects due to RF emissions from hand-held wireless telephones prompted various research programs to investigate whether there is any risk to users of these devices. There is no scientific evidence to date that proves that wireless phone usage can lead to cancer or a variety of other health effects, including headaches, dizziness or memory loss. However, studies are ongoing and key government agencies, such as the Food and Drug Administration (FDA) continue to monitor the results of the latest scientific research on these topics. Also, as noted above, the World Health Organization has established an ongoing program to monitor research in this area and make recommendations related to the safety of mobile phones.

The FDA, which has primary jurisdiction for investigating mobile phone safety, has stated that it cannot rule out the possibility of risk, but if such a risk exists, "it is probably small." Further, it has stated that, while there is no proof that cellular telephones can be harmful, concerned individuals can take various precautionary actions, including limiting conversations on hand-held cellular telephones and making greater use of telephones with hands-free kits where there is a greater separation distance between the user and the radiating antenna. The Web site for the FDA's Center for Devices and Radiological Health provides further information on mobile phone safety: www.fda.gov/cellphones/.

The Government Accounting Office (GAO) prepared a report of its investigation into safety concerns related to mobile phones. The report concluded that further research is needed to confirm whether mobile phones are completely safe for the user, and the report recommended that the FDA take the lead in monitoring the latest research results.

The FCC's exposure guidelines specify limits for human exposure to RF emissions from hand-held mobile phones in terms of Specific Absorption Rate (SAR), a measure of the rate of absorption of RF energy by the body.

unique file structure. These extracts consist of multiple, very large files. OET maintains an index to these databases.

OET has developed a Spectrum Utilization Study Software tool-set that can be used to create a Microsoft Access version of the individual exported licensing databases and then create MapInfo "mid" and "mif" files so that radio assignments can be plotted. This experimental software is used to conduct Internal spectrum utilization studies needed in the rulemaking process. While the FCC makes this software available to the public, no technical support is provided.

For further information on the Commission's existing databases, please contact Donald Campbell at donald.campbell@fcc.gov or . ([Back to Index](#))

WHICH OTHER FEDERAL AGENCIES HAVE RESPONSIBILITIES RELATED TO POTENTIAL RF HEALTH EFFECTS?

Certain agencies in the Federal Government have been involved in monitoring, researching or regulating issues related to human exposure to RF radiation. These agencies include the Food and Drug Administration (FDA), the Environmental Protection Agency (EPA), the Occupational Safety and Health Administration (OSHA), the National Institute for Occupational Safety and Health (NIOSH), the National Telecommunications and Information Administration (NTIA) and the Department of Defense (DOD).

By authority of the Radiation Control for Health and Safety Act of 1968, the Center for Devices and Radiological Health (CDRH) of the FDA develops performance standards for the emission of radiation from electronic products including X-ray equipment, other medical devices, television sets, microwave ovens, laser products and sunlamps. The CDRH established a product performance standard for microwave ovens in 1971 limiting the amount of RF leakage from ovens. However, the CDRH has not adopted performance standards for other RF-emitting products. The FDA is, however, the lead federal health agency in monitoring the latest research developments and advising other agencies with respect to the safety of RF-emitting products used by the public, such as cellular and PCS phones.

The FDA's microwave oven standard is an emission standard (as opposed to an exposure standard) that allows specific levels of microwave energy leakage (measured at five centimeters from the oven surface). The standard also requires ovens to have two independent interlock systems that prevent the oven from generating microwaves if the latch is released or if the door of the oven is opened. The FDA has stated that ovens that meet its standards and are used according to the manufacturer's recommendations are safe for consumer and industrial use. More information is available from: www.fda.gov/cdrh.

The EPA has, in the past, considered developing federal guidelines for public exposure to RF radiation. However, EPA activities related to RF safety and health are presently limited to advisory functions. For example, the EPA chairs an Inter-agency Radiofrequency Working Group, which coordinates RF health-related activities among the various federal agencies with health or regulatory responsibilities in this area.

OSHA is part of the U.S. Department of Labor, and is responsible for protecting workers from exposure to hazardous chemical and physical agents. In 1971, OSHA issued a protection guide for exposure of workers to RF radiation [29 CFR 1910.97]. However, this guide was later ruled to be only advisory and not mandatory. Moreover, it was based on an earlier RF exposure standard that has now been revised. At the present time, OSHA uses the IEEE and/or FCC exposure guidelines for enforcement purposes

under OSHA's "general duty clause" (for more information see:

www.osha.gov/SLTC/radiofrequencyradiation/).

NIOSH is part of the U.S. Department of Health and Human Services. It conducts research and investigations into issues related to occupational exposure to chemical and physical agents. NIOSH has, in the past, undertaken to develop RF exposure guidelines for workers, but final guidelines were never adopted by the agency. NIOSH conducts safety-related RF studies through its Physical Agents Effects Branch in Cincinnati, Ohio.

The NTIA is part of the U.S. Department of Commerce and is responsible for authorizing Federal Government use of the RF electromagnetic spectrum.

Like the FCC, the NTIA also has NEPA responsibilities and has considered adopting guidelines for evaluating RF exposure from U.S. Government transmitters such as radar and military facilities. ([Back to Index](#))

CAN LOCAL AND STATE GOVERNMENTAL BODIES ESTABLISH LIMITS FOR RF EXPOSURE?

In the United States, some local and state jurisdictions have also enacted rules and regulations pertaining to human exposure to RF energy. However, the Telecommunications Act of 1996 contained provisions relating to federal jurisdiction to regulate human exposure to RF emissions from certain transmitting devices. In particular, Section 704 of the Act states that, "No State or local government or instrumentality thereof may regulate the placement, construction, and modification of personal wireless service facilities on the basis of the environmental effects of radio frequency emissions to the extent that such facilities comply with the Commission's regulations concerning such emissions." Further information on FCC policy with respect to facilities siting is available from the FCC's Wireless Telecommunications Bureau (see <http://wireless.fcc.gov/siting/>). ([Back to Index](#))

WHERE CAN I OBTAIN MORE INFORMATION ON POTENTIAL HEALTH EFFECTS OF RADIOFREQUENCY ENERGY?

Although relatively few offices or agencies within the Federal Government routinely deal with the issue of human exposure to RF fields, it is possible to obtain information and assistance on certain topics from the following federal agencies, all of which also have Internet Web sites.

FDA: For information about radiation from microwave ovens and other consumer and industrial products contact: Center for Devices and Radiological Health (CDRH), Food and Drug Administration.
[<http://www.fda.gov/cdrh/radhealth/>]

EPA: The Environmental Protection Agency's Office of Radiation Programs is responsible for monitoring potential health effects due to public exposure to RF fields. Contact: Environmental Protection Agency, Office of Radiation and Indoor Air, Washington, D.C. 20460, . [Click on EPA's website: [Frequent Questions on EMF, RF, & Other Nonionizing Radiation](#)]

OSHA: The Occupational Safety and Health Administration's (OSHA) Health Response Team has been involved in studies related to occupational exposure to RF radiation.
[http://www.osha.gov/SLTC/radiation_nonionizing/index.html]

NIOSH: The National Institute for Occupational Safety and Health (NIOSH) conducts research on RF-related safety issues in workplaces and recommends measures to protect worker health. Contact: NIOSH,

The safe limit for a mobile phone user is an SAR of 1.6 watts per kg (1.6 W/kg), averaged over one gram of tissue, and compliance with this limit must be demonstrated before FCC approval is granted for marketing of a phone in the United States. Somewhat less restrictive limits, *e.g.*, 2 W/kg averaged over 10 grams of tissue, are specified by the ICNIRP guidelines used in Europe and most other countries.

Measurements and analysis of SAR in models of the human head have shown that the 1.6 W/kg limit is unlikely to be exceeded under normal conditions of use of cellular and PCS hand-held phones. The same can be said for cordless telephones used in the home. Testing of hand-held phones is normally done under conditions of maximum power usage, thus providing an additional margin of safety, since most phone usage is not at maximum power. Information on SAR levels for many phones is available electronically through the FCC's Web site and database (see next question). ([Back to Index](#))

HOW CAN I OBTAIN THE SPECIFIC ABSORPTION RATE (SAR) VALUE FOR MY MOBILE PHONE?

As explained above, the Specific Absorption Rate, or SAR, is the unit used to determine compliance of cellular and PCS phones with safety limits adopted by the FCC. The SAR is a value that corresponds to the rate at which RF energy absorbed in the head of a user of a wireless handset. The FCC requires mobile phone manufacturers to demonstrate compliance with an SAR level of 1.6 watts per kilogram (averaged over one gram of tissue).

Information on SAR for a specific cell phone model can be obtained for almost all cellular telephones by using the FCC identification (ID) number for that model. The FCC ID number is usually printed somewhere on the case of the phone or device. In many cases, you will have to remove the battery pack to find the number. Once you have the number proceed as follows. Go to the following website: [Equipment Authorization](#). Click on the link for "FCC ID Search". Once you are there you will see instructions for inserting the FCC ID number. Enter the FCC ID number (in two parts as indicated: "Grantee Code" is comprised of the first three characters, the "Equipment Product Code" is the remainder of the FCC ID). Then click on "Start Search." The grant(s) of equipment authorization for this particular ID number should then be available. Click on a check under "Display Grant" and the grant should appear. Look through the grant for the section on SAR compliance, certification of compliance with FCC rules for RF exposure or similar language. This section should contain the value(s) for typical or maximum SAR for your phone.

For portable phones and devices authorized since June 2, 2000, maximum SAR levels should be noted on the grant of equipment authorization. For phones and devices authorized between about mid-1998 and June 2000, detailed information on SAR levels is typically found in one of the "exhibits" associated with the grant. Therefore, once the grant is accessed in the FCC database, the exhibits can be viewed by clicking on the appropriate entry labeled "View Exhibit." Electronic records for FCC equipment authorization grants were initiated in 1998, so devices manufactured prior to this date may not be included in our electronic database.

Although the FCC database does not list phones by model number, there are certain non-government Web sites such as www.cnet.com that provide information on SAR from specific models of mobile phones. However, the FCC has not reviewed these sites for accuracy and makes no guarantees with respect to them. In addition to these sites, some mobile phone manufacturers make this information available at their own Web sites. Also,

phones certified by the Cellular Telecommunications and Internet Association (CTIA) are now required to provide this information to consumers in the instructional materials that come with the phones.

If you want additional consumer information on safety of cell phones and other transmitting devices please consult the information available below at this Web site. In particular, you may wish to read or download our [OET Bulletin 56](#) (see "OET RF Safety Bulletins" listing) entitled: "Questions and Answers about Biological Effects and Potential Hazards of Radiofrequency Electromagnetic Fields." If you have any problems or additional questions you may contact us at: rf_safety@fcc.gov or you may call: . You may also wish to consult a consumer update on mobile phone safety published by the U.S. Food and Drug Administration (FDA) that can be found at: www.fda.gov/cellphones/. ([Back to Index](#))

DO "HANDS-FREE" EAR PIECES FOR MOBILE PHONES REDUCE EXPOSURE TO RF EMISSIONS? WHAT ABOUT MOBILE PHONE ACCESSORIES THAT CLAIM TO SHIELD THE HEAD FROM RF RADIATION?

"Hands-free" kits with ear pieces can be used with cell phones for convenience and comfort. In addition, because the phone, which is the source of the RF emissions, will not be placed against the head, absorption of RF energy in the head will be reduced. Therefore, it is true that use of an ear piece connected to a mobile phone will significantly reduce the rate of energy absorption (or "SAR") in the user's head. On the other hand, if the phone is mounted against the waist or other part of the body during use, then that part of the body will absorb RF energy. Even so, mobile phones marketed in the U.S. are required to meet safety limit requirements regardless of whether they are used against the head or against the body. So either configuration should result in compliance with the safety limit.

Note that hands-free devices using "Bluetooth" technology also include a wireless transmitter; however, the Bluetooth transmitter operates at a much lower power than the cell phone.

A number of devices have been marketed that claim to "shield" or otherwise reduce RF absorption in the body of the user. Some of these devices incorporate shielded phone cases, while others involve nothing more than a metallic accessory attached to the phone. Studies have shown that these devices generally do not work as advertised. In fact, they may actually increase RF absorption in the head due to their potential to interfere with proper operation of the phone, thus forcing it to increase power to compensate. ([Back to Index](#))

CAN MOBILE PHONES BE USED SAFELY IN HOSPITALS AND NEAR MEDICAL TELEMTRY EQUIPMENT?

The FCC does not normally investigate problems of electromagnetic interference from RF transmitters to medical devices. Some hospitals have policies, which limit the use of cell phones, due to concerns that sensitive medical equipment could be affected. The FDA's Center for Devices and Radiological Health (CDRH) has primary jurisdiction for medical device regulation. FDA staff has monitored this potential problem and more information is available from the CDRH Web site: www.fda.gov/cdrh . ([Back to Index](#))

ARE CELLULAR AND PCS TOWERS AND ANTENNAS SAFE?

Cellular radio services transmit using frequencies between 824 and 894 megahertz (MHz). Transmitters in the Personal Communications Service (PCS) use frequencies in the range of 1850-1990 MHz. Antennas used for

cellular and PCS transmissions are typically located on towers, water tanks or other elevated structures including rooftops and the sides of buildings.

The combination of antennas and associated electronic equipment is referred to as a cellular or PCS "base station" or "cell site." Typical heights for free-standing base station towers or structures are 50-200 feet. A cellular base station may utilize several "omni-directional" antennas that look like poles, 10 to 15 feet in length, although these types of antennas are less common in urbanized areas.

In urban and suburban areas, cellular and PCS service providers commonly use "sector" antennas for their base stations. These antennas are rectangular panels, *e.g.*, about 1 by 4 feet in size, typically mounted on a rooftop or other structure, but they are also mounted on towers or poles.

Panel antennas are usually arranged in three groups of three each. It is common that not all antennas are used for the transmission of RF energy; some antennas may be receive-only.

At a given cell site, the total RF power that could be radiated by the antennas depends on the number of radio channels (transmitters) installed, the power of each transmitter, and the type of antenna. While it is theoretically possible for cell sites to radiate at very high power levels, the maximum power radiated in any direction usually does not exceed 50 watts.

The RF emissions from cellular or PCS base station antennas are generally directed toward the horizon in a relatively narrow pattern in the vertical plane. In the case of sector (panel) antennas, the pattern is fan-shaped, like a wedge cut from a pie. As with all forms of electromagnetic energy, the power density from the antenna decreases rapidly as one moves away from the antenna. Consequently, ground-level exposures are much less than exposures if one were at the same height and directly in front of the antenna.

Measurements made near typical cellular and PCS installations, especially those with tower-mounted antennas, have shown that ground-level power densities are thousands of times less than the FCC's limits for safe exposure.

This makes it extremely unlikely that a member of the general public could be exposed to RF levels in excess of FCC guidelines due solely to cellular or PCS base station antennas located on towers or monopoles.

When cellular and PCS antennas are mounted at rooftop locations it is possible that a person could encounter RF levels greater than those typically encountered on the ground. However, once again, exposures approaching or exceeding the safety guidelines are only likely to be encountered very close to and directly in front of the antennas. For sector-type antennas, RF levels to rear are usually very low. ([Back to Index](#))

For further information on cellular services go to http://wireless.fcc.gov/services/index.htm?job=service_home&id=cellular

ARE CELLULAR AND OTHER RADIO TOWERS LOCATED NEAR HOMES OR SCHOOLS SAFE FOR RESIDENTS AND STUDENTS?

As discussed above, radiofrequency emissions from antennas used for cellular and PCS transmissions result in exposure levels on the ground that are typically thousands of times below safety limits. These safety limits were adopted by the FCC based on the recommendations of expert organizations and endorsed by agencies of the Federal Government responsible for health and safety. Therefore, there is no reason to believe that such towers could constitute a potential health hazard to nearby residents or students.

Other antennas, such as those used for radio and television broadcast transmissions, use power levels that are generally much higher than those used for cellular and PCS antennas. Therefore, in some cases there could be a potential for higher levels of exposure to persons on the ground.

However, all broadcast stations are required to demonstrate compliance with FCC safety guidelines, and ambient exposures to nearby persons from such stations are typically well below FCC safety limits. ([Back to Index](#))

ARE EMISSIONS FROM RADIO AND TELEVISION BROADCAST ANTENNAS SAFE?

Radio and television broadcast stations transmit their signals via RF electromagnetic waves. There are thousands of radio and TV stations on the air in the United States. Broadcast stations transmit at various RF frequencies, depending on the channel, ranging from about 540 kHz for AM radio up to about 800 MHz for UHF television stations. Frequencies for FM radio and VHF television lie in between these two extremes. Broadcast transmitter power levels range from a few watts to more than 100,000 watts. Some of these transmission systems can be a significant source of RF energy in the local environment, so the FCC requires that broadcast stations submit evidence of compliance with FCC RF guidelines.

The amount of RF energy to which the public or workers might be exposed as a result of broadcast antennas depends on several factors, including the type of station, design characteristics of the antenna being used, power transmitted to the antenna, height of the antenna and distance from the antenna. Note that the power normally quoted for FM and TV broadcast transmitters is the "effective radiated power" or ERP not the actual transmitter power mentioned above. ERP is the transmitter power delivered to the antenna multiplied by the directivity or gain of the antenna. Since high gain antennas direct most of the RF energy toward the horizon and not toward the ground, high ERP transmission systems such as used for UHF-TV broadcast tend to have less ground level field intensity near the station than FM radio broadcast systems with lower ERP and gain values. Also, since energy at some frequencies is absorbed by the human body more readily than at other frequencies, both the frequency of the transmitted signal and its intensity is important. Calculations can be performed to predict what field intensity levels would exist at various distances from an antenna.

Public access to broadcasting antennas is normally restricted so that individuals cannot be exposed to high-level fields that might exist near antennas. Measurements made by the FCC, EPA and others have shown that ambient RF radiation levels in inhabited areas near broadcasting facilities are typically well below the exposure levels recommended by current standards and guidelines. There have been a few situations around the country where RF levels in publicly accessible areas have been found to be higher than those recommended in applicable safety standards. As they have been identified, the FCC has required that stations at those facilities promptly bring their combined operations into compliance with our guidelines. Thus, despite the relatively high operating powers of many broadcast stations, such cases are unusual, and members of the general public are unlikely to be exposed to RF levels from broadcast towers that exceed FCC limits

Antenna maintenance workers are occasionally required to climb antenna structures for such purposes as painting, repairs, or lamp replacement.

Both the EPA and OSHA have reported that in such cases it is possible for a worker to be exposed to high levels of RF energy if work is performed on an active tower or in areas immediately surrounding a radiating antenna.

Therefore, precautions should be taken to ensure that maintenance personnel are not exposed to unsafe RF fields. ([Back to Index](#))

HOW SAFE ARE RADIO ANTENNAS USED FOR PAGING AND "TWO-WAY" COMMUNICATIONS? WHAT ABOUT "PUSH-TO-TALK" RADIOS SUCH AS "WALKIE-TALKIES?"

"Land-mobile" communications include a variety of communications systems, which require the use of portable and mobile RF transmitting sources. These systems operate in several frequency bands between about 30 and 1000 MHz. Radio systems used by the police and fire departments, radio paging services and business radio are a few examples of these communications systems. They have the advantage of providing communications links between various fixed and mobile locations.

There are essentially three types of RF transmitters associated with land-mobile systems: base-station transmitters, vehicle-mounted transmitters, and hand-held transmitters. The antennas and power levels used for these various transmitters are adapted for their specific purpose. For example, a base-station antenna must radiate its signal to a relatively large area, and therefore, its transmitter generally has to use higher power levels than a vehicle-mounted or hand-held radio transmitter. Although base-station antennas usually operate with higher power levels than other types of land-mobile antennas, they are normally inaccessible to the public since they must be mounted at significant heights above ground to provide for adequate signal coverage. Also, many of these antennas transmit only intermittently. For these reasons, base-station antennas are generally not of concern with regard to possible hazardous exposure of the public to RF radiation. Studies at rooftop locations have indicated that high-powered paging antennas may increase the potential for exposure to workers or others with access to such sites, *e.g.*, maintenance personnel. This could be a concern especially when multiple transmitters are present. In such cases, restriction of access or other mitigation actions may be necessary.

Transmitting power levels for vehicle-mounted land-mobile antennas are generally less than those used by base-station antennas but higher than those used for hand-held units. Some manufacturers recommend that users and other nearby individuals maintain some minimum distance (*e.g.*, 1 to 2 feet) from a vehicle-mounted antenna during transmission or mount the antenna in such a way as to provide maximum shielding for vehicle occupants. Studies have shown that this is probably a conservative precaution, particularly when the percentage of time an antenna is actually radiating is considered. Unlike cellular telephones, which transmit continuously during a call, two-way radios normally transmit only when the "push-to-talk" button is depressed. This significantly reduces exposure, and there is no evidence that there would be a safety hazard associated with exposure from vehicle-mounted, two-way antennas when the manufacturer's recommendations are followed.

Hand-held "two-way" portable radios such as walkie-talkies are low-powered devices used to transmit and receive messages over relatively short distances. Because of the low power levels used, the intermittency of these transmissions ("push-to-talk"), and due to the fact that these radios are held away from the head, they should not expose users to RF energy in excess of safe limits. Although FCC rules do not require routine documentation of compliance with safety limits for push-to-talk two-way radios as it does for cellular and PCS phones (which transmit continuously during use and which are held against the head), most of these radios are tested and the resulting SAR data are available from the FCC's [Equipment](#)

Authorization database. Click on the link for "FCC ID Search <imbed hypertext link>.". ([Back to Index](#))

HOW SAFE ARE MICROWAVE AND SATELLITE ANTENNAS?

Point-to-point microwave antennas transmit and receive microwave signals across relatively short distances (from a few tenths of a mile to 30 miles or more). These antennas are usually circular ("dish") or rectangular in shape and are normally mounted on a supporting tower, rooftop, sides of buildings or on similar structures that provide clear and unobstructed line-of-sight paths between both ends of a transmission path. These antennas have a variety of uses, such as relaying long-distance telephone calls, and serving as links between broadcast studios and transmitting sites.

The RF signals from these antennas travel in a directed beam from a transmitting antenna to the receiving antenna, and dispersion of microwave energy outside of this narrow beam is minimal or insignificant. In addition, these antennas transmit using very low power levels, usually on the order of a few watts or less. Measurements have shown that ground-level power densities due to microwave directional antennas are normally thousands of times or more below recommended safety limits. Moreover, microwave tower sites are normally inaccessible to the general public. Significant exposures from these antennas could only occur in the unlikely event that an individual were to stand directly in front of and very close to an antenna for a period of time.

Ground-based antennas used for satellite-earth communications typically are parabolic "dish" antennas, some as large as 10 to 30 meters in diameter, that are used to transmit ("uplink") or receive ("downlink") microwave signals to or from satellites in orbit around the earth. These signals allow delivery of a variety of communications services, including television network programming, electronic newsgathering and point-of-sale credit card transactions. Some satellite-earth station antennas are used only to receive RF signals (*i.e.*, like the satellite television antenna used at a residence), and because they do not transmit, RF exposure is not an issue for those antennas.

Since satellite-earth station antennas are directed toward satellites above the earth, transmitted beams point skyward at various angles of inclination, depending on the particular satellite being used. Because of the longer distances involved, power levels used to transmit these signals are relatively large when compared, for example, to those used by the terrestrial microwave point-to-point antennas discussed above. However, as with microwave antennas, the beams used for transmitting earth-to-satellite signals are concentrated and highly directional, similar to the beam from a flashlight. In addition, public access would normally be restricted at uplink sites where exposure levels could approach or exceed safe limits.

Although many satellite-earth stations are "fixed" sites, portable uplink antennas are also used, *e.g.*, for electronic news gathering. These antennas can be deployed in various locations. Therefore, precautions may be necessary, such as temporarily restricting access in the vicinity of the antenna, to avoid exposure to the main transmitted beam. In general, however, it is unlikely that a transmitting earth station antenna would routinely expose members of the public to potentially harmful levels of RF energy. ([Back to Index](#))

ARE RF EMISSIONS FROM AMATEUR RADIO STATIONS HARMFUL?

There are hundreds of thousands of amateur radio operators ("hams") worldwide. Amateur radio operators in the United States are licensed by the

FCC. The Amateur Radio Service provides its members with the opportunity to communicate with persons all over the world and to provide valuable public service functions, such as making communications services available during disasters and emergencies. Like all FCC licensees, amateur radio operators are required to comply with the FCC's guidelines for safe human exposure to RF fields. Under the FCC's rules, amateur operators can transmit with power levels of up to 1500 watts. However, most operators use considerably less power than this maximum. Studies by the FCC and others have shown that most amateur radio transmitters would not normally expose persons to RF levels in excess of safety limits. This is primarily due to the relatively low operating powers used by most amateurs, the intermittent transmission characteristics typically used and the relative inaccessibility of most amateur antennas. As long as appropriate distances are maintained from amateur antennas, exposure of nearby persons should be well below safety limits.

To help ensure compliance of amateur radio facilities with RF exposure guidelines, both the FCC and American Radio Relay League (ARRL) have issued publications to assist operators in evaluating compliance for their stations. The FCC's publication (Supplement B to [OET Bulletin 65](#) can be viewed and downloaded elsewhere at this Web site (see "OET RF Safety Bulletins"). ([Back to Index](#))

WHAT IS THE FCC'S POLICY ON RADIOFREQUENCY WARNING SIGNS? FOR EXAMPLE, WHEN SHOULD SIGNS BE POSTED, WHERE SHOULD THEY BE LOCATED AND WHAT SHOULD THEY SAY?

Radiofrequency warning or "alerting" signs should be used to provide information on the presence of RF radiation or to control exposure to RF radiation within a given area. Standard radiofrequency hazard warning signs are commercially available from several vendors. Appropriate signs should incorporate the format recommended by the Institute for Electrical and Electronics Engineers (IEEE) and as specified in the IEEE standard: IEEE C95.2-1999 (Web address: www.ieee.org). Guidance concerning the placement of signs can be found in IEEE Standard C95.7-2005. When signs are used, meaningful information should be placed on the sign advising affected persons of: (1) the nature of the potential hazard (*i.e.*, high RF fields), (2) how to avoid the potential hazard, and (3) whom to contact for additional information. In some cases, it may be appropriate to also provide instructions to direct individuals as to how to work safely in the RF environment of concern. Signs should be located prominently in areas that will be readily seen by those persons who may have access to an area where high RF fields are present. ([Back to Index](#))

CAN IMPLANTED ELECTRONIC CARDIAC PACEMAKERS BE AFFECTED BY NEARBY RF DEVICES SUCH AS MICROWAVE OVENS OR CELLULAR TELEPHONES?

Over the past several years there has been concern that signals from some RF devices could interfere with the operation of implanted electronic pacemakers and other medical devices. Because pacemakers are electronic devices, they could be susceptible to electromagnetic signals that could cause them to malfunction. Some anecdotal claims of such effects in the past involved emissions from microwave ovens. However, it has never been shown that the RF energy from a properly operating microwave oven is strong enough to cause such interference.

Some studies have shown that mobile phones can interfere with implanted cardiac pacemakers if a phone is used in close proximity (within about 8 inches) of a pacemaker. It appears that such interference is limited to older

pacemakers, which may no longer be in use. Nonetheless, to avoid this potential problem, pacemaker patients can avoid placing a phone in a pocket close to the location of their pacemaker or otherwise place the phone near the pacemaker location during phone use. Patients with pacemakers should consult with their physician or the FDA if they believe that they may have a problem related to RF interference. Further information on this is available from the FDA: www.fda.gov/cdrh . ([Back to Index](#))

DOES THE FCC REGULATE EXPOSURE TO THE ELECTROMAGNETIC RADIATION FROM MICROWAVE OVENS, TELEVISION SETS AND COMPUTER MONITORS?

The Commission does not regulate exposure to emissions from these devices. Protecting the public from harmful radiation emissions from these consumer products is the responsibility of the U.S. Food and Drug Administration (FDA). Inquiries should be directed to the FDA's Center for Devices and Radiological Health (CDRH), and, specifically, to the CDRH Office of Compliance at . ([Back to Index](#))

DOES THE FCC ROUTINELY MONITOR RADIOFREQUENCY RADIATION FROM ANTENNAS?

The FCC does not have the resources or the personnel to routinely monitor the emissions for all of the thousands of transmitters that are subject to FCC jurisdiction. However, the FCC does have measurement instrumentation for evaluating RF levels in areas that may be accessible to the public or to workers. If there is evidence of potential non-compliance with FCC exposure guidelines for an FCC-regulated facility, staff from the FCC's Office of Engineering and Technology or the Enforcement Bureau can conduct an investigation, and, if appropriate, perform actual measurements. It should be emphasized that the FCC does not perform RF exposure investigations unless there is a reasonable expectation that the FCC exposure limits may be exceeded. Potential exposure problems should be brought to the FCC's attention by contacting the FCC at: or by e-mailing: rf-safety@fcc.gov. ([Back to Index](#))

DOES THE FCC MAINTAIN A DATABASE THAT INCLUDES INFORMATION ON THE LOCATION AND TECHNICAL PARAMETERS OF ALL OF THE TRANSMITTER SITES IT REGULATES?

The Commission does not have a comprehensive, transmitter-specific database for all of the services it regulates. The Commission has information for some services such as radio and television broadcast stations, and many larger antenna towers are required to register with the FCC if they meet certain criteria. In those cases, location information is generally specified in terms of degrees, minutes, and seconds of latitude and longitude. In some services, licenses are allowed to utilize additional transmitters or to increase power without notifying the Commission. Other services are licensed by geographic area, such that the Commission has no knowledge concerning the actual number or location of transmitters within that geographic area.

The *FCC General Menu Reports (GenMen)* search engine unites most of the Commission's licensing databases under a single umbrella. Databases included are the Wireless Telecommunications Bureau's ULS, the Media Bureau's CDDBS, COALS (cable data) and BLS, and the International Bureau's IBFS. Entry points or search options in the various databases include frequency, state/county, latitude/longitude, call sign and licensee name.

The FCC also publishes, generally on a weekly basis, bulk extracts of the various Commission licensing databases. Each licensing database has its own

Engineering and Physical Hazards Branch, Mail Stop R-5, 4676 Columbia Parkway, Cincinnati, Ohio 45226, or phone . Toll-free public inquiries: (800) 458-5231, or by email: cdcinfo@cdc.gov. Internet information on workplace RF safety: <http://www.cdc.gov/niosh/topics/emf/#rffields>.

NCI: The National Cancer Institute, part of the U.S. National Institutes of Health, conducts and supports research, training, health information dissemination, and other programs with respect to the cause, diagnosis, prevention, and treatment of cancer. Contact: NCI Public Inquiries Office, 6116 Executive Boulevard, Room 3036A, Bethesda, MD 20892-8322. [<http://www.cancer.gov/cancertopics/factsheet/Risk/cellphones>]

Toll-free number: (800) 458-5231.

FCC: Questions regarding potential RF hazards from FCC-regulated transmitters can be directed to the Federal Communications Commission, Consumer & Governmental Affairs Bureau, 445 12th Street, S.W., Washington, D.C. 20554; Phone: (800) 418-8242; E-mail: rfsafety@fcc.gov; or go to: www.fcc.gov/oet/rfsafety.

In addition to federal government agencies, there are other sources of information regarding RF energy and health effects. Some states and localities maintain non-ionizing radiation programs or, at least, some expertise in this field, usually in a department of public health or environmental control. The following table lists some representative Internet Web sites that provide information on this topic. However, the FCC neither endorses nor verifies the accuracy of any information provided at these sites. They are being provided for information only. ([Back to Index](#))

- **Bioelectromagnetics Society:** <http://www.bioelectromagnetics.org/>
- **EPA's RadTown USA:** <http://www.epa.gov/radtown/basic.html>
- **International Commission on Non-Ionizing Radiation Protection (ICNIRP Europe):** <http://www.icnirp.de/>
- **IEEE Committee on Man & Radiation:** <http://ewh.ieee.org/soc/embs/comar/>
- **Microwave News:** <http://www.microwavenews.com/>
- **National Council on Radiation Protection & Measurements:** <http://www.ncrponline.org/>
- **NJ Dept Radiation Protection:** <http://www.nj.gov/dep/rpp/nrs/index.htm>
- **RFcom (Canada):** <http://www.rfcom.ca/welcome/index.shtml>
- **Wireless Industry (CTIA):** <http://www.ctia.org/>
- **World Health Organization (WHO):** <http://www.who.ch/peh-emf>
- **Germany's EMF Portal:** <http://www.emf-portal.de/>

For more information on this topic please note:

OET Bulletin 56: Questions and Answers About the Biological Effects and Potential Hazards of Radiofrequency Radiation.

Any questions regarding this subject matter should be addressed to: [The RF Safety Program](#)

last reviewed/updated 8/4/10

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Electromagnetic fields and public health

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Fact sheet N° 296
December 2005

For more information contact:

WHO Media centre
Telephone: +41 22 791 2222
E-mail: mediainquiries@who.int

As societies industrialize and the technological revolution continues, there has been an unprecedented increase in the number and diversity of electromagnetic field (EMF) sources. These sources include video display units (VDUs) associated with computers, mobile phones and their base stations. While these devices have made our life richer, safer and easier, they have been accompanied by concerns about possible health risks due to their EMF emissions.

For some time a number of individuals have reported a variety of health problems that they relate to exposure to EMF. While some individuals report mild symptoms and react by avoiding the fields as best they can, others are so severely affected that they cease work and change their entire lifestyle. This reputed sensitivity to EMF has been generally termed "electromagnetic hypersensitivity" or EHS.

This fact sheet describes what is known about the condition and provides information for helping people with such symptoms. Information provided is based on a WHO Workshop on Electrical Hypersensitivity (Prague, Czech Republic, 2004), an international conference on EMF and non-specific health symptoms (COST244bis, 1998), a European Commission report (Bergqvist and Vogel, 1997) and recent reviews of the literature.

What is EHS?

EHS is characterized by a variety of non-specific symptoms, which afflicted individuals attribute to exposure to EMF. The symptoms most commonly experienced include dermatological symptoms (redness, tingling, and burning sensations) as well as neurasthenic and vegetative symptoms (fatigue, tiredness, concentration difficulties, dizziness, nausea, heart palpitation, and digestive disturbances). The collection of symptoms is not part of any recognized syndrome.

EHS resembles multiple chemical sensitivities (MCS), another disorder associated with low-level environmental exposures to chemicals. Both EHS and MCS are characterized by a range of non-specific symptoms that lack

apparent toxicological or physiological basis or independent verification. A more general term for sensitivity to environmental factors is Idiopathic Environmental Intolerance (IEI), which originated from a workshop convened by the International Program on Chemical Safety (IPCS) of the WHO in 1996 in Berlin. IEI is a descriptor without any implication of chemical etiology, immunological sensitivity or EMF susceptibility. IEI incorporates a number of disorders sharing similar non-specific medically unexplained symptoms that adversely affect people. However since the term EHS is in common usage it will continue to be used here.

Prevalence

There is a very wide range of estimates of the prevalence of EHS in the general population. A survey of occupational medical centres estimated the prevalence of EHS to be a few individuals per million in the population. However, a survey of self-help groups yielded much higher estimates. Approximately 10% of reported cases of EHS were considered severe.

There is also considerable geographical variability in prevalence of EHS and in the reported symptoms. The reported incidence of EHS has been higher in Sweden, Germany, and Denmark, than in the United Kingdom, Austria, and France. VDU-related symptoms were more prevalent in Scandinavian countries, and they were more commonly related to skin disorders than elsewhere in Europe. Symptoms similar to those reported by EHS individuals are common in the general population.

Studies on EHS individuals

A number of studies have been conducted where EHS individuals were exposed to EMF similar to those that they attributed to the cause of their symptoms. The aim was to elicit symptoms under controlled laboratory conditions.

The majority of studies indicate that EHS individuals cannot detect EMF exposure any more accurately than non-EHS individuals. Well controlled and conducted double-blind studies have shown that symptoms were not correlated with EMF exposure.

It has been suggested that symptoms experienced by some EHS individuals might arise from environmental factors unrelated to EMF. Examples may include "flicker" from fluorescent lights, glare and other visual problems with VDUs, and poor ergonomic design of computer workstations. Other factors that may play a role include poor indoor air quality or stress in the workplace or living environment.

There are also some indications that these symptoms may be due to pre-existing psychiatric conditions as well as stress reactions as a result of worrying about EMF health effects, rather than the EMF exposure itself.

Conclusions

EHS is characterized by a variety of non-specific symptoms that differ from individual to individual. The symptoms are certainly real and can vary widely in their severity. Whatever its cause, EHS can be a disabling problem for the affected individual. EHS has no clear diagnostic criteria and there is no scientific basis to link EHS symptoms to EMF exposure. Further, EHS is not a medical diagnosis, nor is it clear that it represents a single medical problem.

Physicians: Treatment of affected individuals should focus on the health symptoms and the clinical picture, and not on the person's perceived need for reducing or eliminating EMF in the workplace or home. This requires:

- a medical evaluation to identify and treat any specific conditions that may be responsible for the symptoms,
- a psychological evaluation to identify alternative psychiatric/psychological conditions that may be responsible for the symptoms,
- an assessment of the workplace and home for factors that might contribute to the presented symptoms. These could include indoor air pollution, excessive noise, poor lighting (flickering light) or ergonomic factors. A reduction of stress and other improvements in the work situation might be appropriate.

For EHS individuals with long lasting symptoms and severe handicaps, therapy should be directed principally at reducing symptoms and functional handicaps. This should be done in close co-operation with a qualified medical specialist (to address the medical and psychological aspects of the symptoms) and a hygienist (to identify and, if necessary, control factors in the environment that are known to have adverse health effects of relevance to the patient).

Treatment should aim to establish an effective physician-patient relationship, help develop strategies for coping with the situation and encourage patients to return to work and lead a normal social life.

EHS individuals: Apart from treatment by professionals, self help groups can be a valuable resource for the EHS individual.

Governments: Governments should provide appropriately targeted and balanced information about potential health hazards of EMF to EHS individuals, health-care professionals and employers. The information should include a clear statement that no scientific basis currently exists for a connection between EHS and exposure to EMF.

Researchers: Some studies suggest that certain physiological responses of EHS individuals tend to be outside the normal range. In particular, hyper reactivity in the central nervous system and imbalance in the autonomic nervous system need to be followed up in clinical investigations and the results for the individuals taken as input for possible treatment.

What WHO is doing

WHO, through its International EMF Project, is identifying research needs and co-ordinating a world-wide program of EMF studies to allow a better understanding of any health risk associated with EMF exposure. Particular emphasis is placed on possible health consequences of low-level EMF. Information about the EMF Project and EMF effects is provided in a series of fact sheets in several languages www.who.int/emf/.

FURTHER READING

WHO workshop on electromagnetic hypersensitivity (2004), October 25 - 27, Prague, Czech Republic, www.who.int/peh-emf/meetings/hypersensitivity_prague2004/en/index.html

COST244bis (1998) Proceedings from Cost 244bis International Workshop on Electromagnetic Fields and Non-Specific Health Symptoms. Sept 19-20, 1998, Graz, Austria

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Seitz H, Stinner D, Eikmann Th, Herr C, Roosli M. (2005) Electromagnetic hypersensitivity (EHS) and subjective health complaints associated with electromagnetic fields of mobile phone communication—a literature review published between 2000 and 2004. *Science of the Total Environment*, June 20 (Epub ahead of print).

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Electromagnetic fields and public health

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Base stations and wireless technologies

Fact sheet N°304

May 2006

Mobile telephony is now commonplace around the world. This wireless technology relies upon an extensive network of fixed antennas, or base stations, relaying information with radiofrequency (RF) signals. Over 1.4 million base stations exist worldwide and the number is increasing significantly with the introduction of third generation technology.

Other wireless networks that allow high-speed internet access and services, such as wireless local area networks (WLANs), are also increasingly common in homes, offices, and many public areas (airports, schools, residential and urban areas). As the number of base stations and local wireless networks increases, so does the RF exposure of the population. Recent surveys have shown that the RF exposures from base stations range from 0.002% to 2% of the levels of international exposure guidelines, depending on a variety of factors such as the proximity to the antenna and the surrounding environment. This is lower or comparable to RF exposures from radio or television broadcast transmitters.

There has been concern about possible health consequences from exposure to the RF fields produced by wireless technologies. This fact sheet reviews the scientific evidence on the health effects from continuous low-level human exposure to base stations and other local wireless networks.

Health concerns

A common concern about base station and local wireless network antennas relates to the possible long-term health effects that whole-body exposure to the RF signals may have. To date, the only health effect from RF fields identified in scientific reviews has been related to an increase in body temperature ($> 1\text{ }^{\circ}\text{C}$) from exposure at very high field intensity found only in certain industrial facilities, such as RF heaters. The levels of RF exposure from base stations and wireless networks are so low that the temperature increases are insignificant and do not affect human health.

The strength of RF fields is greatest at its source, and diminishes quickly with distance. Access near base station antennas is restricted where RF signals may exceed international exposure limits. Recent surveys have indicated that RF exposures from base stations and wireless technologies in publicly accessible areas (including schools and hospitals) are normally thousands of times below international standards.

In fact, due to their lower frequency, at similar RF exposure levels, the body absorbs up to five times more of the signal from FM radio and television than from base stations. This is because the frequencies used in FM radio (around 100 MHz) and in TV broadcasting (around 300 to 400 MHz) are lower than those employed in mobile telephony (900 MHz and 1800 MHz) and because a person's height makes the body an efficient receiving antenna. Further, radio and television broadcast stations have been in operation for the past 50 or more years without any adverse health consequence being established.

While most radio technologies have used analog signals, modern wireless telecommunications are using digital transmissions. Detailed reviews conducted so far have not revealed any hazard specific to different RF modulations.

Cancer: Media or anecdotal reports of cancer clusters around mobile phone base stations have heightened public concern. It should be noted that geographically, cancers are unevenly distributed among any population. Given the widespread presence of base stations in the environment, it is expected that possible cancer clusters will occur near base stations merely by chance. Moreover, the reported cancers in these clusters are often a collection of different types of cancer with no common characteristics and hence unlikely to have a common cause.

Scientific evidence on the distribution of cancer in the population can be obtained through carefully planned and executed epidemiological studies. Over the past 15 years, studies examining a potential relationship between RF transmitters and cancer have been published. These studies have not provided evidence that RF exposure from the transmitters increases the risk of cancer. Likewise, long-term animal studies have not established an increased risk of cancer from exposure to RF fields, even at levels that are much higher than produced by base stations and wireless networks.

Other effects: Few studies have investigated general health effects in individuals exposed to RF fields from base stations. This is because of the difficulty in distinguishing possible health effects from the very low signals emitted by base stations from other higher strength RF signals in the environment. Most studies have focused on the RF exposures of mobile phone users. Human and animal studies examining brain wave patterns, cognition and behaviour after exposure to RF fields, such as those generated by mobile phones, have not identified adverse effects. RF exposures used in these studies were about 1000 times higher than those associated with general public exposure from base stations or wireless

networks. No consistent evidence of altered sleep or cardiovascular function has been reported.

Some individuals have reported that they experience non-specific symptoms upon exposure to RF fields emitted from base stations and other EMF devices. As recognized in a recent WHO fact sheet "Electromagnetic Hypersensitivity", EMF has not been shown to cause such symptoms. Nonetheless, it is important to recognize the plight of people suffering from these symptoms.

From all evidence accumulated so far, no adverse short- or long-term health effects have been shown to occur from the RF signals produced by base stations. Since wireless networks produce generally lower RF signals than base stations, no adverse health effects are expected from exposure to them.

Protection standards

International exposure guidelines have been developed to provide protection against established effects from RF fields by the International Commission on Non-Ionizing Radiation Protection (ICNIRP, 1998) and the Institute of Electrical and Electronic Engineers (IEEE, 2005).

National authorities should adopt international standards to protect their citizens against adverse levels of RF fields. They should restrict access to areas where exposure limits may be exceeded.

Public perception of risk

Some people perceive risks from RF exposure as likely and even possibly severe. Several reasons for public fear include media announcements of new and unconfirmed scientific studies, leading to a feeling of uncertainty and a perception that there may be unknown or undiscovered hazards. Other factors are aesthetic concerns and a feeling of a lack of control or input to the process of determining the location of new base stations. Experience shows that education programmes as well as effective communications and involvement of the public and other stakeholders at appropriate stages of the decision process before installing RF sources can enhance public confidence and acceptability.

Conclusions

Considering the very low exposure levels and research results collected to date, there is no convincing scientific evidence that the weak RF signals from base stations and wireless networks cause adverse health effects.

WHO Initiatives

WHO, through the International EMF Project, has established a programme to monitor the EMF scientific literature, to evaluate the health effects from exposure to EMF in the range from 0 to 300 GHz, to provide advice about possible EMF hazards and to identify suitable mitigation measures.

Following extensive international reviews, the International EMF Project has promoted research to fill gaps in knowledge. In response national governments and research institutes have funded over \$250 million on EMF research over the past 10 years.

While no health effects are expected from exposure to RF fields from base stations and wireless networks, research is still being promoted by WHO to determine whether there are any health consequences from the higher RF exposures from mobile phones.

The International Agency for Research on Cancer (IARC), a WHO specialized agency, is expected to conduct a review of cancer risk from RF fields in 2006-2007 and the International EMF Project will then undertake an overall health risk assessment for RF fields in 2007-2008.

Further Reading

ICNIRP (1998) www.icnirp.org/documents/emfgdl.pdf

IEEE (2006) IEEE C95.1-2005 "IEEE Standard for Safety Levels with Respect to Human Exposure to Radio Frequency Electromagnetic Fields, 3 kHz to 300 GHz"

Related links

[Base stations & wireless networks: Exposures & health consequences](#)

[Fact sheet: Electromagnetic fields and public health: Electromagnetic Hypersensitivity](#)

[WHO handbook on "Establishing a Dialogue on Risks from Electromagnetic Fields"](#)

[2006 WHO Research Agenda for Radio Frequency Fields pdf, 100kb](#)

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New Hampshire Electric Cooperative's Smart Grid Project Frequently Asked Questions (FAQ)

What is the project overview?

Between now and March 2013, NHEC will be replacing all of its existing electric meters with "smart meters" that are capable of sending and receiving usage data.

NHEC's Smart Grid project is actually two projects in one – the creation of a Communications Systems Infrastructure (CSI) and an Advanced Metering Infrastructure (AMI). When complete, the two projects will work together to allow your electric meter to report its readings, receive signals from NHEC and provide a wealth of usage data that you can use to control costs and manage your energy use.

Why is NHEC installing a Smart Grid system?

There are a number of benefits to both the membership and the Co-op, but first, some background...

For much of the past century, the relationship between an electric utility and its customers has been a one-way street. The utility sells electricity at a set price, sends out a meter reader once a month to record monthly usage, then sends the customer a bill. With a Smart Grid system in place, meters report their readings wirelessly several times per day. With a free web portal or in-home display that communicates with the meter, members are able to see their electric usage in daily, hourly, or even five-minute increments. Having the ability to review energy usage patterns can help members determine ways to save on energy costs and identify problems that increase energy use, such as a failing well pump. And because smart meters can send and receive data, the utility is able to provide innovative new rate structures and programs that can help consumers better understand when and how to use electricity.

Smart Grid means a number of operational efficiencies for the Co-op, including the elimination of manual meter reading and big improvements in outage reporting and management. For the first time, NHEC will not have to rely upon the member calling in to report an outage. Each smart meter is equipped with a capacitor that issues a "last gasp" signal when it loses power.

This means that NHEC will know down to the individual meter where outages are occurring and will be able to respond more efficiently.

What is the Communications Systems Infrastructure (CSI) part of the project ?

NHEC's CSI project is the communications backbone of the Smart Grid project. It is a microwave and fiber optic network connecting 20 tower sites that provide seamless communications to and from all 83,000 NHEC electric meters, from Derry in the south to Pittsburg in the far northern part of the state. The CSI is designed to work in concert with the wireless "mesh network" of meters that form the Advanced Metering Infrastructure (AMI), which will be reporting electric usage data several times a day via brief Radio Frequency (RF) transmissions.

What is a mesh network?

Think of your smart meter as one link in a big chain. Your meter will be automatically reporting readings and interval data seven times per day. Each transmission, approximately 1.5 seconds in duration, can travel up to 1,600 feet. In most cases, your meter will be reporting readings to the next closest meter, which gathers that data, adds its own readings and moves it along to the next meter in the chain. Eventually, that bundle of data reaches a gatekeeper. (Repeaters will be installed on existing poles to relay the readings of those meters that are located more than 1,600 feet away from the closest meter). Each night, the gatekeepers will transmit their bundles of readings via a mid-tier radio system to the nearest "takeout point," where the data will be sent back to Co-op headquarters in Plymouth for processing via one or more of the 20 microwave tower sites that form the Communications System Infrastructure (CSI). To assure the robustness and security of the system that carries all this data, NHEC has also installed a 30-mile stretch of fiber optic cable that connects our Plymouth headquarters to our facility in Meredith, which will provide a back-up operations center in the event that Plymouth is unavailable.

When will smart meters be installed?

The first smart meters will be installed as early as summer 2011. Installations will occur first in the Lakes Region and Plymouth areas, as the Communications System Infrastructure (CSI) is up and running in these locations. All meter installations are scheduled to be complete by March 2013. Members that are scheduled for meter replacement will be notified approximately one month ahead of the scheduled installation.

What will happen to the old meters?

Meters coming out of the field will be disassembled and recycled. NHEC investigated the possibility of donating functioning meters to developing countries through the National Rural Electric Cooperative Association's International Program, but found little demand for the meters. With electric utilities across the country installing millions of smart meters, there is more than enough supply to meet demand overseas.

Will I be paying a different rate for electricity once my smart meter is installed?

No. NHEC members will continue to be billed under their current rate structure once smart meters are installed. If NHEC decides to implement new “dynamic pricing” rate structures or programs, information will be made available and enrollment will be purely voluntary. Members will continue to receive a monthly bill after receiving a smart meter. After 30 days with a new smart meter, members will be able to access a free web portal (located on your Account homepage at www.nhec.coop) that will display detailed usage and cost information associated with your meter.

Will my smart meter affect the operation of my generator?

No. Your generator will continue to function as it always has. Regardless of the electric meter or generator, NHEC’s terms of service require that any generator operating in NHEC service territory be equipped with a transfer switch. NHEC reserves the right to inspect generators for the safety of members and NHEC line crews that may be working nearby. NHEC offers a free generator safety inspection. To schedule an inspection, please contact Member Solutions at 1-800-698-2007.

I don’t want a smart meter. Can I opt out?

All NHEC members – residential and commercial – will receive smart meters. This is a mandatory meter upgrade. All electric meters in NHEC service territory are owned by NHEC and our terms and conditions allow us to remove or replace any and all meters. For practical purposes, there will be no more meter readers to read traditional meters once the Smart Grid conversion is complete. Also, the effectiveness of the mesh network is degraded with the removal of each meter from the network.

Will NHEC be making new rates or programs available to take advantage of Smart Grid technology?

As part of its initial rollout of Smart Grid technology, NHEC will be providing up to 2,000 in-home displays to members who volunteer to be part of a pilot program starting in 2012. Members eligible to receive an in-home display will be chosen from among the first 30,000 members to receive smart meters. These in-home displays can be used to show, among other things, your current electric use, the cost of the power you are using and historical usage data. NHEC will be assessing the impact of in-home displays on members’ usage before deciding whether or not to make them available to the entire membership. Similarly, NHEC will be conducting other pilot programs beginning in 2012 that may include new time-of-use rates and the installation of load control switches in the home. Ultimately, the goal of NHEC’s Smart Grid project is to make available those tools and resources that will help its members better understand their electric usage and take steps to reduce their costs. Participation in any programs offered by NHEC will be strictly voluntary.

Will Smart Grid allow NHEC to control my electric usage?

No. Simply installing a smart meter at your home or business does not give NHEC the ability to remotely adjust your energy usage. This feature can only work with the installation of load control devices that will not be installed unless 1) NHEC makes them available, 2) you want

them, and 3) you expressly allow NHEC to install them. Members will be receiving information at a later date if and when NHEC decides to make this feature available to all members.

How much will the NHEC Smart Grid project cost and what will be the impact on my electric rates?

The total cost of the Smart Grid project is approximately \$36 million. NHEC was able to qualify for \$15.8 million in federal grants to help pay for the conversion. The funding for the remainder of the project costs is already included in your monthly bill as represented by the Delivery Charge component.

In order to fund the project without raising members' rates (for these specific projects), NHEC has re-purposed current funding toward this project. Those funds were used to pay for other projects such as the installation of equipment in our substations throughout our system to improve reliability. In addition, as NHEC continues to pay down its debt, the funds from this debt repayment will also be repurposed to pay for the Smart Grid conversion.

Over the course of the next several years, NHEC will utilize short-term borrowing through an existing line of credit to fund these projects; be reimbursed from the Federal government under the grants and pay the remainder off with funds already collected from the membership. We are also actively seeking partnerships to use and pay for the system, which will further reduce the cost to our membership.

What is NHEC doing to ensure the security of the data coming to and from my smart meter?

Transmissions sent and received by Smart meters will not contain members' personal information, such as bank/debit/credit account numbers, name, phone number or address. It is physically impossible for personal financial information to be acquired through hacking of or tampering with data being sent and received by Smart meters. The only information transmitted by a smart meter will be voltage and wattage data, and an identifying number that associates that data with a particular meter.

In the interest of safeguarding members' information, NHEC employs a full-time Information Systems Security Executive with the responsibility of overseeing the organization's Information Systems Security Program. This program is audited annually by an independent information technology security auditing organization. NHEC has developed a Cyber Security Plan specifically for this Smart Grid project which, has been reviewed and approved by the Department of Energy (DOE). Additionally, NHEC will be working diligently with the selected Smart Grid vendor to ensure that the system incorporates the highest possible levels of security to prevent unauthorized access.

What about the health effects of Radio Frequency transmissions?

NHEC understands that our members want to be well informed about new technologies. Electric Smart meters are digital meters that have been widely used since the 1980s, including several dozen currently in use in NHEC service territory. The generation of smart meters being installed across Co-op service territory is equipped with a small 1/4-watt radio that allows two-way communication between the member and NHEC, which enables the member to review their daily energy use.

In everyday use, your Smart meter will be transmitting usage data approximately seven to 10 times a day. Each transmission is approximately 1.5 seconds in duration and broadcasts in the 900 MHz spectrum at a power output of 250 milliwatts. Smart meters transmit relatively weak radio signals, resembling those of many other products most people use every day, like cell phones, baby monitors and microwave ovens. However, given the Smart meter's location outside the home or business, the infrequency of transmissions and the relative weakness of the signal, its radio waves are much less powerful than even the devices listed above. In fact, radio waves from a Smart meter, at a distance of 10 feet, are only about one one-thousandth as much as a typical cell phone.

Based on years of studying whether radio waves cause health effects, the Federal Communications Commission (FCC) has adopted [Maximum Permissible Exposure \(MPE\)](#) limits for radio transmitters of all types, including Smart meters. It includes a margin of safety just in case some health effects are too subtle to have been detected. Even so, Smart meters operate far below the limit—typically only about one-seventieth as much.

Learn more...

In January, 2011, the California Council on Science and Technology (CCST) released a preliminary study entitled "[Health Impacts of Radio Frequency from Smart meters](#)".

Quoting from the study, there are two primary conclusions:

1. The Federal Communications Commission (FCC) standard for Maximum Exposure provides a currently accepted factor of safety against known thermally induced health impacts of smart meters and other electronic devices in the same range of RF emissions. Exposure levels from Smart meters are well below the thresholds for such effects.
2. There is no evidence that additional standards are needed to protect the public from smart meters.



February 10, 2012

Radio Frequency Radiation and Health: Smart Meters

Electric utilities are working to install advanced metering technology known as “smart meters” that use radio signals to communicate electricity demand through mobile telecommunications. The signals that are used – radio frequency radiation or RFR – are the same type as those used for radio and TV broadcasting for many years. Microwave ovens, radar and wi-fi devices also emit RFR, but today mobile telephones are the most common source of exposure to RFR.

There is little scientific data specific to smart meters. However, the RFR from smart meters and mobile telephones are nearly identical, so investigations on potential health effects from mobile telephones can be used to estimate potential health effects from smart meters. Smart meters, according to both mathematical modeling and field tests, emit RFR at very low levels, lower than mobile telephones. The current health protection standards established for mobile telephones in the U.S. and in most other countries around the world are generally accepted as sufficient to prevent health effects from smart meters.

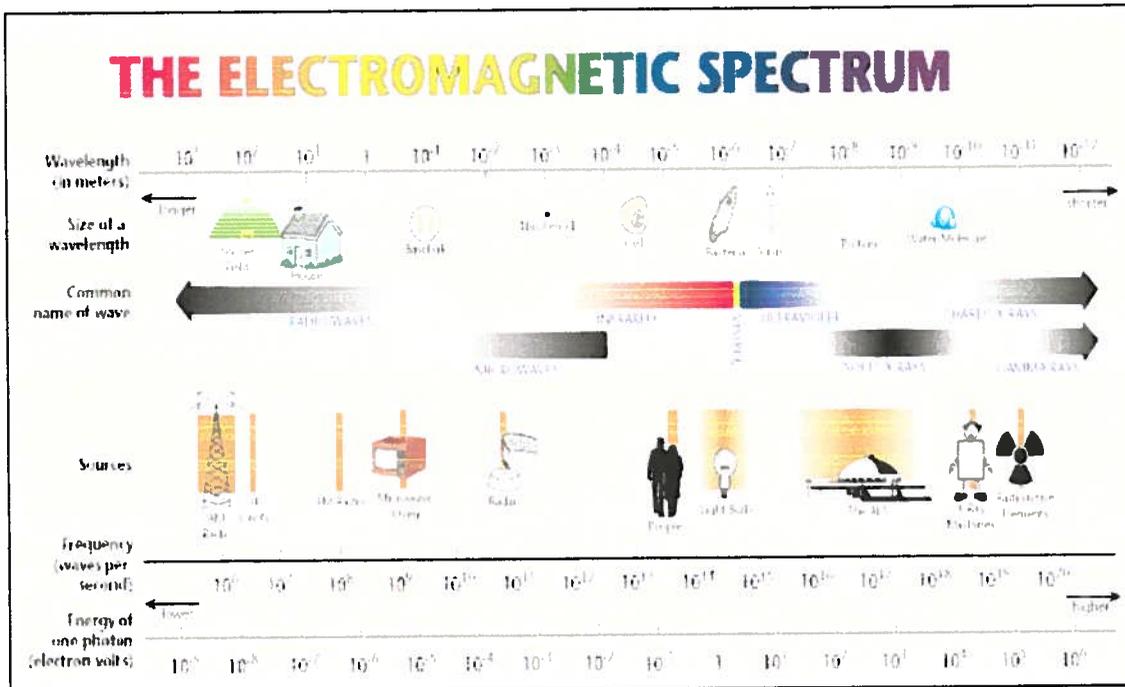
In January 2012, the Vermont Department of Health made actual measurements at active smart meters installed by Green Mountain Power in Colchester. The readings from these devices verify that they emit no more than a small fraction of the RFR emitted from a wireless phone, even at very close proximity to the meter, and are well below regulatory limits set by the Federal Communications Commission (FCC).

For example, measurements taken directly in contact with a smart meter on the exterior wall of a residence ranged from 50 to 140 $\mu\text{W}/\text{cm}^2$ compared to the FCC’s maximum permissible exposure limit of 610 $\mu\text{W}/\text{cm}^2$ for a member of the public. Measurements at distances of three feet or more away from the smart meter were at or near background. (See *Smart Meter Measurements in Vermont*, p. 4 for full discussion.)

After extensive review of the scientific literature available to date and current FCC regulatory health protection standards, we agree with the opinion of experts:

- The thermal health effects of RFR are well understood, and are the current basis for regulatory exposure limits. These limits are sufficient to prevent thermal health effects.
- Non-thermal health effects have been widely studied, but are still theoretical and have not been recognized by experts as a basis for changing regulatory exposure limits.

The Vermont Department of Health has concluded that the current regulatory standards for RFR from smart meters are sufficient to protect public health.



SOURCE: Lawrence Berkeley National Laboratory

Regulation of Radio Frequency Radiation

Exposure to RFR from devices is generally regulated by the Federal Communications Commission (FCC), which licenses entities that use radio frequencies. The FCC has taken the recommendations of the National Council on Radiation Protection and Measurements (NCRP) and the Institute of Electrical and Electronics Engineers (IEEE) to put forth maximum permissible exposure (MPE) limits for radio frequency radiation as generated by devices using the frequencies it licenses. The MPEs are based on preventing thermal effects from RFR. The NCRP guidelines and the IEEE standard are formulated with knowledge and analysis of the scientific literature regarding non-thermal effects of RFR. Neither the NCRP nor the IEEE considered the evidence from epidemiological and laboratory studies of non-thermal effects sufficient for guidance or standard-setting.

The FCC maximum permissible exposure limits are established to prevent thermal effects of RFR using units of power density. Power density is measured in units of watts per square meter (W/m^2), milliwatts per square centimeter (mW/cm^2) or microwatts per square centimeter ($\mu W/cm^2$). The MPE varies over the range of radio frequencies because the human body absorbs some radio frequencies more than others. Whatever the frequency, exposures less than the MPE will maintain the thermal energy absorption in the human body well below any hazardous level.

Basis of the Regulatory Standards

The human body is capable of absorbing a range of thermal energy changes with physiological cooling mechanisms. However, at certain rates of heating, the body cannot compensate. The MPE limits are designed to prevent heating of human tissues beyond this capacity and are derived from what are called specific absorption rates. MPE limits are set to ensure that the heating of our bodies is at a rate that our bodies can handle without risk of adverse effects. A wide safety margin is provided. In particular, the lowest specific absorption rate found in laboratory animals and human test subjects to cause adverse biological effects is 4.0 watts of heating per kilogram of tissue as averaged over the entire mass of the body. To provide a safety margin, the MPE limits for workers are based on 0.4 watts per kilogram (W/kg), which is 10 times lower than this lowest observable adverse effect level. The public MPE limit is based on a specific absorption rate of no more than 0.08 W/kg because it is assumed that members of the public may be exposed 168 hours per week rather than the 40 hours per week a worker might be maximally exposed.

The MPE limit is designed to prevent thermal effects, and scientific panels reviewed hundreds of research studies to arrive at a consensus. The MPE limit is not based on any non-thermal effects. Nevertheless, the committees making the recommendations for the MPE limits evaluated health effects and other research that focused on possible non-thermal effects. Members of NCRP Committee 53, which prepared NCRP Report 86. *Biological Effects and Exposure Criteria for Radiofrequency Electromagnetic Fields* considered numerous laboratory studies of cells, whole animals and humans as well as numerous epidemiological studies of human populations exposed in occupational and public settings which sought to quantify an association of RFR exposure with effects that are not related to temperature change. The IEEE Standards Coordinating Committee 28 did the same for its IEEE C95.1-1999 publication *IEEE Standard for Safety Levels with Respect to Human Exposure to Radio Frequency Electromagnetic Fields, 3 kHz to 300 GHz*.

The 1986 NCRP publication devoted significantly less attention to non-thermal effects than did the 1999 IEEE publication. Neither the NCRP nor the IEEE determined that there was sufficient evidence of harm. The NCRP stated that:

There are several thousands of reports – scientific papers, books, articles, and newspaper accounts – of widely varying scientific quality that present data or opinion on the biological response to [radio-frequency electromagnetic] radiations, no consensus has emerged regarding thresholds and mechanisms of injury at specific absorption rates (SARs) below a few watts per kilogram (W/kg).

Nevertheless, the vast majority of new research and more recent summaries on the health effects of radio frequency radiation have focused on non-thermal effects. Other issues of interest include concerns that certain people are more sensitive to RFR than others, that certain frequency modulations are uniquely harmful, and that long-term exposure to RFR can have cumulative effects.

The IEEE (1999) stated:

That no reliable scientific data exist indicating that a) certain subgroups of the population are more at risk than others; b) exposure duration at ANSI C95.1-1982 levels is a significant risk; c) damage from exposure to electromagnetic fields is cumulative; or d) nonthermal effects (other than shock) or modulation-specific sequelae of exposure may be meaningfully related to human health.

Smart Meter Measurements in Vermont

Smart meters are a part of enhancements to the electricity distribution system designed to help manage and prevent electricity demands that surpass supply throughout the day and over longer periods of time. Some smart meters relay user electricity demand information to the electricity providers using hard wire, while others use wireless devices. The wireless devices work similarly to how a mobile telephone does: a radio signal is sent from the user's meter via a small transmitter to an antenna connected to another radio transmitter, which repeats the process until the user information is collected at its final destination. This network of radio transmitter/receivers may take many shapes depending on the distribution of users and topography.

Some wireless smart meters operate at the frequency range of 902 to 928 megahertz (MHz). Other frequencies used include 2.4 gigahertz (GHz) and, to a lesser extent, 150-222, 450-470 and 950 MHz. These are frequencies also previously or currently used by mobile telephones. The radio signal from smart meter transmitters is measured in watts (W). The typical smart meter has a power level of 0.250 W or less, although some may have a power level of 1.0 W. By comparison, a mobile telephone might have a power level of 3.0 W. A cordless telephone might use 0.25 W and a wireless router used to connect computer components might use about 1.0 W.

Gatekeeper Meter Measurements

A "gatekeeper" meter is mounted on the roof of the Green Mountain Power facility in Colchester where it communicates with a nearby neighborhood where the electric meters have been replaced with smart meters. Its radio signal is more powerful than that of the smart meters as it communicates with many simultaneously. On January 11, 2012, the Vermont Department of Health obtained measurements of RFR from its antenna located at the top of the gatekeeper case.

This site is restricted from public use. The maximum permissible exposure limit for occupational exposures from this site is **3,050 $\mu\text{W}/\text{cm}^2$** .

- RFR emissions from the unit ranged from 2,100 to 2,888 microwatts per square centimeter ($\mu\text{W}/\text{cm}^2$) on contact with the transmitting antenna.
- Emissions measured $120 \mu\text{W}/\text{cm}^2$ at 12 inches from the transmitter. RFR levels were measured at background levels at distances of three feet or more from the transmitter.

Residential Smart Meter Measurements

Also on January 11, 2012, the Health Department obtained RFR measurements from an operating smart meter on the exterior wall of a residence in Colchester, when it was instructed to download data to the gatekeeper. Measurements were taken with a Narda Model 8712 RFR Survey Meter. The surveyor has been specifically trained by Narda to obtain these readings.

This smart meter is in a residential neighborhood. The maximum permissible exposure limit for a member of the general public for RFR from this smart meter is **610 $\mu\text{W}/\text{cm}^2$** .

- Measurements of RFR during transmission ranged from 50 to 140 $\mu\text{W}/\text{cm}^2$ on contact with the smart meter in the vicinity of its transmitting antenna.
- Measurements at 12 inches from the smart meter during transmission ranged between 10 and 50 $\mu\text{W}/\text{cm}^2$. Measurements at distances of three feet or more away from the smart meter were at or near the background level.
- A separate set of measurements were made within the residence in the room on the opposite side of the wall in the photograph above. No measurements of RFR above background were recorded during multiple instructions from the gatekeeper for the smart meter to transmit.
- A separate set of measurements were made in this neighborhood for the simultaneous transmission of all smart meters. No RFR could be distinguished above background during multiple tests.
- Another smart meter at a different residence was tested to see if RFR levels would differ during a remote connection and remote disconnection of the smart meter from the network. During multiple tests of this process, RFR was measured in the range of 50 to 90 $\mu\text{W}/\text{cm}^2$ on contact with the smart meter.
- RFR was indistinguishable from background more than three feet from the smart meter during normal transmissions.

A mobile telephone was used to test the Narda RFR Survey Meter in between measurements to verify satisfactory operations. The transmission of RFR from this mobile telephone at the time of measurement was 490 $\mu\text{W}/\text{cm}^2$.

Studies of Health Effects Specific to Smart Meters

There are not yet any research studies on health effects using smart meters as the source. The devices are very similar to mobile telephones in both radio frequency and radio power. As such, looking at the health effects research where mobile telephones are the source of RFR exposure makes sense.

One important difference between exposure from smart meters and mobile telephones is that of the physical arrangements of exposure. While a mobile telephone exposes the user's eyes, skull and brain with a transmitting antenna in close proximity, smart meters are fixed sources attached to the outside of buildings. This should make comparisons to the health effects research findings from mobile telephones a "worst case scenario."

Vermont is not the first state to investigate the health impacts of smart meters. Both Maine and California have previously published their assessment of smart meters for public health impacts. The following are summaries from recent efforts to characterize health risk from smart meter RFR conducted by the Maine Center for Disease Control, the California Council on Science and Technology and the Monterey County, California Health Department.

Maine Center for Disease Control

The Maine Center for Disease Control assembled a panel of state government leaders to review the scientific literature on smart meter and mobile phone RFRs, and published a summary opinion:

Our review of these national and international government or government-affiliated assessments indicate a broad consensus that studies to date give no consistent or convincing evidence of a causal relation between RF exposure in the range of frequencies and power used by smart meters and adverse health effects.

We found little information in these assessments that spoke directly about the safety of RF exposure from smart meters. There is, however, much discussion about the safety of mobile phones. Mobile phone use represents an RF exposure qualitatively similar to smart meters in range of frequency, but because the power is higher and typical use results in exposure closer to the body, the resulting exposure to RF appears to be quantitatively much greater than that from smart meters. Thus, it appears to us that the lack of any consistent and convincing evidence of a causal relation between RF exposure from mobile phones and adverse health effects would indicate even less concern for potential health effects from use of smart meters.

The full report is available at: <http://www.maine.gov/dhhs/mecdc/environmental-health/documents/smart-meters-maine-cdc-executive-summary-11-08-10.pdf>

Maine CDC also published a summary of the specific documents reviewed about smart meters and RFR: <http://www.maine.gov/dhhs/mecdc/environmental-health/smart-meters.shtml>

California Council on Science and Technology

The California Council on Science and Technology made a comprehensive review of the costs and benefits of smart metering, including a comparison of RFR emissions from various technologies and the real and perceived risks of RFR exposure from smart meters. The full report is available at:

<http://www.ccst.us/publications/2011/2011/smartA.pdf>

Monterey County Health Department

Like the Maine CDC, the Monterey County Health Department published its summary of a literature review. The full report is available at:

http://publicagendas.co.monterey.ca.us/MG97205/AS97224/AS97230/AI99413/DO99416/DO_99416.pdf

Health Effect Studies from a Regulatory Perspective

In the U.S., the FCC has long used the guidance of the National Council for Radiation Protection and Measurements. Before the FCC established its role (primarily due to the evolution of wireless technologies), industry standards of the Institute of Electrical and Electronics Engineers were used to establish RFR safety in the workplace and for the general public. The FCC is part of a federal Interagency Working Group. Other members include the Food and Drug Administration, the Occupational Safety and Health Administration and the Environmental Protection Agency.

In many parts of the rest of the world, regulations are adopted from standards recommended by the World Health Organization (WHO). The WHO relies on the work of the International Commission on Non-Ionizing Radiation Protection (ICNIRP) for science-based guidance in establishing regulatory recommendations.

National Council for Radiation Protection and Measurements (NCRP)

NCRP Report Number 86, *Biological Effects and Exposure Criteria for Radiofrequency Electromagnetic Fields*, provides the basis of current regulations for protecting workers and the general public as adopted by the FCC. This 1986 report is a comprehensive review of the thousands of research studies conducted up to that date. The research covered most areas of physical harm possible from RFR.

The NCRP guidance resolved on preventing thermal effects from what they called radiofrequency electromagnetic (RFEM) radiations, as measured by specific absorption rates (SAR) measured in watts of energy absorbed per kilogram (W/kg) of human tissue. The research at that time led them to conclude thermal effects were the only reproducible effects, and their SAR limits of 0.4 W/kg for workers and 0.08 W/kg for the general public remain the norm today, both in the U.S. and around the world.

With regard to the growing interest in non-thermal effects, the NCRP stated:

Although there are several thousands of reports – scientific papers, books, articles, and newspaper accounts – of widely varying scientific quality that

present data or opinion on the biological response to RFEM radiations, no consensus has emerged regarding thresholds and mechanisms of injury at specific absorption rates (SARs) below a few watts per kilogram (W/kg).

Institute of Electrical and Electronics Engineers (IEEE)

The IEEE has deliberated on the scientific literature of RFR exposure and effects since the 1950s. It has provided recommendations primarily to industry for protecting workers and the general public. Lacking other guidance, the IEEE standards served as the best available guidance for entities outside of industry until the NCRP published its recommendations in 1986. The IEEE health protection recommendations are similar to those of the NCRP and the International Commission for Non-Ionizing Radiation Protection (ICNIRP). The IEEE exposure limits are very similar to those adopted by the FCC and WHO.

From a 2005 publication by the IEEE's Committee on Man and Radiation:

The IEEE and other RF/microwave exposure limit standards are based principally on laboratory studies of animals using short exposure durations (hours at most). The limiting effect for whole body exposures (behavioral disruption) is clearly a thermal phenomenon. Some investigators have reported effects at much lower exposure levels, which are sometimes called "nonthermal" effects. Each version of the IEEE standard has acknowledged the existence of such reports, while at the same time indicating that they were insufficient to be considered a health hazard or to be used as a basis to develop exposure guidelines. For example, the 1991 standard states that "research on the effects of chronic exposure and speculations on the biological significance of nonthermal interactions have not yet resulted in any meaningful basis for alteration of the standard. It remains to be seen what future research may produce for consideration at the time of the next revision of this standard". Other organizations have independently reached this same conclusion.

The full publication is available at: <http://ewh.ieee.org/soc/embs/comar/standardsTIS.pdf>

Federal Communications Commission (FCC)

In the U.S., the FCC is the regulatory agency that has jurisdiction for health and safety relative to RFR from wireless technologies, including smart meters and mobile telephones. The FCC has promulgated limits for RFR exposure for workers and the general public. It also licenses organizations that use frequencies under its regulatory authority. Its perspective on RFR health protection is summarized in this document <http://transition.fcc.gov/oet/rfsafety/rf-faqs.html#Q5>:

Biological effects can result from exposure to RF energy. Biological effects that result from heating of tissue by RF energy are often referred to as "thermal"

effects. It has been known for many years that exposure to very high levels of RF radiation can be harmful due to the ability of RF energy to heat biological tissue rapidly. This is the principle by which microwave ovens cook food. Exposure to very high RF intensities can result in heating of biological tissue and an increase in body temperature. Tissue damage in humans could occur during exposure to high RF levels because of the body's inability to cope with or dissipate the excessive heat that could be generated. Two areas of the body, the eyes and the testes, are particularly vulnerable to RF heating because of the relative lack of available blood flow to dissipate the excess heat load.

At relatively low levels of exposure to RF radiation, i.e., levels lower than those that would produce significant heating; the evidence for production of harmful biological effects is ambiguous and unproven. Such effects, if they exist, have been referred to as "non-thermal" effects. A number of reports have appeared in the scientific literature describing the observation of a range of biological effects resulting from exposure to low-levels of RF energy. However, in most cases, further experimental research has been unable to reproduce these effects. Furthermore, since much of the research is not done on whole bodies (in vivo), there has been no determination that such effects constitute a human health hazard. It is generally agreed that further research is needed to determine the generality of such effects and their possible relevance, if any, to human health. In the meantime, standards-setting organizations and government agencies continue to monitor the latest experimental findings to confirm their validity and determine whether changes in safety limits are needed to protect human health.

A more detailed report is available from the FCC Office of Engineering and Technology. OET Bulletin 56, fourth edition, published in 1999 is available at:
http://transition.fcc.gov/Bureaus/Engineering_Technology/Documents/bulletins/oet56/oet56e4.pdf.

Food and Drug Administration (FDA)

The FDA is a part of the Interagency Working Group, which also includes the National Institute for Occupational Safety and Health, the Environmental Protection Agency, the Federal Communications Commission, the Occupational Safety and Health Administration and the National Telecommunications and Information Administration. The FDA will also investigate any mobile telephone that is suspected of emitting RFR in excess of FCC regulatory limits for device emissions. On its website, the FDA defines its perspective on mobile telephone RFR:

Cell phones emit low levels of radiofrequency energy (RF). Over the past 15 years, scientists have conducted hundreds of studies looking at the biological effects of the radiofrequency energy emitted by cell phones. While some researchers have reported biological changes associated with RF energy, these studies have failed to be replicated. The majority of studies published have failed to show an association between exposure to radiofrequency from a cell phone and health problems.

The low levels of RF cell phones emit while in use are in the microwave frequency range. They also emit RF at substantially reduced time intervals when in the stand-by mode. Whereas high levels of RF can produce health effects (by heating tissue), exposure to low level RF that does not produce heating effects causes no known adverse health effects.

This and other information from the FDA is available at: <http://www.fda.gov/radiation-emittingproducts/radiationemittingproductsandprocedures/homebusinessandentertainment/cellphones/default.htm>.

International Commission on Non-Ionizing Radiation Protection (ICNIRP)

ICNIRP is relied upon by the World Health Organization (WHO) for guidance on RFR and other non-ionizing radiation from low frequency electromagnetic fields from power lines to ultraviolet radiation. Numerous countries rely on WHO and ICNIRP guidance as they may not have the infrastructure to conduct their own science-based health protection research.

ICNIRP has updated its guidance most recently in 2009 in ICNIRP 16, *Exposure to High Frequency Electromagnetic Fields, Biological Effects and Health Consequences (100 kHz-300 GHz)*. This guidance reflects consideration of a great deal of evidence available since the NCRP published its Report 86, which serves as the basis of U.S. health protection regulations. This includes 15 years of laboratory and epidemiologic study of mobile telephone use, where the primary public health concern was cancer of the head and neck. It concludes:

In the last few years the epidemiologic evidence on mobile phone use and risk of brain and other tumors of the head has grown considerably. In our opinion, overall the studies published to date do not demonstrate a raised risk within approximately ten years of use for any tumor of the brain or any other head tumor. However, some key methodological problems remain - for example, selective non-response and exposure misclassification. Despite these methodologic shortcomings and the still limited data on long latency and long-term use, the available data do not suggest a causal association between mobile phone use and fast-growing tumors such as malignant glioma in adults, at least those tumors with short induction periods. For slow-growing tumors such as meningioma and acoustic neuroma, as well as for glioma among long-term users, the absence of associations reported thus far is less conclusive because the current observation period is still too short. Currently data are completely lacking on the potential carcinogenic effect of exposures in childhood and adolescence.

Electromagnetic Hypersensitivity

The WHO provides numerous guidance documents based upon ICNIRP research and deliberation, including on electromagnetic field (EMF) hypersensitivity or EHS. See <http://www.who.int/mediacentre/factsheets/fs296/en/index.html>.

The WHO concluded:

A number of studies have been conducted where EHS individuals were exposed to EMF similar to those that they attributed to the cause of their symptoms. The aim was to elicit symptoms under controlled laboratory conditions.

The majority of studies indicate that EHS individuals cannot detect EMF exposure any more accurately than non-EHS individuals. Well controlled and conducted double-blind studies have shown that symptoms were not correlated with EMF exposure.

It has been suggested that symptoms experienced by some EHS individuals might arise from environmental factors unrelated to EMF. Examples may include “flicker” from fluorescent lights, glare and other visual problems with VDUs, and poor ergonomic design of computer workstations. Other factors that may play a role include poor indoor air quality or stress in the workplace or living environment.

There are also some indications that these symptoms may be due to pre-existing psychiatric conditions as well as stress reactions as a result of worrying about EMF health effects, rather than the EMF exposure itself.

EHS is characterized by a variety of non-specific symptoms that differ from individual to individual. The symptoms are certainly real and can vary widely in their severity. Whatever its cause, EHS can be a disabling problem for the affected individual. EHS has no clear diagnostic criteria and there is no scientific basis to link EHS symptoms to EMF exposure. Further, EHS is not a medical diagnosis, nor is it clear that it represents a single medical problem

Earlier Research on Mobile Phones

There is only a limited amount of scientific research about the RFR from smart meters. However, the frequency of RFR from smart meters and the radiated power of transmitters employed in smart meters are the same as used in mobile telephones. This makes comparison to the scientific research on RFR from mobile telephones relevant. There is one very important difference between smart meter and mobile telephone RFR. Mobile telephone RFR is experienced by users often with the transmitting antenna very close to the body, including the skull, brain and eyes as compared to smart meters, which operate in fixed positions on the outside wall of a house or business.

The Royal Society of Canada (RSC) for Health Canada

In 1999, the Royal Society of Canada published *A Review of the Potential Health Risks of Radiofrequency Fields from Wireless Telecommunication Devices*.

This report provided a comprehensive review of the scientific literature available up to 1999 as part of Health Canada's routine activities for periodic review and revision of its safety codes. This report also concluded:

Scientific studies performed to date suggest that exposure to low intensity non-thermal RF fields do not impair health of humans or animals. However, the existing scientific evidence is incomplete, and inadequate to rule out the possibility that these non-thermal biological effects could lead to adverse health effects. Moreover, without an understanding of how low energy RF fields cause these biological effects, it is difficult to establish safety limits for non-thermal exposures.

The NRPB sponsored Independent Expert Group on Mobile Phones

In 2000, the National Radiological Protection Board of the United Kingdom, now a part of the UK's Health Protection Agency, sponsored its own comprehensive review of the scientific literature, *Mobile Phones and Health*. The report may be read in full at:

<http://www.iegmp.org.uk/report/text.htm>.

Its findings were similar to those published a year earlier by the Royal Society of Canada:

Despite public concern about the safety of mobile phones and base stations, rather little research specifically relevant to these emissions has been published in the peer-reviewed scientific literature. This presumably reflects the fact that it is only recently that mobile phones have been widely used by the public and as yet there has been little opportunity for any health effects to become manifest. There is, however, some peer-reviewed literature from human and animal studies, and an extensive non-peer-reviewed information base, relating to potential health effects caused by exposure to RF radiation from mobile phone technology.

The balance of evidence to date suggests that exposures to RF radiation below NRPB and ICNIRP guidelines do not cause adverse health effects to the general population.

There is now scientific evidence, however, which suggests that there may be biological effects occurring at exposures below these guidelines. This does not necessarily mean that these effects lead to disease or injury, but it is potentially important information and we consider the implications below.

There are additional factors that need to be taken into account in assessing any possible health effects. Populations as a whole are not genetically homogeneous and people can vary in their susceptibility to environmental hazards. There are well-established examples in the literature of the genetic predisposition of some

groups, which could influence sensitivity to disease. There could also be a dependence on age. We conclude therefore that it is not possible at present to say that exposure to RF radiation, even at levels below national guidelines, is totally without potential adverse health effects, and that the gaps in knowledge are sufficient to justify a precautionary approach.

In the light of the above considerations we recommend that a precautionary approach to the use of mobile phone technologies be adopted until much more detailed and scientifically robust information on any health effects becomes available.

We note that a precautionary approach, in itself, is not without cost but we consider it to be an essential approach at this early stage in our understanding of mobile phone technology and its potential to impact on biological systems and on human health.

In addition to these general considerations, there are concerns about the use of mobile phones in vehicles. Their use may offer significant advantages – for example, following accidents when they allow emergency assistance to be rapidly summoned. Nevertheless, the use of mobile phones whilst driving is a major issue of concern and experimental evidence demonstrates that it has a detrimental effect on drivers' responsiveness. Epidemiological evidence indicates that this effect translates into a substantially increased risk of an accident. Perhaps surprisingly, current evidence suggests that the negative effects of phone use while driving are similar whether the phone is hand-held or hands-free. Overall we conclude that the detrimental effects of hands-free operation are sufficiently large that drivers should be dissuaded from using either hand-held or hands-free phones whilst on the move.

Recent Scientific Findings: The Interphone Study

Much of the RFR health-related guidance of the 1990s concluded there was need for more research, especially for long-term users of mobile phones. The May 2010 publication of the results of the largest epidemiological study to date, the Interphone Study, provided it. Soon after the results were published in *Lancet*, the British medical journal, the International Agency for Research on Cancer (IARC) classified RFR from mobile telephones as a possible (Group 2B) carcinogen. This classification of RFR from mobile telephones as a possible carcinogen by IARC is explained in the press release issued at publication of the study:

Dr Christopher Wild, Director of IARC said: "An increased risk of brain cancer is not established from the data from Interphone. However, observations at the highest level of cumulative call time and the changing patterns of mobile phone use since the period studied by Interphone, particularly in young people, mean that further investigation of mobile phone use and brain cancer risk is merited.

The WHO, which includes IARC, provided more detail as to why RFR was classified as a Group 2B carcinogen:

The international pooled analysis of data gathered from 13 participating countries found no increased risk of glioma or meningioma with mobile phone use of more than 10 years. There are some indications of an increased risk of glioma for those who reported the highest 10% of cumulative hours of cell phone use, although there was no consistent trend of increasing risk with greater duration of use. The researchers concluded that biases and errors limit the strength of these conclusions and prevent a causal interpretation. Based largely on these data, IARC has classified radiofrequency electromagnetic fields as possibly carcinogenic to humans (Group 2B), a category used when a causal association is considered credible, but when chance, bias or confounding cannot be ruled out with reasonable confidence.

Numerous other organizations have reflected on the Interphone Study. ICNIRP provided a comprehensive review of a study titled *Mobile Phones, Brain Tumours and the Interphone Study: Where Are We Now?* published in the journal *Environmental Health Perspectives*. The objective of the study was to review the evidence on whether mobile phone use raises risk of the main types of brain tumour, glioma and meningioma, with a particular focus on the 13-country Interphone Study. It concluded that, although there remains some uncertainty, the trend in the accumulating evidence is increasingly against the hypothesis that mobile phone use can cause brain tumors in adults.

The full report is available at: <http://www.icnirp.org/documents/SCIREview2011.pdf>.

Food and Drug Administration

The FDA is part of the U.S. Interagency Working Group for mobile telephone safety, and will investigate reports of excessive RFR from mobile telephones. FDA responded to the Interphone Study:

The study reported little or no risk of brain tumors for most long-term users of cell phones. "There are still questions on the effect of long-term exposure to radio frequency energy that are not fully answered by Interphone," says Abiy Desta, network leader for science at FDA's Center for Devices and Radiological Health. "However, this study provides information that will be of great value in assessing the safety of cell phone use."

The full response is available at:

<http://www.fda.gov/downloads/ForConsumers/ConsumerUpdates/UCM212306.pdf>

This FDA consumer update cites a National Cancer Institute study that found no evidence of causality in an analysis of brain cancer incidence rates over the years 1992 to 2006, a period of rapidly growing mobile telephone use. NCI's fact sheet on cell telephones expresses its own perspective on the most recent mobile telephone epidemiological studies at <http://www.cancer.gov/cancertopics/factsheet/Risk/cellphones>:

Studies thus far have not shown a consistent link between cell phone use and cancers of the brain, nerves, or other tissues of the head or neck. More research is needed because cell phone technology and how people use cell phones have been changing rapidly.

The Health Physics Society (HPS)

The HPS is a professional organization of radiation protection professionals. HPS publishes fact sheets for public outreach, and one on mobile telephone RFR starts with:

To date, no adverse health effects have been established for mobile phone use. However, epidemiology data regarding long-term (more than 10 years) use of mobile phones (also known as “wireless” or “cell” phones) are sparse and unreliable and do not permit conclusions to be drawn about possible risks from long-term use of mobile phones.

The fact sheet provides also includes other recent expert assessments, such as from the European Commission Scientific Committee on Emerging and Newly Identified Health Risks, which stated in 2007:

No health effect has been consistently demonstrated at exposure levels below the ICNIRP limits established in 1998. The data for this evaluation is limited, especially for long-term, low-level exposure.

It also cites the Swedish Radiation Protection Authority for its 2008 opinion:

Short-term use of mobile phones does not appear to be associated with brain or head and neck cancer risks in adults.” It also cites ICNIRP 16, Exposure to High Frequency Electromagnetic Fields, Biological Effects and Health Consequences (100 kHz-300 GHz) where the Commission stated “results of epidemiological studies to date give no consistent or convincing evidence of a causal relation between RF exposure and any adverse health effect.

The full fact sheet may is available at:

http://hps.org/documents/Mobile_Telephone_Fact_Sheet_update_May_2010.pdf

**MAINE CDC EXECUTIVE SUMMARY OF
REVIEW OF HEALTH ISSUES RELATED TO
SMART METERS
November 8, 2010**

Background

On October 25th, 2010 a complaint was filed with the Maine Public Utilities Commission (PUC) focusing on concerns related to health, safety (malfunctioning, shorting out, and igniting), and security (vulnerability to hacking) of smart meters, also known as advanced metering infrastructure. The complaint requests several steps related to the stated health concerns, including asking the PUC for:

- A moratorium on the installation of smart meters, repeaters, nodes, antennas, and related wireless equipment in Maine in order for there to be a “thorough, independent and transparent investigation of the health, safety and security impacts relative to the CMP ‘Smart Meter Initiative’”;
- A consideration of “scientific, peer-reviewed studies on the safety of Smart Meter mesh networks and the pulsing radiofrequency signals to which the utility seeks to expose Maine families”;
- An “opt-out” from smart meters, including for those with electro-sensitivities and other qualifying medical conditions;
- A requirement that CMP accommodate those who “opt out” by ensuring mesh networks and pulsing radiofrequencies “do not permeate their residences at unacceptable and/or unhealthy levels” and to consider creating “safe zones”; and
- An opportunity to hear from national and international experts.

Maine CDC Approach

Since the end of September, Maine CDC has received and reviewed numerous emails and other communications on the issue of smart meters. During October and early November Dr. Mills reviewed numerous materials sent to her by both opponent and proponents of smart meters. She assembled several Maine CDC staff to review these materials. These staff, comprising a “Maine CDC Smart Meters Team” include: Jay Hyland, Andy Smith, ScD, Molly Schwenn, MD, Lauren Ball, DO, MPH, and Nancy Beardsley. Brief descriptions of their credentials are included at the end of this document.

After reviewing the large amount of materials sent to us, the Maine CDC team decided to increasingly focus our reviews on health studies and assessments by government agencies and some affiliated private and academic organizations, including the:

- World Health Organization (WHO),
- U.S. Federal Communications Commission (FCC),
- National Cancer Institute (NCI) in the National Institutes of Health (NIH),
- Health Canada (Canada’s public health agency),
- Health Protection Agency of the United Kingdom (U.K.’s public health agency),
- International Commission on Non-Ionizing Radiation Protection (ICNRP),
- Institute of Electrical and Electronics Engineers (IEEE),

- University of Ottawa's McLaughlin Centre for Population Health Risk Assessment,
- Ontario Agency for Health Protection and Promotion,
- Swedish Radiation Protection Authority, and
- Australian Radiation Protection and Nuclear Safety Agency.

A compilation of the summaries of these agencies' studies and assessments is included in the attached document "Smart Meter Review of Government Resources 11 08 10" (referred to as "review document"). These agency reviews focus on the health effects of the radiofrequency (RF) band of non-ionizing radiation, ie frequencies on the EMF (electromagnetic field) spectrum below those of visible light and X-rays, and higher than those of power lines.

Public Statements

Additionally, Dr. Mills received several press calls the past few weeks. Her speaking points with all of them are as follows:

- We (Maine CDC) received information from opponents of smart meters starting the end of September. We received information from CMP about a week later. We are reviewing both sets of information as well as reviewing some peer-reviewed literature and other materials on the matter. We have not had time yet to fully vet these materials, especially because of their volume.
- However, thus far, it appears from the information we have collected and vetted, that smart meters emit non-ionizing radiation, and not the kind that is found in X-Rays (which over-exposure from can change the structure and function of cells).
- It also appears that smart meters emit (non-ionizing) radiation that has a similar frequency and power as that of wireless routers, which many homes now have. And, that smart meters are used at the most about 10% of the time. So, smart meters appear to be similar to having a wireless router on the side of a house that we understand operates about 10% of the time. The frequencies and power of smart meters are also in the range of those found in cordless phones and cell phones. Therefore, there does not seem to be an analogy to having a cell phone tower on the side of one's house, as is reported by some of the emails we have received.
- Some of the same arguments we heard last winter in relation to cell phone use are similar to what we've seen presented with smart meters.
- Although we are commenting on possible health issues related to smart meters, this does not mean we are weighing in on whether or not people should have a choice in having them on their homes. We are also not analyzing the security or safety issues raised by some opponents, as these are not within our areas of expertise.

Brief Summary of Maine CDC's Findings

Our review of these national and international government or government-affiliated assessments indicate a broad consensus that studies to date give no consistent or convincing evidence of a causal relation between RF exposure in the range of frequencies and power used by smart meters and adverse health effects.

We found little information in these assessments that spoke directly about the safety of RF exposure from smart meters. There is, however, much discussion about the safety of mobile phones. Mobile phone use represents an RF exposure qualitatively similar to smart meters in range of frequency, but because the power is higher and typical use results in exposure closer to the body, the resulting exposure to RF appears to be quantitatively much greater than that from smart meters. Thus, it appears to us that the lack of any consistent and convincing evidence of a causal relation between RF exposure from mobile phones and adverse health effects would indicate even less concern for potential health effects from use of smart meters.

Cell Phones

The most comprehensive study to date on cell phones and cancer concerns, called the Interphone study, is an international pooled analysis of data gathered from 13 participating countries that was released in May of 2010 in the *International Journal of Epidemiology* (see relevant excerpts from this study in the accompanying review document).

Interphone researchers reported that overall, cell phone users have no increased risk for two of the most common types of brain tumor - glioma and meningioma. In addition, they found no evidence of increasing risk with progressively increasing number of calls, longer call time, or years since beginning cell phone use. For the small proportion of study participants who reported spending the most total time on cell phone calls, there was some increased risk of glioma, but the researchers and a number of reviewers considered this finding inconclusive because of the limitations resulting from biases and errors in the study. The researchers and most reviewers have noted the lack of data for mobile phone use over time periods longer than 15 years or data on exposure during childhood years, and thus recommend further research of mobile phone use and brain cancer risk.

We also are aware of a very recently published study (this month, November, 2010, see accompanying review document) by the National Cancer Institute (NCI) in the National Institutes of Health looking at brain cancer incidence in the U.S. The NCI study examined trends in brain cancer between 1992 and 2006, a time during which mobile phone subscribers in the U.S. increased from 50 million to nearly 250 million. The investigators concluded, "these incidence data do not provide support to the view that cellular phone use causes brain cancer."

Electromagnetic Hypersensitivity

Several of the national and international assessments included in the accompanying review document discuss electromagnetic hypersensitivity or EHS. The assessments report that a number of studies have been conducted in which EHS individuals were exposed to EMF similar to those that they attributed to the cause of their symptoms, with the aim to elicit symptoms under controlled laboratory conditions. The assessments further state that the majority of studies indicated that EHS individuals cannot detect EMF exposure any more accurately than non-EHS individuals, and that well controlled and conducted double-blind studies have shown that symptoms were not correlated with EMF exposure.

Other Health-Related Issues

Some of the concerns expressed in the complaint filed with PUC related to mesh networks are addressed in the accompanying document labeled "Smart Meter FCC Letter August 2010". This letter from the FCC explains that multiple meters in the same geographical area can only communicate to a controller one at a time, therefore "eliminating the potential for exposure to multiple signals at the same time." The letter goes on to address some concerns related to interference with medical devices.

In the accompanying review document, we have included relevant excerpts from the President's Cancer Panel 2008-2009 report and a link to the entire document. We do not see a "global call for the 'precautionary principle'" related to cell phones, smart meters, or similar technologies as is iterated in the complaint filed with PUC.

Dr. Mills has also been in contact with her colleagues from other states, including New Mexico (since it is cited in the complaint filed with PUC), and has asked the Complainant for the names of any government health official who is concerned about health effects related to smart meter technologies. At this time, Dr. Mills cannot find any state health department or official representing the health department who is taking action or is of the opinion the health department should take action to stop the conversion to smart meters.

Conclusion

In conclusion, our review of these agency assessments and studies do not indicate any consistent or convincing evidence to support a concern for health effects related to the use of radiofrequency in the range of frequencies and power used by smart meters. They also do not indicate an association of EMF exposure and symptoms that have been described as electromagnetic sensitivity.

It should be noted, however, that our review is subject to several limitations related to the complaint filed with PUC.

First, our review focused primarily on assessments and studies conducted by agencies we typically rely on for such work, such as government (U.S. and international governments) or government affiliated institutions. We were unable to review the entire body of literature on the subject of non-ionizing radiation and health because this would be a

massive undertaking for a small public health agency. We therefore are making the assumption that these agency reviews have considered all credible published findings.

Second, the Maine CDC staff involved with this review have not spent their entire careers nor work fulltime in the topic area of health effects of RF radiation.

Third, some of the focus of the complaint filed with the PUC is on safety and security issues, both of which are topics we do not have expertise to analyze.

If further health analysis is desired, we recommend consultation with credible non-biased experts in the fields of non-ionizing radiation pathophysiology, non-ionizing radiation dosimetry, and epidemiology of non-ionizing radiation health effects. The ICNIRP (<http://www.icnirp.net/what.htm>), FCC, RF-COM at the University of Ottawa (<http://www.rfcom.ca/about/index.shtml>), and other agencies listed above may provide potential resources for experts on the health issues related to smart meters.

Comparisons of Common Sources of Non-Ionizing Radiation

Item	Frequency in GHz	Power (max) in Watts	Power (average) Watts
Smart meter	2.4	1	0.100
G router	2.4	1	depends on use
N router	2.4 or 5.0	1	depends on use
Cordless Phone	2.4	0.25	0.010
Cell Phone	1.9	3	depends on use
FM Radio Tower	0.1	100,000	100,000
Cell Phone Tower	0.8 to 1.99	48,000	depends on use/loc

GHz = 10⁹ Hz

Maine CDC Smart Meters Team

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**Eight Leading Questions/Concerns of
Maine CDC's Approach to and Report on Smart Meters**
November 29, 2010

In October, the Maine CDC was requested by the Office of the Public Advocate (OPA) to comment on health concerns related to the wireless communication technology, also known as smart meters, being installed by Central Maine Power (CMP). As a result, Maine CDC submitted a report on November 8th to OPA and the Public Utilities Commission (PUC) of our review of national and international government-affiliated organizations' analyses on this subject (http://www.maine.gov/dhhs/boh/smart_meters.shtml).

Subsequently, we at the Maine CDC and others received several correspondences from people expressing concerns about our review. In order to make sure OPA, PUC, and the correspondents have our responses in a concise format, we have grouped the concerns into eight topic areas and compiled our responses into this document.

Concern #1: Maine CDC's review of smart meters was outcome-driven and only presented a selective one-sided choice of sources.

The six members of Maine CDC's Smart Meters Team, after reviewing the many documents sent to us in October about smart meters, acknowledged that a full review of all the literature on the subject matter of radiofrequency (RF) and health was beyond the scope of a small state's public health agency. The Maine CDC is not an agency with the amount of resources for reviews and analyses such as are done by the U.S. CDC, National Institutes of Health (NIH), or the World Health Organization (WHO). We also could not find any other state health department's recent review of the literature on this subject or expressions of health concerns about smart meters, including from states with smart meters already installed.

Therefore, we approached this issue as we often do on a subject matter (such as RF and health) that has thousands of articles, studies, and research published on it – by reviewing the analyses of the literature conducted by federal and international agencies (such as the U.S. CDC, NIH, and WHO). We commonly rely on such authorities to conduct reviews and analyses since they have the depth and breadth of expertise and resources to do so, and are generally considered impartial.

Maine CDC often focuses on U.S. federal resources for such reviews, but for the one on smart meters/wireless technologies we decided to include the work of some well reputed international government affiliated organizations such as the World Health Organization (WHO), the International Commission on Non-Ionizing Radiation Protection (ICNIRP), Health Canada, the Health Protection Agency of the United Kingdom, the Swedish Radiation Protection Authority, the Australian Radiation Protection and Nuclear Safety Agency, and others. For U.S. federal agencies, we mainly focused on the information published by the Federal Communications Commission (FCC) and the National Institutes

of Health (NIH). (The FCC's work is in turn informed by the U.S. Department of Health and Human Services.)

Concern #2: Many references in Maine CDC's review mention scientific uncertainty, inconclusively, and the need for more data and research.

Maine CDC included in its report what we felt were the relevant excerpts from a number of analyses and/or links to websites with applicable information. These excerpts and links discuss the levels of uncertainties in the science, along with the conclusions the current scientific evidence points to.

When trying to evaluate health outcomes associated with exposure from relatively new technologies, it is extremely common and even expected that there will be uncertainties limiting our ability to fully comprehend and evaluate the question at hand. Since many of the sources of radiofrequency (RF) exposure have not been in common existence until modern times (radio, television, cell phones, pagers, cordless phones, wireless communications), there are likely to be uncertainties related to their health risks for years or decades to come. Therefore, decisions related to public health should take into account such factors as: the scientific research indicating evidence of risks of the technologies; the ease, risks, and benefits of implementing alternatives; as well as the uncertainties.

We acknowledged these uncertainties by including them in the excerpts and links in our report as well as noting the ones related to cell phones (the lack of very long term studies and the lack of studies involving significant exposure in childhood) and pointing out other caveats or limitations in our executive summary. However, in addition to these uncertainties, we also recognized the conclusions of the many reviews that we read, which pointed to no consistent or convincing evidence to support a concern for health effects related to the use of RF in the range of frequencies and power used by smart meters.

Concern #3: Maine CDC's approach to using comparisons with cell phone studies is flawed since cell phones operate in a much lower frequency band.

Cell phones in the United States operate in two different radiofrequency "bands". The first band is from 0.8 to 0.9 gigahertz (GHz) and was the frequency range that original mobile phones used. The newer phones use that frequency range as well as the 1.8 to 2.0 GHz range. Central Maine Power's smart meters operate in the 2.4 GHz range.

However, we do not agree that the difference in frequency means we should not consider results of studies from cell phone users to assess potential health problems from smart meters.

First, the frequency ranges are relatively close. For instance, the frequency ranges for non-ionizing electromagnetic fields are generally between 50 Hz (e.g. residential electrical power) to 1,000,000,000,000,000 Hz = 10^{15} (e.g. visible light). The frequency range of RF (radiofrequency) is generally 3 kHz (kHz = 1,000 Hz) to 300 GHz (GHz = 10^9 Hz), which is equal to 3,000 Hz to 300,000,000,000 Hz. Therefore, the radio frequency ranges of cell phones, 0.8 – 2.0 GHz (800,000,000 to 2,000,000,000 Hz), are relatively close to that of CMP's smart meters, 2.4 GHz (2,400,000,000 Hz), and are even in close proximity within the range of frequencies contained in RF. This range of RF that includes cell phones and other wireless technologies such as smart meters is also regulated the same or similarly by the FCC (<http://www.fcc.gov/oet/rfsafety/>).

Source of EMF	Approximate Hertz Range	Examples
Non-ionizing EMF	50 – 1,000,000,000,000,000	electrical power to light
Radiofrequency	3,000 – 300,000,000,000	radio, tv, cell phones, smart meters
Cell Phones	800,000,000 – 2,000,000,000	
CMP Smart Meters	2,400,000,000	

Second, the overall RF exposure from cell phones is greater than that from smart meters. RF exposure, or dose, is considered the most important overall measure of impact, and is calculated using the factors of frequency, power and/or distance from the body. Exposure can be measured several different ways, such as by calculating the specific absorption rates, or SAR (watts per kilogram), or by calculating the power density (milliwatts per square centimeter). When either measure is used to compare the RF exposure of smart meters with cell phones, the results indicate that the estimated RF exposure from smart meters is less than that from cell phones.

The table below shows the estimated exposure (mW/cm^2) using the power density calculation for smart meters of various distances from the body compared with Bluetooth wireless and cell phone radiofrequencies. Even when one assumes very close physical proximity to smart meters, the RF exposure is smaller than with typical cell phone use.

Source	Distance from source (inches)	Frequency (MHz)	Broadcast power (watts)	OET 65 equation 7 (partial reflection) mW/cm^2	OET 65 equation 6 (full reflection) mW/cm^2	OET 65 equation 3 (no reflection) mW/cm^2
Smart Meter	2	2400	1	7.8941	12.3345	3.0836
Smart Meter	6	2400	1	0.8771	1.3705	0.3426
Smart Meter	12	2400	1	0.2193	0.3426	0.0857
Smart Meter	36	2400	1	0.0244	0.0381	0.0095
Repeater	180	5800	1	0.0010	0.0015	0.0004

(CMP collector)						
Bluetooth	6	2442	0.1	0.0877	0.1371	0.0343
G Router	12	2400	0.2	0.0439	0.0685	0.0171
N Router	12	5800	0.2	0.0439	0.0685	0.0171
cell phone	1	1910	1	31.5764	49.3382	12.3345
cell phone	12	1910	1	0.2193	0.3426	0.0857

The equations of power density used in the table above can be found in the FCC's Office of Engineering and Technology (OET) Bulletin 65 on pages 20 – 21 (<http://www.fcc.gov/oet/info/documents/bulletins/>). The three equations assume different levels of reflection of the RF from the surroundings, such as from the ground or a wall lacking the ability to absorb RF energy. Reflection of RF is not much of a consideration with cell phones since the antenna is next to the body, so the "no reflection" equation is the most appropriate to use. Partial reflection is the most appropriate equation for most situations involving smart meters.

Since the RF bands used by smart meters and cell phones are close together in frequency and since the overall exposure of RF is higher from cell phones, we feel it is reasonable to use studies that examine the potential health effects of exposure to cell phone RF to inform an assessment about the potential health effects of smart meter RF exposure. Because the exposure to RF appears to be greater with cell phones than with smart meters, it seems to us that the lack of any consistent and convincing evidence of a causal relation between RF exposure from cell phones and adverse health effects would indicate even less concern for potential health effects from use of smart meters.

Concern #4: Cell phone use causes cancer.

The numerous national and international analyses of the literature that Maine CDC reviewed do not conclude that the evidence thus far points to cell phones causing cancer. Below are just three relevant excerpts from the most recent studies or reviews on this topic that are also found in our report. See the November 8th report for additional reviews.

The Conclusion from the May 2010 Interphone Study:

<http://ije.oxfordjournals.org/content/39/3/675.full>

"This is the largest study of the risk of brain tumours in relation to mobile phone use conducted to date and it included substantial numbers of subjects who had used mobile phones for ≥10 years. Overall, no increase in risk of either glioma or meningioma was observed in association with use of mobile phones. There were suggestions of an increased risk of glioma, and much less so meningioma, at the highest exposure levels, for ipsilateral exposures and, for glioma, for tumours in the temporal lobe. However,

biases and errors limit the strength of the conclusions we can draw from these analyses and prevent a causal interpretation.”

Key Points from the National Cancer Institute’s Review and Analysis, May 2010:

<http://www.cancer.gov/cancertopics/factsheet/Risk/cellphones>

- *“Cell phones emit radiofrequency (RF) energy, which is another name for radio waves.*
- *Research suggests that the amount of RF energy produced by cell phones is too low to cause significant tissue heating or an increase in body temperature.*
- *Concerns have been raised that RF energy from cell phones may pose a cancer risk to users.*
- *Researchers are studying tumors of the brain and central nervous system and other sites of the head and neck because cell phones are typically held next to the head when used.*
- ***Research studies have not shown a consistent link between cell phone use and cancer.** A large international study (Interphone) published in (May) 2010 found that, overall, cell phone users have no increased risk for two of the most common types of brain tumor—glioma and meningioma. For the small proportion of study participants who reported spending the most total time on cell phone calls there was some increased risk of glioma, but the researchers considered this finding inconclusive.”*

Conclusion from the November 2010 Study from the National Institute of Cancer in the National Institutes of Health

<http://www.ncbi.nlm.nih.gov/pubmed/20639214>

*“The use of cellular telephones has grown explosively during the past two decades, and there are now more than 279 million wireless subscribers in the United States. If cellular phone use causes brain cancer, as some suggest, the potential public health implications could be considerable. One might expect the effects of such a prevalent exposure to be reflected in general population incidence rates, unless the induction period is very long or confined to very long-term users. To address this issue, we examined temporal trends in brain cancer incidence rates in the United States, using data collected by the Surveillance, Epidemiology, and End Results (SEER) Program...**Overall, these incidence data do not provide support to the view that cellular phone use causes brain cancer.”***

Concern #5: Smart meters will be forming a mesh network, something that Maine CDC is not considering, and some who have written Maine CDC requested a calculation of the RF exposure from such networks.

We included a statement from the FCC about this issue in our report, and refer further questions on mesh networks to the FCC and other such experts.

Concern #6: Maine CDC should promote the precautionary principal and ask that new meters use alternative technologies to wireless systems, such as hard wired meters.

The precautionary principle provides a framework for making decisions in the face of scientific uncertainty. Maine CDC has used and referred to “The Precautionary Principle in Action: A Handbook” in related work (can be found at <http://environmentalcommons.org/precaution-handbook.pdf>).

A description of a six-step process for applying the precautionary principle to a particular problem can be found in Section VI, pages 7 – 10 of the handbook. The six steps are pasted in below from these pages. We have included our very brief summary responses to the first two steps, which are the ones that are most relevant to Maine CDC’s work. The other steps (3 – 6) are more appropriate for organizations such as OPA and the PUC to answer. We believe there are several outcomes possible if the precautionary principle is applied to the situation related to smart meters, and they do not necessarily include a ban on the use of wireless technologies.

“Step One: Identify the possible threat and characterize the problem

The purpose of this step is to gain a better understanding of what might happen should the activity continue and to ensure that you are asking the right questions about this activity. Poor solutions are often a result of badly defined problems. Identify both the immediate problem and any other global issues that might go along with this threat.

Here are questions to ask:

Why is this a problem? Presumably it has the potential to threaten public health or the environment. What is the potential spatial scale of the threat - local, statewide, regional, national, global? What is the full range of potential impacts? To human health, ecosystems, or both? Will there be impacts to specific species or loss of biodiversity? Are the impacts to waterways, air, or soil? Do indirect impacts need to be considered (such as a product's lifecycle-production and disposal)? Will some populations (human or ecosystems) be disproportionately affected? What is the magnitude of possible impacts (intensity)? Is the extent of harm negligible, minimal, moderate, considerable, catastrophic? What is the temporal scale of the threat? There are two issues to consider: 1) The time lapse between a threat and possible harm (immediate, near future, future, future generations). The further in the future harm might occur, the less likely that impacts can be predicted, the harder it will be to identify and halt a problem, and the more likely that future generations will be impacted. 2) Persistence of impacts (immediate, short term, mid term, long term, inter-generational). How reversible is the threat? If the threat were to occur would it be easy to fix or last for generations? (easily/quickly reversed, difficult/expensive to reverse, irreversible, unknown) A note about existing problems: Defining a problem at hand is less difficult than projecting problems from a future project. But the first questions are similar: Is the problem local pollution from a particular facility or broader lack of attention to pollution prevention or

both? Is it caused by a government failure or a company's negligence? Is it a serious threat or just an eyesore?"

Maine CDC's very brief answer to Step One is from the executive summary of our November 8th report: "In conclusion, our review of these agency assessments and studies do not indicate any consistent or convincing evidence to support a concern for health effects related to the use of radiofrequency in the range of frequencies and power used by smart meters. They also do not indicate an association of EMF exposure and symptoms that have been described as electromagnetic sensitivity."

"Step Two: Identify what is known and what is not known about the threat.

The goal of this step is to gain a better picture of the uncertainty involved in understanding this threat. Scientists often focus on what we know, but it is equally, and perhaps more, important to be clear about what we don't know. There are degrees and types of uncertainty, as the later discussion explains.

Relevant questions:

Can the uncertainty be reduced by more study or data? If so, and if the threat is not great, a project with substantial benefits might be continued. Are we dealing with something that is unknowable nor about which we are totally ignorant? High uncertainty about possible harm is good reason not to go ahead with a project. What is known about additive and synergistic effects from exposure to multiple stressors and cumulative effects from combined exposures to various stressors? Do industry and government claims that an activity is safe mean only that it has not yet been proven dangerous? You might want to make a chart listing what is known and what is not known about the threat to gain a better comparative picture and understand gaps in understanding."

Maine CDC's very brief answer to Step Two includes the uncertainties identified in our executive summary:

- Lack of very long term studies of cell phone use (>> 10 years), especially among high-end users;
- Lack of long term studies that include significant exposure during childhood; and
- Lack of specific data on actual RF exposures from the expected use of smart meters.

These uncertainties can be reduced over time by existing ongoing studies and/or data collection.

"Step Three: Reframe the problem to describe what needs to be done

The goal of this step is to better understand what purpose the proposed activity serves. For example, a development provides housing, a solvent provides degreasing, a pesticide provides pest management, a factory provides jobs and a product for a specific service. The problem can then be reframed in terms of what needs to be achieved in order to more readily identify alternatives."

Presumably OPA and/or the PUC have a full understanding of the purposes and benefits of smart meter wireless technology.

“Step Four: Assess alternatives.

Proposed and existing activities are addressed somewhat differently in this step.

Proposed activities: Integral to the precautionary principle is a comprehensive, systematic analysis of alternatives to threatening activities. This refocuses the questions to be considered by a regulator or company from how much risk is acceptable to whether there is a safer and cleaner way to undertake this activity. Assessing alternatives drives ingenuity and innovation. It is more difficult to dismiss proposals that not only name problems but set forth alternatives, or demand that they be considered. The "no action" alternative must be considered: perhaps an activity should not proceed because it poses too much of a threat and/or is not needed.

Existing activities: At this point you would develop and assess a range of alternative courses of action to deal with the problem. The options can be to study further, to completely stop the activity, prevent, control, mitigate, or remediate. In either case, the assessment of alternatives is a multi-stage process.

First, you might brainstorm a wide range of alternatives, then screen out those options that seem impossible. The next stage is to assess the alternatives to determine whether they are politically, technically, and economically feasible. Do not let conventional wisdom limit this assessment. Keep in mind that something that is not economically or technically feasible today may be feasible in the near future. And government agencies and firms rarely consider the "external" costs of threatening activities harm to health, loss of species, etc. which are often unquantifiable. These concerns must be incorporated in the assessment. The last step of the alternatives assessment is to consider potential unintended consequences of the proposed alternatives. A common criticism of the precautionary principle is that its implementation will lead to more hazardous activities. This need not be true: alternatives to a threatening activity must be equally well examined.”

Likewise, we assume OPA and/or the PUC have information related to possible alternatives available to smart meter wireless technologies.

“Step Five: Determine the course of action.

Take all the information collected thus far and determine how much precaution should be taken: stopping the activity, demanding alternatives, or demanding modifications to reduce potential impacts. A useful way to do this is by convening a group of people to weigh the evidence, considering the information on the range and magnitude impacts, uncertainties, and alternatives coming from various sources. The weight of evidence would lead to a determination of the correct course of action.”

“Step Six: Monitor and follow up

No matter what action is taken, it is critical to monitor that activity over time to identify expected and unexpected results. Those undertaking the activity should bear the financial responsibility for such monitoring, but when possible this should be conducted by an independent source. The information gathered might warrant additional or different courses of action.”

Steps 5 and 6 we also assume OPA and/or the PUC would be appropriate parties to answer these questions if the precautionary principle were to be applied to smart meters.

Concern #7: Why did Maine CDC only cite studies that negate the existence of electromagnetic hypersensitivity condition and not cite other studies?

We focused our October/early November reviews on national and international government or government-affiliated analyses and research. All such documents we found came to the same or similar conclusion as the World Health Organization, which states, “*EHS (electromagnetic hypersensitivity) has no clear diagnostic criteria and there is no scientific basis to link EHS symptoms to EMF exposure. Further, EHS is not a medical diagnosis, nor is it clear that it represents a single medical problem.*”

The following reviews related to electromagnetic hypersensitivity were included in our report:

- World Health Organization 2005 review of electromagnetic hypersensitivity, <http://www.who.int/mediacentre/factsheets/fs296/en/index.html>
- The 2002 consensus report on electromagnetic hypersensitivity of the Institute of Electrical and Electronics Engineers (IEEE) <http://ewh.ieee.org/soc/embs/comar/Hypersensitivity.htm>
- A 2010 review of 46 studies on electromagnetic hypersensitivity <http://www.ncbi.nlm.nih.gov/pubmed/19681059>
- A review by the University of Ottawa’s McLaughlin Centre for Population Health Risk Assessment <http://www.rfcom.ca/faq/answers.shtml#q13>
- A 2009 review by the Swedish State Radiation Protection Authority, Swedish State Radiation Protection Authority: Recent Research on EMF and Health Risks.

We also could not find any reference to electromagnetic hypersensitivity or similar diagnosis in the International Classification of Diseases (ICD) systems (ICD-9 or ICD-10).

Concern #8: The U.S. Access Board recognizes electromagnetic hypersensitivity, so therefore it is a legitimate medical condition (<http://www.access-board.gov/>).

According to their website, *"The Access Board is an independent Federal agency devoted to accessibility for people with disabilities. Created in 1973 to ensure access to federally funded facilities, the Board is now a leading source of information on accessible design."*

On the U.S. Access Board's website we found the following reference to electromagnetic hypersensitivity: *"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."* (First paragraph from <http://www.access-board.gov/research/ieq/intro.cfm>.)

Besides the comments from individuals in response to the proposed rule, the other main source of reference informing their recognition of electromagnetic sensitivity by the U.S. Access Board was a 1998 California telephone survey that asked people if they had sensitivity to electromagnetic fields.

The 1998 California survey results can be found on this website:

<http://www.ehib.org/index.jsp> (search under "Levallois", the author). In it, the authors recognized that electromagnetic sensitivity is not necessarily a bona fide diagnosis. For instance, on page A-79 of the survey's report, they state:

"The literature reports a weak if any association of hypersensitivity with electric and magnetic field exposures (1, 12, 13). In fact, most of the provocation studies have been negative (1). In particular, in blind exposure experiments, HSEMF (hypersensitivity to electromagnetic fields) subjects were not able to detect the presence of the fields at low intensities (14-15). Therefore, HSEMF has been sometimes considered a subset of a more general "environmental illness" as multiple chemical sensitivity (11, 16). Other authors have suggested that it is a manifestation of somatization or conversion of stress (17) but its association with perception of risk has not been studied."

Therefore, from a review of the U.S. Access Board's website, it appears that their recognition of electromagnetic sensitivity may not be scientifically based, but rather based on some public comments as well as a 1998 telephone survey, whose report acknowledges the improbability that such a disorder exists in relation to EMF exposure. We have contacted the U.S. Access Board to learn more about the basis of their recognition so that we have a more complete understanding of their perspective. We will share that information with the PUC, OPA, and others when it is available.