ORIGINAL

OPEN MEETING AGENDA ITE

Docket No.: E-00000C-11-0328

85028

June 26, 2013

1200 West Washington Street

Phoenix, Arizona 85007

Dear Commissioners:

I have been aware of the work of Cindy Sage and Sage Associates, environmental consultants, ever since I discovered their findings on why women of Marin County, CA, had such high rates of breast cancer. On the following pages I have chosen to display for you the Addendum to the report, "Assessment of Radiofrequency Microwave Radiation Emissions from Smart Meters." The Addendum format allows me to show you a number of Tables that point to conditions for health effects to occur. Then from page 20 on please find excerpts of the report itself.

The Addendum is for a model of meter that is not, apparently, used in Arizona. Therefore the demarcation for the meter's emissions potentially exceeding safety limits, say, in a nursery or a kitchen at a certain distance in each Table would be different for the meter model most used in Arizona. Please see the first Table on page 10 for an example of how to get the sense of the Tables for Arizona. (When I printed out the Tables, I was under the impression I could produce a heavy line showing the difference. On close inspection the data is not straight across from the report to the addendum.) To me the general information is valuable enough to include for consideration of its premise, in this instance what may we expect when conditions for health effects exist?

Thank you for seeking this kind of information on the health impacts of smart meters.

Sincerely,

Helen S Pierce

Helen S Pierce

P.S. The Tables in the full report, "Assessment of Radiofrequency Microwave Radiation Emissions from Smart Meters," apply directly to Arizona. The report is available at

http://www.sagereports.com/smart-meter-rf/

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Assessment of Radiofrequency Microwave Radiation Emissions from

Silver Springs OWS-NIC514

Model Wireless Electric Meter

Sage Associates

Santa Barbara, CA

USA

February 18, 2011

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INTRODUCTION AND PURPOSE OF THIS ADDENDUM

This Report Addendum has been prepared to document radiofrequency radiation (RF) levels associated with the Silver Springs/PG&E wireless smart meter model OWS-NIC514 that is being installed in northern California and other service areas within PG&E territory.

Following completion of the original Smart Meter RF Assessment which used the Itron SKAMI-4 meter as the 'type' meter, it came to the attention of the authors that PG&E's OWS-NIC514 model might have higher RF emissions. This would likely result in greater numbers of conditions where FCC violations of the public safety limit could occur; and greater space within private residences and properties that might be chronically exposed to excessively high RF levels, some of which could reach levels reported to cause adverse health effects.

The previous report (also downloadable from this webpage) provided predicted RF levels from the ITRON SKAMI-4 model in use by Southern California Edison and possibly other utilities.

As with the original Report, computer modeling shows of the range of possible smart meter RF levels that are occurring in the typical installation and operation of a single smart meter, and also multiple meters in one location. Four reflection factors and ten duty cycles are modeled for each scenario (one meter or multiple meters). Collector meters are not assessed in this addendum.

SUMMARY OF FINDINGS

The RF emissions from the Silver Springs/PG&E OWS-NIC514 smart meter are **4.87 times (or 487% higher)** than the Itron SKAMI-4 meter. This ratio holds constant for any of the modeling scenarios previously assessed.

Potential violations of current FCC public safety standards for smart meters in the manner installed and operated in California are predicted in this Report, based on computer modeling (Data Tables D1 – D24).

Violations of FCC safety limits for uncontrolled public access are identified at distances out to a distance of more than one foot for a single meter, and several feet for multiple meters, even under the most restrictive FCC formula using only a 60% reflection factor.

This means that there is significantly more space within the area around the wireless meter that may either violate FCC public safety limits, or create excessively elevated RF levels in occupied space that is potentially exposing occupants to chronically elevated RF exposures.

See CONCLUSIONS Section for complete information.

PUBLIC SAFETY LIMITS FOR RADIOFREQUENCY RADIATION

The FCC adopted limits for Maximum Permissible Exposure (MPE) are generally based on recommended exposure guidelines published by the National Council on Radiation Protection and Measurements (NCRP) in "Biological Effects and Exposure Criteria for Radiofrequency Electromagnetic Fields," (NCRP, 1986). In the United States, the Federal Communications Commission (FCC) enforces limits for both occupational exposures (in the workplace) and for public exposures. The allowable limits are variable, according to the frequency transmitted. Only public safety limits for uncontrolled public access are assessed in this report.

Maximum permissible exposures (MPE) to radiofrequency electromagnetic fields are usually expressed in terms of the plane wave equivalent power density expressed in units of milliwatts per square centimeter (mW/cm2) or alternatively, absorption of RF energy is a function of frequency (as well as body size and other factors). The limits vary with frequency. Standards are more restrictive for frequencies at and below 300 MHz. Higher intensity RF exposures are allowed for frequencies between 300 MHz and 6000 MHz than for those below 300 MHz. In the frequency range from 100 MHz to 1500 MHz, exposure limits for field strength and power density are also generally based on the MPE limits found in Section 4.1 of "*IEEE Standard for Safety Levels with Respect to Human Exposure to Radio Frequency Electromagnetic Fields, 3 kHz to 300 GHz*," ANSI/IEEE C95.1-1992 (IEEE, 1992, and approved for use as an American National Standard by the American National Standards Institute (ANSI).

US Federal Communications Commission (FCC) Exposure Standards

Table 1, Appendix A FCC LIMITS FOR MAXIMUM PERMISSIBLE EXPOSURE (MPE)

(A) Limits for Occupational/Controlled Exposure

Frequency Range (MHz)	Electric Field Strength (E) (V/m)	Magnetic Field Strength (H) (A/m)	Power Density (S) (mW/cm2)	Averaging Time [E]2 [H]2 or S (minutes)
0.3-3.0	614	1.63	(100)*	6
3.0-30	1842/f	4.89/f	(900/f2)*	6
30-300	61.4	0.163	1.0	6
300-1500			f/300	6
1500-100,000			5	6

B) FCC Limits for General Population/Uncontrolled Exposure

Frequency Range (MHz)	Electric Field Strength (E) (V/m)	Magnetic Field Strength (H) (A/m)	Power Density (S) (mW/cm2)	Averaging Time [E]2 [H]2 or S (minutes)
0.3-3.0	614	1.63	(100)*	30
3.0-30	824/f	2.19/f	(180/f2)*	30
30-300	27.5	0.073	0.2	30
300-1500	–	–	f/1500	30
1500-100000	–	–	1.0	30

---

f = frequency in MHz *Plane-wave equivalent power density

NOTE 1: ***Occupational/controlled*** limits apply in situations in which persons are exposed as a consequence of their employment provided those persons are fully aware of the potential for exposure and can exercise control over their exposure. Limits for occupational/controlled exposure also apply in situations when an individual is transient through a location where occupational/controlled limits apply provided he or she is made aware of the potential for exposure.

NOTE 2: ***General population/uncontrolled*** exposures apply in situations in which the general public may be exposed, or in which persons that are exposed as a consequence of their employment may not be fully aware of the potential for exposure or can not exercise control over their exposure. Source: FCC Bulletin OET 65 Guidelines, page 67 OET, 19

METHODOLOGY

Radiofrequency fields associated with SMART Meters were calculated following the methodology described here. Prediction methods specified in Federal Communications Commission, Office of Engineering and Technology Bulletin 65 Edition 97-01, August 1997 were used in the calculations.1

FCC equations 6 and 10 require use of a 100% duty cycle (how much time the meter is transmitting RF signals), since the public cannot be excluded from areas around the meter. The report, however, calculates RF levels from 1% duty cycle to 100% duty cycle, for informational purposes, and because there is still much uncertainty and debate about how frequently the meters will be emitting RF signals. In this meter, both the 915 MHz antenna and the 2400 MHz antenna can transmit at the same time.

Section 2 of FCC OET 65 provides methods to determine whether a given facility would

be in compliance with guidelines for human exposure to RF radiation. We used equation (3)

$S = \frac{P \times G \times \partial}{4 \times \partial \times R2} = \frac{EIRP \times \partial}{4 \times \partial \times R2} = \frac{1.64 \times ERP \times \partial}{4 \times \partial \times R2}$

where:

S = power density (in μW/cm2)

P = power input to the antenna (in W)

G = power gain of the antenna in the direction of interest relative to an isotropic radiator

∂ = duty cycle of the transmitter (percentage of time that the transmitter actually transmits over time)

R = distance to the center of radiation of the antenna

EIRP = PG

ERP = 1.64 EIRP

where:

EIRP = is equivalent (or effective) isotropically radiated power referenced to an isotropic radiator

ERP = is equivalent (or effective) radiated power referenced to a half-wave dipole radiator

SMART Meter Assumptions

Red figures used to Calculate ERP		ACS and TCB Certification data sheet							
		SK9AMI-2A				SK9A3II-4			
		ACS		TCB		ACS		TCB	
Radio	Frequency	dBm	Watts	dBi	Watts	dBm	Watts	dBi	Watts
GSM	850	31.8	1.5136	-1.0					
LAN	0	21.92	0.1556	3.0	0.189	24.27	0.2673	2.2	0.26*
LAN SSN	0	29.36	0.9683	4.00	1.483				1.483
GSM	1900	28.7	0.7413	1.0					
Register	2405	18.71	0.0743	1.0	0.074	19.17	0.0826	4.4	
WLAN SSN	2405	21.7	0.1479	1.0	0.114				
Cell Relay	2480	-13.00	0.00004	4.00					

Assumptions: TPO per TCB , Antenna Gain per ACS Certification

ERP Calculation: **Bold** figures are used for single meter ERP in modeling

Type	TPO	dBi	dB	Mult	ERP	Freq		Delta ERP
1900 GSM	0.741	1.0	-1.15	0.77	0.5689	1900		
850 GSM	1.514	-1.0	-3.15	0.48	0.7328	850	Model	
RFLAN	0.26*	2.2	0.05	1.01	**0.2704**	915	SK9AMI-4	
Silver Springs	0.968	4.0	1.85	1.53	**1.4825**	915	Silver Springs Network Pg 54	5.48
ZIGBEE	0.074	1.0	-1.15	0.77	**0.0570**	2405	SK9AMI-2A	
Silver Springs	0.148	1	-1.15	0.77	**0.1135**	2405	Silver Springs Network Pg 31	1.99

ERP (Effective Radiated Power) used in the computer modeling here is calculated using the TPO and antenna gain established for each model. The figures in red are used in this analysis (from Silver Springs FCC data).

Reflection Factor

This equation is modified with the inclusion of a ground reflection factor as recommended by the FCC. The ground reflection factor accounts for possible ground reflections that could enhance the resultant power density. A 60% (0.6) enhancement would result in a 1.6 (1 + 0.6) increase of the field strength or a 2.56 = (1.6)2 increase in the power density. Similar increases for larger enhancements of the field strength are calculated by the square of the original field plus the enhancement percentage. 2.3.4

Reflection Factors:

60% = (1 + 0.6)2 = 2.56 times

100% = (1 + 1)2 = 4 times

1000% = (1 + 10)2 = 121 times

2000% = (1 + 20)2 = 441 times

Duty Cycle

How frequently SMART Meters can and will emit RF signals from each of the antennas within the meters is uncertain, and subject to wide variations in estimation. For this reason, and because FCC OET 65 mandates a 100% duty cycle (continuous exposure where the public cannot be excluded) the report gives RF predictions for all cases from 1% to 100% duty cycle at 10% intervals. The reader can see the variation in RF emissions predicted at various distances from the meter (or bank of meters) using this report at all duty cycles. Thus, for purposes of this report, duty cycles have been estimated from infrequent to continuous.

Duty cycles for SMART Meters were calculated at:

Duty cycle @:

1%	50%
5%	60%
10%	70%
20%	80%
30%	90%
40%	100%

Continuous Exposure

FCC Bulletin OET 65 and the ANSI/IEEE C95.1-1992, 1999 requires that continuous exposure be calculated for situations where there is uncontrolled public access. Continuous exposure in this case means reading the tables at 100% duty cycle.

"Another feature of the exposure guidelines is that exposures, in terms of power density, E2 or H2, may be averaged over certain periods of time with the average not to exceed the limit for continuous exposure.11

"As shown in Table 1 of Appendix A, the averaging time for occupational/controlled exposures is 6 minutes, while the averaging time for general population/uncontrolled exposures is 30 minutes. It is important to note that for general population/uncontrolled exposures it is often not possible to control exposures to the extent that averaging times can be applied. In those situations, it is often necessary to assume continuous exposure." (FCC OET 65, Page 15)

Calculation Distances in Tables (3-inch increments)

Calculations were performed in 3-inch (.25 foot) increments from the antenna center of radiation. Calculations have been taken out to a distance of 96 feet from the antenna center for radiation for each of the conditions above. The antenna used for the various links in a SMART Meter is assumed to be at the center of the SMART Meter from front to back – approximately 3 inches from the outer surface of the meter.

Calculations have also been made for a typical nursery and kitchen. In the nursery it has been assumed that the baby in his or her crib that is located next to the wall where the electric SMART Meters are mounted. The closest part of the baby's body can be as close as 11 inches* from the meter antenna. In the kitchen it has been assumed that a person is standing at the counter along the wall where the electric SMART Meters are mounted. In that case the closest part of the adult's body can be located as close to the meter antenna as 28 inches.

CONCLUSIONS

FCC compliance violations for the OWS-NIC514 meter made by Silver Springs are likely to occur under widespread conditions of installation and operation of smart meters and collector meters in California. Violations of FCC safety limits for uncontrolled public

access are identified at distances about one foot for a single meter, and several feet for multiple meters.

The RF emissions from the Silver Springs/PG&E OWS-NIC514 smart meter are **4.87 times (or 487% higher)** than the Itron SKAMI-4 meter. This ratio holds constant for any of the modeling scenarios previously assessed.

Potential violations of current FCC public safety standards for smart meters in the manner installed and operated in California are predicted in this Report, based on computer modeling (Data Tables D1 – D24).

Violations of FCC safety limits for uncontrolled public access are identified at distances out to a distance of more than one foot for a single meter, and several feet for multiple meters, even under the most restrictive FCC formula using only a 60% reflection factor.

This means that there is significantly more space within the area around the wireless meter that may either violate FCC public safety limits, or create excessively elevated RF levels in occupied space that is potentially exposing occupants to chronically elevated RF exposures.

Table 1 shows how far away the meter(s) may violate the FCC thermal public safety limit of 655 uW/cm2. Even using the most conservative FCC equation with a 60% reflection factor, the meter exceeds the FCC limit outside the meter itself at 40% duty cycle, and all higher duty cycles to 100%. Using the FCC's reflection factor of 100%, the FCC limit is exceeded at all duty cycles from 30% to 100%. The emissions from one meter are strong enough that the public is put at risk from exposures outward from the meter from approximately one foot to over six feet, depending on the reflection factor. For multiple meters at the same location, the zone of impact where FCC limit may be violated is somewhere between three feet and 19 feet, depending on the reflection factor.

Table 2 shows predicted RF levels and potential FCC violations of the public safety limit in a simulated nursery or bedroom, where the sleeping area is against a wall with a wireless meter flush-mounted on the outside wall at 11" distance from occupied space. Violations are predicted to occur in all scenarios modeled, with higher RF exposures predicted with higher reflection factors and higher duty cycles. The lowest RF level calculated under any of the conditions is 6.8 uW/cm2 at 11", which is an excessively high RF level for chronic exposure. Most of the predictions fall in the range of several hundred microwatts per centimeter squared at 11" distance from the single meter. For multiple meters, the lowest predicted figure is 23.4 uW/cm2. Nearly all conditions modeled show that FCC violations may occur, regardless of how conservative the reflection factors and duty cycles are. For multiple meters at the same location, RF levels range from 23 to over 2000 uW/cm2 depending on duty cycle (at 60% reflection). RF levels range from 37 to over 3600 uW/cm2 depending on duty cycle (at 100% reflection).

Table 3 shows predicted RF levels and potential FCC violations of the public safety limit in a simulated kitchen, where the counter workspace is against a wall with a wireless meter flush-mounted on the outside wall at 28" distance from occupied space. There are no FCC violations predicted at 28" for the two lower reflection factors (60% and 100%), however, there are numerous predicted violations at the higher reflection factors (1000% and 2000%). For one meter, at 28", the RF levels range from 1.1 to 105 uW/cm2 at 60% reflection; and 1.6 to 165 uW/cm2 at 100% reflection.. For multiple meters, the comparable ranges are 2.7 to 268 uW/cm2 at 60% reflection, and 4.2 to 418 uW/cm2 at 100% reflection (the two lowest factors).

The absolute RF levels are significantly higher that those reported in many scientific studies to be associated with adverse health effects.

Tables 4 and 5 compare RF levels in the nursery simulation (at 11") and the kitchen simulation (at 28") to RF levels reported to impair DNA repair in human stem cells. Tables 4 and 5 allow a comparison of predicted RF levels from the OWS-NIC514 meter against a

scientific benchmark for harm of 92 uW/cm2 that is reported to impair the ability of human stem cells to repair damage to DNA.

Nearly every scenario modeled predicts RF levels from either one smart meter or multiple smart meters to be in excess of that shown to reduce DNA repair in human stem cells.

Of 96 cases modeled at 11" (nursery crib example), only seven are below the 92 uW/cm2 benchmark for harm.

Of 96 cases modeled at 28" (kitchen workspace example) only 27 are below the 92 uW/cm2 benchmark for harm.

Tables 6 and 7 compare RF levels in the nursery simulation (at 11") and the kitchen simulation (at 28") to RF levels reported to cause pathological leakage of the blood-brain barrier. Such leakage is associated with neuron death (death of brain cells).

Every scenario modeled predicts RF levels from either one smart meter or multiple smart meters to be in excess of associated with pathological leakage of the blood-brain barrier. Regardless of duty cycle or reflection factor, ALL cases modeled showed that for a single meter or multiple meters, RF levels exceed that associated with damage to the blood-brain barrier.

Of 96 cases modeled at 11" (nursery crib example), ALL produce RF levels in excess of the 0.4-8 uW/cm2 benchmark for harm to the blood-brain barrier.

Of 96 cases modeled at 28" (kitchen workspace example, ALL produce RF levels in excess of the 0.4 – 8 uW/cm2 benchmark for harm to the blood-brain barrier.

Table 8 and 9 compare RF levels in the nursery and kitchen simulations to RF levels reported to cause adverse neurological symptoms (headache, sleep disruption, restlessness, tremor, cognitive impairment, tinnitus), increased cancer risk or heart problems (arrhythmias, altered heart rhythm, palpitations).

Of 96 cases modeled at 11" (nursery crib example) ALL produce RF levels in excess of the 0.1uW/cm2 benchmark for neurological effects, cardiac problems and increased cancer risk.

Of 96 cases modeled at 28" (kitchen workspace example) ALL produce RF levels in excess of the 0.1uW/cm2 benchmark for neurological effects, cardiac problems and increased cancer risk.

FCC compliance violations for the OWS-NIC514 meter made by Silver Springs are likely to occur under widespread conditions of installation and operation of smart meters and collector meters in California. Violations of FCC safety limits for uncontrolled public access are identified at distances about one foot for a single meter, and several feet for multiple meters.

PUBLIC SAFETY LIMITS FOR RADIOFREQUENCY RADIATION - NO Baseline RF Assessment

Consumers may also have already increased their exposures to radiofrequency radiation in the home through the voluntary use of wireless devices (cell and cordless phones), PDAs like BlackBerry and iPhones, wireless routers for wireless internet access, wireless home security systems, wireless baby surveillance (baby monitors), and other emerging wireless applications. Neither the FCC, the CPUC, the utility nor the consumer know what portion of the allowable public safety limit is already being used up or pre-empted by RF from other sources already present in the particular location a smart meter may be installed and operated.

Consumers, for whatever personal reason, choice or necessity who have already eliminated all possible wireless exposures from their property and lives, may now face excessively high RF exposures in their homes from smart meters on a 24-hour basis. This may force limitations on use of their otherwise occupied space, depending on how the meter is located, building materials in the structure, and how it is furnished.

People who are afforded special protection under the federal Americans with Disabilities

Act are not sufficiently acknowledged nor protected. People who have medical and/or metal implants or other conditions rendering them vulnerable to health risks at lower levels than FCC RF limits may be particularly at risk (Tables 30-31). This is also likely to hold true for other subgroups, like children and people who are ill or taking medications, or are elderly, for they have different reactions to pulsed RF. Childrens' tissues absorb RF differently and can absorb more RF than adults (Christ et al, 2010; Wiart et al, 2008). The elderly and those on some medications respond more acutely to some RF exposures.

Safety standards for peak exposure limits to radiofrequency have not been developed to take into account the particular sensitivity of the eyes, testes and other ball shaped organs. There are no peak power limits defined for the eyes and testes, and it is not unreasonable to imagine situations where either of these organs comes into close contact with smart meters and/or collector meters, particularly where they are installed in multiples (on walls of multi-family dwellings that are accessible as common areas).

In summary, no positive assertion of safety can be made by the FCC, nor relied upon by the CPUC, with respect to pulsed RF when exposures are chronic and occur in the general population. Indiscriminate exposure to environmentally ubiquitous pulsed RF from the rollout of millions of new RF sources (smart meters) will mean far greater general population exposures, and potential health consequences. Uncertainties about the existing RF environment (how much RF exposure already exists), what kind of interior reflective environments exist (reflection factor), how interior space is utilized near walls), and other characteristics of residents (age, medical condition, medical implants, relative health, reliance on critical care equipment that may be subject to electronic interference, etc) and unrestrained access to areas of property where meter is located all argue for caution.

Table 1
Potential OWS-NICS14 FCC Violations of TWA 655 (in inches)
(One Smart Meter, Four Meters)

One Meter Duty Cycle	Table D1 60% Reflection	Table D2 100% Reflection	Table D3 1000% Reflection	Table D4 2000% Reflection
1%	1.2"	1.4"	7.9"	15.1"
10%	3.7"	4.5"	25.0"	47.6"
20%	5.2"	6.4"	35.3"	67.4"
30%	6.3"	7.9"	43.2"	82.5"
40%	7.3"	9.1"	49.9"	95.3"
50%	8.2"	10.1"	55.8"	107
60%	9.0"	11.1"	61.1"	117
70%	9.7"	12.0"	66.0"	126"
80%	10.3"	12.8"	70.6"	135
90%	11.0"	13.6"	74.9"	143"
100%	11.5"	14.3"	78.9"	151"

Four Meters Duty Cycle	Table D5 60% Reflection	Table D6 100% Reflection	Table D7 1000% Reflection	Table D8 2000% Reflection
1%	1.4"	2.9"	22.0"	43"
10%	9.9"	12.6"	70.5"	135"
20%	14.3"	18.0"	99.6"	191"
30%	17.6"	22.1"	122"	235"
40%	20.4"	25.5"	141"	270"
50%	22.8"	28.6"	158"	301"
60%	25.0"	31.3"	173"	330"
70%	27.0"	33.9"	187"	357"
80%	28.9"	36.2"	200"	381"
90%	30.7"	38.4"	212"	404"
100%	32.4"	40.5"	223"	426"

This table shows how far away from the meter a possible FCC violation can occur

Table 2
Potential OWS-NIC514 FCC Violations of 655 uW/cm2 TWA Safety Limit
Nursery at 11"
(One Smart Meter, Four Meters)

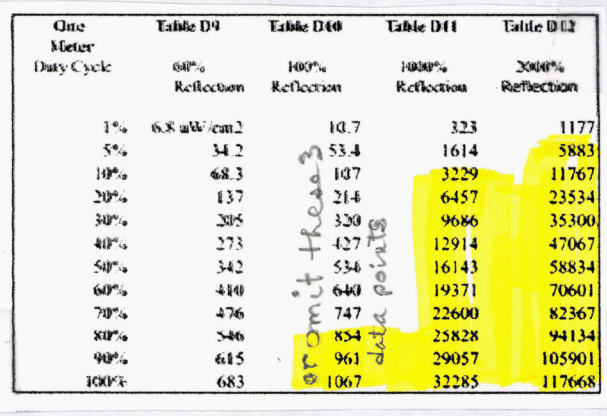
One Meter Duty Cycle	Table D9 60% Reflection	Table D10 100% Reflection	Table D11 1000% Reflection	Table D12 2000% Reflection
1%	6.8 uW/cm2	10.7	323	1177
5%	34.2	53.4	1614	5883
10%	68.3	107	3229	11767
20%	137	214	6457	23534
30%	205	320	9686	35300
40%	273	427	12914	47067
50%	342	534	16143	58834
60%	410	640	19371	70601
70%	476	747	22600	82367
80%	546	854	25828	94134
90%	615	961	29057	105901
100%	683	1067	32285	117668

Four Meters Duty Cycle	Table D13 60% Reflection	Table D14 100% Reflection	Table D15 1000% Reflection	Table D16 2000% Reflection
1%	23.4	36.6	1108	4038
5%	117	183	5540	20192
10%	234	366	11080	40383
20%	467	733	22160	80766
30%	703	1099	33240	121148
40%	938	1465	44321	161532
50%	1172	1831	55400	201915
60%	1407	2198	66481	242298
70%	1641	2564	77561	282681
80%	1875	2930	88641	323064
90%	2110	3297	99721	363448
100%	2344	3663	110802	403831

This table shows RF power density FCC violations at 11".

Exceeds 655 uW/cm2 FCC TWA Safety Limit

As the example, as shown here ↓, please imagine the



featured portion of the Table, the color, down one or two entries (I show one) and to the right one or two columns for an approximation of the potential violations of the smart meter model most deployed in Arizona.

Please apply this mental shift to get the sense of the subsequent Tables. Better yet go to the similar Tables in the full report, "Assessment of Radiofrequency Microwave Radiation Emissions from Smart Meters," www.sagereports.com/smart-meter-rf/

Table 3
Potential OWS-NIC514 FCC Violations of the 655 uW/cm2 Safety Limit at 28" in the Kitchen
(One Smart Meter, Four Meters)

One Meter Duty Cycle	Table D17 60% Reflection	Table D18 100% Reflection	Table D19 1000% Reflection	Table D20 2000% Reflection
1%	1.1 uW/cm2	1.6	49.8	182
5%	5.3	8.2	249	908
10%	10.5	16.5	498	1816
20%	21.1	32.9	997	3632
30%	31.6	49.4	1495	5448
40%	42.2	65.9	1993	7264
50%	52.7	82.4	2491	9080
60%	63.3	98.8	2990	10896
70%	73.8	115	3488	12712
80%	84.3	132	3986	14528
90%	94.9	148	4485	16334
100%	105	165	4983	18166

Four Meters Duty Cycle	Table D21 60% Reflection	Table D22 100% Reflection	Table D23 1000% Reflection	Table D24 2000% Reflection
1%	2.7	4.2	127	461
5%	13.4	20.9	633	2305
10%	26.8	41.8	1265	4610
20%	53.5	83.6	2530	9221
30%	80.3	126	3795	13831
40%	107	167	5060	18442
50%	134	209	6325	23052
60%	161	251	7590	27663
70%	187	293	8855	32273
80%	214	335	10120	36684
90%	241	376	11385	41494
100%	268	418	12650	46014

This table shows RF power density readings at 28" in the kitchen work space.

Exceeds 655 uW/cm2 FCC Limit

Table 4
OWS-NIC514 RF Levels Associated with Impaired DNA Repair Human Stem Cells
Nursery at 11" (One Smart Meter, Four Meters)

One Meter Duty Cycle	Table D9 60% Reflection	Table D10 100% Reflection	Table D11 1000% Reflection	Table D12 2000% Reflection
1%	6.8 uW/cm2	10.7	323	1177
5%	34.2	53.4	1614	5883
10%	68.3	107	3229	11767
20%	137	214	6457	23534
30%	205	320	9686	35300
40%	273	427	12914	47067
50%	342	534	16143	58834
60%	410	640	19371	70601
70%	476	747	22600	82367
80%	546	854	25828	94134
90%	615	961	29057	105901
100%	683	1067	32285	117668

Four Meters Duty Cycle	Table D13 60% Reflection	Table D14 100% Reflection	Table D15 1000% Reflection	Table D16 2000% Reflection
1%	23.4	36.6	1108	4038
5%	117	183	5540	20192
10%	234	366	11080	40383
20%	467	733	22160	80766
30%	703	1099	33240	121148
40%	938	1465	44321	161532
50%	1172	1831	55400	201915
60%	1407	2198	66481	242298
70%	1641	2564	77561	282681
80%	1875	2930	88641	323064
90%	2110	3297	99721	363448
100%	2344	3663	110802	403831

Exceeds 0.037 W/Kg or ~ 92 uW/cm2
Reported to impair human stem cell DNA repair

Table 5
OWS-NIC514 RF Levels Associated with Impaired DNA Repair Human Stem Cells Kitchen at 28"
(One Smart Meter, Four Meters)

One Meter Duty Cycle	Table D17 60% Reflection	Table D18 100% Reflection	Table D19 1000% Reflection	Table D20 2000% Reflection
1%	1.1 uW/cm2	1.6	49.8	182
5%	5.3	8.2	249	908
10%	10.5	16.5	498	1816
20%	21.1	32.9	997	3632
30%	31.6	49.4	1495	5448
40%	42.2	65.9	1993	7264
50%	52.7	82.4	2491	9080
60%	63.3	98.8	2990	10896
70%	73.8	115	3488	12712
80%	84.3	132	3986	14528
90%	94.9	148	4485	16334
100%	105	165	4983	18166

Four Meters Duty Cycle	Table D21 60% Reflection	Table D22 100% Reflection	Table D23 1000% Reflection	Table D24 2000% Reflection
1%	2.7	4.2	127	461
5%	13.4	20.9	633	2305
10%	26.8	41.8	1265	4610
20%	53.5	83.6	2530	9221
30%	80.3	126	3795	13831
40%	107	167	5060	18442
50%	134	209	6325	23052
60%	161	251	7590	27663
70%	187	293	8855	32273
80%	214	335	10120	36684
90%	241	376	11385	41494
100%	268	418	12650	46014

This table shows RF power density readings at 28" in the kitchen work space.

Exceeds 0.037 W/Kg or ~ 92 uW/cm2
Reported to impair human stem cell DNA repair

Table 6
OWS-NIC514 RF Levels Associated with Pathological Leakage of the Blood-brain Barrier Nursery at 11"
(One Smart Meter, Four Meters)

One Meter Duty Cycle	Table D9 60% Reflection	Table D10 100% Reflection	Table D11 1000% Reflection	Table D12 2000% Reflection
1%	6.8 uW/cm2	10.7	323	1177
5%	34.2	53.4	1614	5883
10%	68.3	107	3229	11767
20%	137	214	6457	23534
30%	205	320	9686	35300
40%	273	427	12914	47067
50%	342	534	16143	58834
60%	410	640	19371	70601
70%	476	747	22600	82367
80%	546	854	25828	94134
90%	615	961	29057	105901
100%	683	1067	32285	117668

Four Meters Duty Cycle	Table D13 60% Reflection	Table D14 100% Reflection	Table D15 1000% Reflection	Table D16 2000% Reflection
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5%	117	183	5540	20192
10%	234	366	11080	40383
20%	467	733	22160	80766
30%	703	1099	33240	121148
40%	938	1465	44321	161532
50%	1172	1831	55400	201915
60%	1407	2198	66481	242298
70%	1641	2564	77561	282681
80%	1875	2930	88641	323064
90%	2110	3297	99721	363448
100%	2344	3663	110802	403831

Exceeds 0.4 to 8 uW/cm2

Exceeds 8 uW/cm2

Table 7
OWS-NIC514 RF Levels Associated with Pathological Leakage of the Blood-brain Barrier - Kitchen at 28"
(One Smart Meter, Four Meters)

One Meter Duty Cycle	Table D17 60% Reflection	Table D18 100% Reflection	Table D19 1000% Reflection	Table D20 2000% Reflection
1%	1.1 uW/cm2	1.6	49.8	182
5%	5.3	8.2	249	908
10%	10.5	16.5	498	1816
20%	21.1	32.9	997	3632
30%	31.6	49.4	1495	5448
40%	42.2	65.9	1993	7264
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70%	73.8	115	3488	12712
80%	84.3	132	3986	14528
90%	94.9	148	4485	16334
100%	105	165	4983	18166

Four Meters Duty Cycle	Table D21 60% Reflection	Table D22 100% Reflection	Table D23 1000% Reflection	Table D24 2000% Reflection
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5%	13.4	20.9	633	2305
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20%	53.5	83.6	2530	9221
30%	80.3	126	3795	13831
40%	107	167	5060	18442
50%	134	209	6325	23052
60%	161	251	7590	27663
70%	187	293	8855	32273
80%	214	335	10120	36684
90%	241	376	11385	41494
100%	268	418	12650	46014

Exceeds 0.4 - 8 uW/cm2
and
Exceeds 8 uW/cm2

Table 8
OWS-NIC514 RF Levels Associated with Adverse Neurological Symptoms, Cardiac Problems and Increased Cancer Risk
Nursery at 11'
(One Smart Meter, Four Meters)

One Meter Duty Cycle	Table D9 60% Reflection	Table D10 100% Reflection	Table D11 1000% Reflection	Table D12 2000% Reflection
1%	6.8 uW/cm2	10.7	323	1177
5%	34.2	53.4	1614	5883
10%	68.3	107	3229	11767
20%	137	214	6457	23534
30%	205	320	9686	35300
40%	273	427	12914	47067
50%	342	534	16143	58834
60%	410	640	19371	70601
70%	476	747	22600	82367
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100%	683	1067	32285	117668

Four Meters Duty Cycle	Table D13 60% Reflection	Table D14 100% Reflection	Table D15 1000% Reflection	Table D16 2000% Reflection
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40%	938	1465	44321	161532
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60%	1407	2198	66481	242298
70%	1641	2564	77561	282681
80%	1875	2930	88641	323064
90%	2110	3297	99721	363448
100%	2344	3663	110802	403831

All exposure levels exceed those identified in Khurana et al, 2010; Kundi and Hutter, 2009; and the BioInitiative Report, 2007 to be associated with increased risk of adverse neurological symptoms (headache, sleep disruption, restlessness, tremor, cognitive impairment, tinnitus) increased cancer risk or heart problems (arrythmias, altered heart rhythm, palpitations). These effects are reported in populations living at distances < 500 m from cell towers, and at levels at or over 0.05-0.1 uW/cm2 in healthy populations.

Table 9
OWS-NIC514 RF Levels Associated with Adverse Neurological Symptoms. Cardiac Problems and Increased Cancer Risk Kitchen at 28'' (One Smart Meter, Four Meters)

One Meter Duty Cycle	Table D17 60% Reflection	Table D18 100% Reflection	Table D19 1000% Reflection	Table D20 2000% Reflection
1%	1.1 uW/cm2	1.6	49.8	182
5%	5.3	8.2	249	908
10%	10.5	16.5	498	1816
20%	21.1	32.9	997	3632
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100%	105	165	4983	18166

Four Meters Duty Cycle	Table D21 60% Reflection	Table D22 100% Reflection	Table D23 1000% Reflection	Table D24 2000% Reflection
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5%	13.4	20.9	633	2305
10%	26.8	41.8	1265	4610
20%	53.5	83.6	2530	9221
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40%	107	167	5060	18442
50%	134	209	6325	23052
60%	161	251	7590	27663
70%	187	293	8855	32273
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100%	268	418	12650	46014

All exposure levels exceed those identified in Khurana et al, 2010; Kundi and Hutter, 2009; and the BioInitiative Report, 2007 to be associated with increased risk of adverse neurological symptoms (headache, sleep disruption, restlessness, tremor, cognitive impairment, tinnitus) increased cancer risk or heart problems (arrythmias, altered heart rhythm, palpitations). These effects are reported in populations living at distances < 500 m from cell towers, and at levels at or over 0.05-0.1 uW/cm2 in healthy populations.

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Appendix D Tables D1 –D24 - Download the Appendix D Tables as a PDF

Radiofrequency Radiation Versus Distance

One Smart Meter

Table D1 60% Reflection (1%-100% duty cycles in each table)

Table D2 100% Reflection (1%-100% duty cycles in each table)

Table D3 1000% Reflection* (1%-100% duty cycles in each table)

Table D4 2000% Reflection* (1%-100% duty cycles in each table)

Multiple Smart Meters (Four)**

Table D5 60% Reflection (1%-100% duty cycles in each table)

Table D6 100% Reflection (1%-100% duty cycles in each table)

Table D7 1000% Reflection (1%-100% duty cycles in each table) Table D8 2000% Reflection (1%-100% duty cycles in each table)

Nursery Tables (Crib at 11")

One Smart Meter

Table D9	60% Reflection	(1%-100% duty cycles in each table)
Table D10	100% Reflection	(1%-100% duty cycles in each table)
Table D11	1000% Reflection	(1%-100% duty cycles in each table)
Table D12	2000% Reflection	(1%-100% duty cycles in each table)

Four Smart Meters

Table D13	60% Reflection	(1%-100% duty cycles in each table)
Table D14	100% Reflection	(1%-100% duty cycles in each table)
Table D15	1000% Reflection	(1%-100% duty cycles in each table)
Table D16	2000% Reflection	(1%-100% duty cycles in each table)

Kitchen Tables (Work Space at 28")

One Smart Meter

Table D17	60% Reflection	(1%-100% duty cycles in each table)
Table D18	100% Reflection	(1%-100% duty cycles in each table)
Table D19	1000% Reflection	(1%-100% duty cycles in each table)
Table D20	2000% Reflection	(1%-100% duty cycles in each table)

Four Smart Meters

Table D21	60% Reflection	(1%-100% duty cycles in each table)
Table D22	100% Reflection	(1%-100% duty cycles in each table)
Table D23	1000% Reflection	(1%-100% duty cycles in each table)
Table D24	2000% Reflection	(1%-100% duty cycles in each table)

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Assessment of Radiofrequency Microwave Radiation Emissions from Smart Meters

Sage Associates

Santa Barbara, CA

USA

January 1, 2011

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DOCKET: E-00000C-11-0328

On-going Assessment of Radiofrequency Radiation Health Risks

The US NIEHS National Toxicology Program nominated radiofrequency radiation for study as a carcinogen in 1999. Existing safety limits for pulsed RF were termed "not protective of public health" by the Radiofrequency Interagency Working Group (a federal interagency working group including the FDA, FCC, OSHA, the EPA and others). Recently, the NTP issued a statement indicating it will complete its review by 2014 (National Toxicology Program, 2009). The NTP radiofrequency radiation study results have been delayed for more than a decade since 1999 and very little laboratory or epidemiological work has been completed. Thus, he explosion of wireless technologies is producing radiofrequency radiation exposures over massive populations before questions are answered by federal studies about the carcinogenicity or toxicity of low-intensity RF such as are produced by smart meters and other SmartGrid applications of wireless. The World Health Organization and the International Agency for Research on Cancer have not completed their studies of RF (the IARC WHO RF Health Monograph is not expected until at least 2011). In the United States, the National Toxicology Program listed RF as a potential carcinogen for study, and has not released any study results or findings a decade later. There are no current, relevant public safety standards for pulsed RF involving chronic exposure of the public, nor of sensitive populations, nor of people with metal and medical implants that can be affected both by localized heating and by electromagnetic interference (EMI) for medical wireless implanted devices.

Considering that millions of smart meters are slated to be installed on

virtually every electrified building in America, the scope of the question is large and highly personal. Every family home in the country, and every school classroom – every building with an electric meter – is to have a new wireless meter – and thus subject to unpredictable levels of RF every day.

1) Have smart meters been tested and shown to comply with FCC public safety limits (limits for uncontrolled public access)?

2) Are these FCC public safety limits sufficiently protective of public health and safety? This question is posed in light of the last thirty years of international scientific investigation and public health assessments documenting the existence of bioeffects and adverse health effects at RF levels far below current FCC standards. The FCC's standards have not been updated since 1992, and did not anticipate nor protect against chronic exposures (as opposed to acute exposures) from low-intensity or non-thermal RF exposures, particularly pulsed RF exposures.

3) What demonstration is there that wireless smart meters will comply with existing FCC limits, as opposed to under strictly controlled conditions within government testing laboratories?

4) Has the FCC been able to certify that compliance is achievable under real-life use conditions including, but not limited to:

    • In the case where there are both gas and electric meters on the home located closely together.

- In the case where there is a "bank" of electric and gas meters, on a multi-family residential building such as on a condominium or apartment building wall. There are instances of up to 20 or more meters located in close proximity to occupied living space in the home,in the classroom or other occupied public space.

- In the case where there is a collector meter on a home that serves the home plus another 500 to 5000 other residential units in the area, vastly increasing the frequency of RF bursts.

- In the case where there is one smart meter on the home but it acts as a relay for other local neighborhood meters. What about 'piggybacking' of other neighbors' meters through yours? How can piggybacking be reasonably estimated and added onto the above estimates?

- What about the RF emissions from the power transmitters? Power transmitters installed on appliances (perhaps 10-15 of them per home) and each one is a radiofrequency radiation transmitter.

- How can the FCC certify a system that has an unknown number of such transmitters per home, with no information on where they are placed?

- Where people with medical/metal implants are present? (Americans with Disabilities Act protects rights)

5) What assessment has been done to determine what pre-existing conditions of RF exposure are already present. On what basis can compliance for the family inside the residence be assured, when there is no verification of what other RF sources exist on private property? How is the problem of cumulative RF exposure properly assessed (wireless routers, wireless laptops, cell phones, PDAs, DECT or other active-base cordless phone systems, home security systems, baby monitors, contribution of AM, FM, television, nearby cell towers, etc).

6) What is the cumulative RF emissions worst-case profile? Is this estimate in compliance?

7) What study has been done for people with metal implants* who require protection under Americans with Disabilities Act? What is known about how metal implants can intensity RF, heat tissue and result in adverse effects below RF levels allowed for the general public. What is known about electromagnetic interference (EMI) from spurious RF sources in the environment (RFID scanners, cell towers, security gates, wireless security systems, wireless communication devices and routers, wireless smart meters, etc)

*Note: There are more than 20 million people in the US who need special protection against such exposures that may endanger them. High peak power bursts of RF may disable electronics in some critical care and medical implants. We already have reports of wireless devices disabling deep brain stimulators in Parkinson's patients and there is published literature on malfunctions with critical care equipment.

In this report, the public safety limit for a smart meter is a combination of the individual antenna frequency limits and how much power output they create. A smart meter contains two antennas. One transmits at 915 MHz and the other at 2405 MHz. They can transmit at the same time, and so their effective radiated power is summed in the calculations of RF power density. Their combined limit is 655 uW/cm2. This limit is calculated by formulas from Table 1, Part B and is proportionate to the power output and specific safety limit (in MHz) of each antenna.

For the collector meter, with it's three internal antennas, the combined public safety limit for time-averaged exposure is 571 MHz (a more restrictive level since it includes an additional 824 MHz antenna that has a lower limit than either the 915 MHz or the 2405 MHz antennas). In a collector meter, only two of the three antennas can transmit simultaneously (the 915 MHz LAN and the GSM 850 MHz (from the FCC Certification Exhibit titled RF Exposure Report for FCC ID: SK9AMI-2A). The proportionate power output of each antenna plus the safety limit for each antenna frequency combines to give a safety limit for the collector meter of 571 uW/cm2. Where one collector meter is combined with multiple smart meters, the combined limit is weighted upward by the additional smart meters' contribution, and is 624 uW/cm2.

Continuous Exposure

FCC Bulletin OET 65 guidelines require the assumption of continuous exposure in calculations. Duty cycles offered by the utilities are a fraction of continuous use,

and significantly diminish predictions of RF exposure.

At present, there is no evidence to prove that smart meters are functionally unable to operate at higher duty cycles that some utilities have estimated (estimates vary from 1% to 12.5% duty cycle, and as high as 30%). Confirming this is the Electric Power Research Institute (EPRI) in its "Perspective on Radio-Frequency Exposure Associated with Residential Automatic Meter Reading Technology (EPRI, 2010) According to EPRI:

> *"The technology not only provides a highly efficient method for obtaining usage data from customers, but it also can provide up-to-the-minute information on consumption patterns since the meter reading devices can be programmed to provide data as often as needed."*
> Emphasis added

The FCC Bulletin OET 65 guidelines specify that continuous exposure (defined by the FCC OET 65 as 100% duty cycle) is required in calculations where it is not possible to control exposures to the general public.

> *"It is important to note that for general population/uncontrolled exposures it is often not possible to control exposures to the extent that averaging times can be applied. In those situations, it is often necessary to assume continuous exposure."* (emphasis added)
> FCC Bulletin OET 65, p, 10

> ***"Duty factor**. The ratio of pulse duration to the pulse period of a periodic pulse train. Also, may be a measure of the temporal transmission characteristic of an intermittently transmitting RF source such as a paging antenna by dividing average transmission duration by the average period for transmissions. A duty factor of 1.0 corresponds to continuous operation."* (emphasis added)
> FCC Bulletin OET 65, p, 2

This provision then specifies duty cycles to be increased to 100%.

The FCC Guidelines (OET 65) further address cautions that should be observed for uncontrolled public access to areas that may cause exposure to high levels of RF.

Re-radiation

The foregoing also applies to high RF levels created in whole or in part by re-eradiation. A convenient rule to apply to all situations involving RF radiation is the following:

(1) Do not create high RF levels where people are or could reasonably be expected to be present, and (2) [p]revent people from entering areas in which high RF levels are necessarily present.

(2) Fencing and warning signs may be sufficient in many cases to protect the general public. Unusual circumstances, the presence of multiple sources of radiation, and operational needs will require more elaborate measures.

(3) Intermittent reductions in power, increased antenna heights, modified antenna radiation patterns, site changes, or some combination of these may be necessary, depending on the particular situation.

FCC OET 65, Appendix B, p. 79

Fencing, distancing, protective RF shielded clothing and signage warning occupants not to use portions of their homes or properties are not feasible nor desirable in public places the general public will spend time (schools, libraries,

cafes, medical offices and clinics, etc) These mitigation strategies may be workable for RF workers, but are unsuited and intolerable for the public.

Reflections

A major, uncontrolled variable in predicting RF exposures is the degree to which a particular location (kitchen, bedroom, etc) will reflect RF energy created by installation of one or more smart meters, or a collector meter and multiple smart meters. The reflectivity of a surface is a measure of the amount of reflected radiation. It can be defined as the ratio of the intensities of the reflected and incident radiation. The reflectivity depends on the angle of incidence, the polarization of the radiation, and the electromagnetic properties of the materials forming the boundary surface. These properties usually change with the wavelength of the radiation. The reflectivity of polished metal surfaces is usually quite high (such as stainless steel and polished metal surfaces typical in kitchens, for example).

Reflections can significantly increase localized RF levels. High uncertainty exists about how extensive a problem this may create in routine installations of smart meters, where the utility and installers have no idea what kind of reflectivity is present within the interior of buildings.

Reflections in Equation 6 and 10 of the FCC OET Bulletin 65 include rather minimal reflection factors of 100% and 60%, respectively. This report includes higher reflection factors in line with published studies by Hondou et al, 2006, Hondou, 2002 and Vermeeren et al, 2010. Reflection factors are modeled at 1000% and 2000% as well as at 60% and 100%, based on published scientific evidence for highly reflective environments. Hondou (2002) establishes that

power density can be higher than conventional formulas predict using standard 60% and 100% reflection factors.

> *"We show that this level can reach the reference level (ICNIRP Guideline) in daily life. This is caused by the fundamental properties of electromagnetic field, namely, reflection and additivity. The level of exposure is found to be much higher than estimated by conventional framework of analysis that assumes that the level rapidly decreases with the inverse square distance between the source and the affected person."*
>
> *"Since the increase of electromagnetic field by reflective boundaries and the additivity of sources has not been recognized yet, further detailed studies on various situations and the development of appropriate regulations are required."*

Hondou et al (2006) establishes that power densities 1000 times to 2000 times higher than the power density predictions from computer modeling (that does not account properly for reflections) can be found in daily living situations. Power density may not fall off with distance as predicted by formulas using limited reflection factors. The RF hot spots created by reflection can significantly increase RF exposures to the public, even above current public safety limits.

> *"We confirm the significance of microwave reflection reported in our previous Letter by experimental and numerical studies. Furthermore, we show that 'hot spots' often emerge in reflective areas, where the local exposure level is much higher than average."*
>
> *"Our results indicate the risk of 'passive exposure' to microwaves."*
>
> *"The experimental values of intensity are consistently higher than predicted values. Intensity does not even decrease with distance from the source."*
>
> *"We further confirm the existence of microwave 'hotspots', in which he microwaves are 'localized'. The intensity measured at one hot spot 4.6 m from the transmitter is the same as that at 0.1 m from the transmitter in the case with out reflection (free boundary condition).*
> *Namely, the intensity at the hot spot is increased by* ***approximately 2000***

***times** by reflection."* Emphasis added

"To confirm our experimental findings of the greater-than-predicted intensity due to reflection, as well as the hot spots, we performed two numerical simulations...". " intensity does not monotonically decrease from the transmitter, which is in clear contrast to the case without reflection."

*"The intensity at the hot spot (X, Y, Z) = 1.46, -0.78, 105) around 1.8 m from the transmitter in the reflective boundary condition is **approximately 1000 times higher** than that at the same position in the free boundary condition. The result of the simulation is thus consistent with our experiments, although the values differ owing to the different conditions imposed by computational limits."*

Emphasis added

"(t)he result of the experiment is also reproduced: a greater than predicted intensity due to reflection, as well as the existence of hot spots."

*"In comparison with the control simulation using the free boundary condition, we find that the power density at the hot spot is increased **by approximately a thousand times** by reflection."*

Emphasis added

Further, the author comments that:

"we may be passively exposed beyond the levels reported for electro-medical interference and health risks."

"Because the peak exposure level is crucial in considering electro-medical interference, interference (in) airplanes, and biological effects on human beings, we also need to consider the possible peak exposure level, or 'hot spots', for the worst-case estimation."

Reflections and re-radiation from common building material (tile, concrete, stainless steel, glass, ceramics) and highly reflective appliances and furnishings are common in kitchens, for example. Using only low reflectivity FCC equations 6 and 10 may not be informative. Published studies underscore how use of even the

highest reflection coefficient in FCC OET Bulletin 65 Equations 6 and 10 likely underestimate the potential for reflection and hot spots in some situations in real-life situations.

This report includes the FCC's reflection factors of 60% and 100%, and also reflection factors of 1000% and 2000% that are more in line with those reported in Hondou, 2001; Hondou, 2006 and Vermeeren et al, 2010. The use of a 1000% reflection factor in this report is still conservative in comparison to Hondou, 2006. A 1000% reflection factor is 12% of Hondou's larger power density prediction (or 121 times, rather than 1000 times)/ The 2000% reflection factor is 22% of Hondou's figure (or 441 times in comparison to 2000 times higher power density in Hondou, 2006).

Peak Power Limits

In addition to time-averaged public safety limits that require RF exposures to be time-averaged over a 30 minute time period, the FCC also addresses peak power exposures. The FCC refers back to the ANSI/IEEE C95.1-1992 standard to define what peak power limits are.

The ANSI/IEEE C95.1-1999 standard defines peak power density as "*the maximum instantaneous power density occurring when power is transmitted.*" (p. 4) Thus, there is a second method to test FCC compliance that is not being assessed in any FCC Grants of Authorization.

> *"Note that although the FCC did not explicitly adopt limits for peak power density, guidance on these types of exposures can be found in Section 4.4 of the ANSI/IEEE C95.1-1992 standard."*
>
> *Page 10, OET 65*

The ANSI/IEEE limit for peak power to which the FCC refers is:

> *"For exposures in uncontrolled environments, the peak value of the mean squared field strengths should not exceed 20 times the square of the allowed spatially averaged values (Table 2) at frequencies below 300 MHz, or the equivalent power density of 4 mW/cm2 for f between 300 MHz and 6 GHz".*

The peak power exposure limit is 4000 uW/cm2 for all smart meter frequencies (all transmitting antennas) for any instantaneous RF exposure of 4 milliwatts/cm2 (4 mW/cm2) or higher which equals 4000 microwatts/cm2 (uW/cm2).

This peak power limit applies to all smart meter frequencies for both the smart meter (two-antenna configuration) and the collector meter (three-antenna configuration). All these antennas are within the 300 MHz to 6 GHz frequency range where the 4000 uW/cm2 peak power limit applies (Table 3, ANSI/IEEE C95.1-1999, page 15).

Smart meters emit frequencies within the 800 MHz to 2400 MHz range.

Exclusions

This peak power limit applies to all parts of the body with the important exception of the eyes and testes.

The ANSI/IEEE C95.1-1999 standard specifically excludes exposure of the eyes

and testes from the peak power limit of 4000 uW/cm2*. However, nowhere in the ANSI/IEEE nor the FCC OET 65 documents is there a lower, more protective peak power limit given for the eyes and testes (see also Appendix C).

> *"The following relaxation of power density limits is allowed for exposure of all parts of the body except the eyes and testes." (p.15)*
>
> *"Since most exposures are not to uniform fields, a method has been derived, based on the demonstrated peak to whole-body averaged SAR ratio of 20, for equating nonuniform field exposure and partial body exposure to an equivalent uniform field exposure. This is used in this standard to allow relaxation of power density limits for partial body exposure, except in the case of the eyes and the testes." (p.20)*
>
> *"In the case of the eyes and testes, direct relaxation of power density limits is not permitted."(p. 30)*

*Note: This leaves unanswered what instantaneous peak power is permissible from smart meters. The level must be below 4000 uW/cm2. This report shows clearly that smart meters can create instantaneous peak power exposures where the face (eyes) and body (testes) are going to be in close proximity to smart meter RF pulses. RF levels at and above 4000 uW/cm2 are likely to occur if a person puts their face close to the smart meter to read data in real time. The digital readout of the smart meter requires close inspection, particularly where there is glare or bright sunlight, or low lighting conditions. Further, some smart meters are installed inside buildings within inches of occupied space, virtually guaranteeing exposures that may violate peak power limits. Violations of peak power limits are likely in these circumstances where there is proximity within about 6" and highly reflective surfaces or metallic objects. The eyes and testes are not adequately protected by the 4000 uW/cm2 peak power limit, and in the cases described above, may be more vulnerable to damage (Appendix C for further discussion).

Calculation Distances in Tables

Calculations have also been made for a typical nursery and kitchen. In the nursery it has been assumed that the baby in his or her crib that is located next to the wall where the electric SMART Meters are mounted. The closest part of the baby's body can be as close as 11 inches* from the meter antenna. In the kitchen it has been assumed that a person is standing at the counter along the wall where the electric SMART Meters are mounted. In that case the closest part of the adult's body can be located as close to the meter antenna as 28 inches.

The exposure limits are variable according to the frequency (in megahertz). Table 1, Appendix A show exposure limits for occupational (Part A) and uncontrolled public (Part B) access to radiofrequency radiation such as is emitted from AM, FM, television and wireless sources.

* Flush-mounted main electric panels that house smart meters are commonly installed; placing smart meters 5" 6" closer to occupied space than box-mounted main electric panels that sit outward on exterior building walls. Assumptions on spacing are made for flush-mounted panels.

Conditions Influencing Radiofrequency Radiation Level Safety

The location of the meter in relation to occupied space, or outside areas of private property such as driveways, walk-ways, gardens, patios, outdoor play areas for children, pet shelters and runs, and many typical configurations can place people in very close proximity to smart meter wireless emissions. In many instances, smart meters may be within inches or a few feet of occupied space or space that is used by occupants for daily activities.

Factors that influence how high RF exposures may be include, but are not limited to where the meter is installed in relation to occupied space, how often the meters are emitting RF pulses (duty cycle), and what reflective surfaces may be present that can greatly intensify RF levels or create 'RF hot spots' within rooms, and so on. In addition, there may be multiple wireless meters installed on some multi-family residential buildings, so that a single unit could have 20 or more electric meters in close proximity to each other, and to occupants inside that unit. Finally, some meters will have higher RF emissions, because – as collector units – their purpose is to collect and resend the RF signals from many other meters to the utility. A collector meter is estimated to be required for every 500 to 5000 buildings. Each collector meter contains three, rather than two transmitting

antennas. This means higher RF levels will occur on and inside buildings with a collector meter, and significantly more frequent RF transmissions can be expected. At present, there is no way to predict whose property will be used for installation of collector meters.

People who are visually reading the wireless meters 'by sight' or are visually inspecting and/or reading the digital information on the faceplate may have their eyes and faces only inches from the antennas.

Current standards for peak power limit do not have limits to protect the eyes and testes from instantaneous peak power from smart meter exposures, yet relevant documents identify how much more vulnerable these organs are, and the need for such safety limits to protect the eyes and testes.

No Baseline RF Assessment

Smart meter and collector meter installation are taking place in an information vacuum. FCC compliance testing takes place in an environment free of other sources of RF, quite unlike typical urban and some rural environments. There is no assessment of baseline RF conditions already present (from AM, FM, television and wireless communication facilities (cell towers), emergency and dispatch wireless, ham radio and other involuntary RF sources. Countless properties already have elevated RF exposures from sources outside their own control.