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STATE OF MAINE  
PUBLIC UTILITIES COMMISSION

ED FRIEDMAN, ET AL,  
Request for Commission Investigation into  
Smart Meters and Smart Meter Opt-Out

Docket No. 2011-00262

**COMPLAINANTS' POST-HEARING BRIEF**

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## **I. INTRODUCTION**

Central Maine Power Company (“CMP”) has installed radio-frequency (“RF”) transmitting smart meters on or in houses and commercial buildings throughout its service territory as part of an advanced metering infrastructure (“AMI”) system. The meters use 2.4GHz RF radiation to transmit electric usage information to CMP’s headquarters, referred to as the head-end component of the AMI system. The meters communicate with each other and with “collectors” within a “mesh network” of RF transmitting devices. The RF radiation within the mesh network travels unimpeded through most buildings, and permeates the public spaces within CMP’s 11,000 square mile territory. The mesh of RF radiation also extends into the private spaces of individual residences. Every yard, driveway, play area, living room and bedroom of CMP customers located within proximity of a smart meter or other AMI device is now intermittently permeated with RF radiation.

Each smart meter serves as a relay station within the mesh network, receiving RF transmissions from other meters in the vicinity. The meters that relay their transmissions to other meters are called “descendants” of the other meters. As the system is currently configured, each meter transmits at least 34 times per day (once every hour plus ten transmissions during the “active period”). Under the current configuration, the most descendants a meter can have is 4,998. By relaying 34 transmissions for each descendant, a meter with the maximum number of descendants will transmit approximately at least 170,000 times per day. This does not include “maintenance command” transmissions or retry transmissions, which occur whenever the transmission traffic is heavy.

CMP installed the AMI system under authority granted by the Maine Public Utility Commission (“Commission”). CMP received many customer complaints, citing concerns about health and safety, as well as privacy, security, and property rights, which can also implicate safety concerns. *Data Response* (“D.R.”) *Fr. 01-01*; *D.R.Stone 01-02*. The health complaints included people experiencing severe electro-hypersensitivity (“EHS”) symptoms, and people concerned about heightened vulnerability to RF radiation due to existing health conditions, *e.g.* immune deficiencies, heart conditions, pacemakers and other medical implants, and brain tumors. *See e.g., D.R.Fr. 01-01*, Att. 1, p. 2, 5, 8-9, 12, 13, 16-17, 19; Att. 2, p. 10.

In a prior proceeding commenced by different Complainants, the Commission decided to let customers keep their old meters by “opting out,” but only if they pay an initial fee of \$40.00 plus a \$12.00 monthly fee, for as long as they remain a utility customer. Complainants commenced this case in 2011 alleging the Commission had failed to adequately address health, privacy, security and property rights concerns. The Commission dismissed the complaint and Complainants appealed the dismissal. The Maine Supreme Court granted the appeal and remanded the case directing the Commission to determine whether smart meters are safe. *Friedman v. PUC*, 2012 ME 90, 48 A.3d 794. Accordingly, the Commission commenced this investigation into the health and safety of the smart meters and the AMI system. *PUC NOI Order (7/24/2012)*.

The purpose of this investigation is to determine whether smart meters and the AMI system are safe<sup>1</sup> within the context of CMP’s obligation to furnish safe, reasonable and

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<sup>1</sup> It is undisputed that health concerns are subsumed within the term safety. Thus, the existence of a risk of adverse health effects precludes a finding that CMP has ensured safety.

adequate facilities (35-A MRS §301) and the Commission's obligation to ensure the safety of all utility facilities. 35-A MRS §10 ("safe, reasonable and adequate service"). These legislative obligations are reinforced by two independently operative legal mandates -- every Maine citizen's constitutional right to "pursue and obtain safety" (*Me. Const. Art. I, §1*) and the judicial maxim *salus populi suprema lex*, which means the safety of the people is the supreme law. *Seavey v. Preble*, 64 Me. 120, 121 (Me. 1874). In this context, the obligation to ensure safety must be carefully and strictly construed to require proof of safety for all CMP customers from RF exposures assessed in a worst case scenario analysis.

Before this investigation, CMP took no action to ensure safety other than confirming the smart meters and AMI equipment had been laboratory tested in accordance with requirements of the Federal Communications Commission ("FCC"). *D.R.Fr. 01-09*. It made no effort to keep track of safety and health complaints. *D.R.Fr. 01-04*. It developed no policies related to the health and safety effects of smart meters. *D.R.Stone 01-05*. It relied on the FCC and its consultants to conclude there are no health effects and to ignore the many health complaints it received. Ironically and quite sadly, CMP was far more responsive to complaints about interference with other RF devices than it was to interference with human health. CMP tracked complaints about interference with computers and other electronic equipment. *11/8/2012 Tr.* p. 42, l.8. Even when there was no proof of causation, the electronic problems were addressed, while human health was ignored because of uncertain causation. "[W]e did not do a root cause assessment to say what is the cause of interference here. We essentially just worked to mitigate -- to address whatever the customer's issue might be." *Id.*, p. 43, ll.13-16.

During this investigation, CMP has provided no affirmative proof that the AMI system does not cause adverse health effects. It hired Exponent, Inc. (“Exponent”), an industry defense firm or “product protection firm,” to mount a defense strategy of sowing doubt and uncertainty about the causal link between smart meter RF and health risks. *See, Morgan Test.*, p.6-7. Two employees of Exponent, Drs. Bailey and Shkolnikov, testified with assistance from other Exponent employees. Dr. Bailey is a neuropsychologist and Dr. Shkolnikov is an electrical engineer. Neither has performed original research about the biological effects of RF radiation. *11/8/2012 Tr.* p. 45, ll. 13-17. Before the case is over, however, Exponent will likely receive close to a million dollars for their defense advocacy on behalf of CMP in this case.<sup>2</sup> Dr. Shkolnikov tested RF radiation levels from a few CMP smart meters and produced a report about the testing. *Exponent Validation Report*, 09/19/2012 (“Validation Report”). As explained below, the test results are unreliable and either irrelevant or not informative on the question to be decided by the Commission.

Exponent’s defensive approach fails as a matter of law because it attempts to shift the burden of proof to Complainants. CMP, not Complainants, has the burden to resolve doubts and uncertainties, whether it be about the state of the science, the level of RF radiation emitted, or ultimately the extent of the safety risk. The burden of resolving uncertainties must fall on the party with the affirmative obligation to ensure safety, not on the individuals who are exposed to the risk and are exercising their constitutional right to obtain safety in their own homes. CMP’s failure to resolve or explain the uncertainties in the science and to provide affirmative proof of safety compels a finding against CMP before even considering Complainants’ affirmative evidence of risk.

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<sup>2</sup> As of 4/27/2013, Exponent had been paid \$457,347.23. *D.R.Fr. 03-01*.

Complainants presented testimony from nine expert witnesses. Some of these experts have conducted extensive original research and are among the most qualified experts in the world on the health effects of low-level RF radiation. Their testimony confirms that low-level RF radiation creates health and safety risks to humans. This conclusion is further supported by hundreds of scientific studies and by the sworn lay witness testimony of dozens of people who have suffered adverse health effects from exposure to RF radiation, including smart meter radiation. CMP did not challenge any of Complainants' witnesses through cross-examination and failed to otherwise rebut the quality and reliability of their evidence. The risk is clear and safety is not ensured.

## **II. LEGAL STANDARDS**

### **A. Ensuring safety.**

Ensuring safety is fundamental to the Commission's mission and regulatory authority. "The basic purpose of this regulatory system is to *ensure* safe, reasonable and adequate service at rates which are just and reasonable to customers and public utilities." 35-A M.R.S. §101 (emphasis added). This is the "essence of the regulatory approach undertaken" by the Legislature. *New England Tel. & Tel. Co. v. Public Utilities Com.*, 354 A.2d 753, 756 (Me. 1976). The Legislature, recognizing the monopoly status of utilities and the potential for widespread harm from unsafe facilities, further mandates that "[e]very public utility shall furnish safe, reasonable and adequate facilities and service." 35-A M.R.S. §301(1). And finally, the Legislature emphasizes that all provisions in Title 35-A "shall be interpreted and construed liberally to accomplish the purpose of this Title." 35-A M.R.S. §104 (emphasis added).



“Ensure” is the operative word chosen by the Legislature and emphasized by the Court to describe the Commission’s fundamental duty, for which the Commission is entrusted by the Legislature as “the primary guardian of the public interest.” *Brink's, Inc. v. Maine Armored Car & Courier Service, Inc.*, 423 A.2d 536, 538 (Me. 1980). “Ensure” means to “guarantee or to warrant” that something is accomplished or occurs. *United States v. Ray*, 273 F. Sup. 2d 1160, 1165 (D. Mont. 2003); *see also, Heckman v. Pennsylvania Bd. of Probation & Parole*, 744 A.2d 371, 375 (Pa. Commw.Ct. 2000) (“‘to make sure [or] certain’ or to ‘guarantee.’” quoting Webster's Third New International Dictionary 756 (1993)). “Safety” is defined as “freedom from harm or danger; the state of being safe; a place that is free from harm or danger; a safe place.” *Merriam Webster Online Dictionary*. To conclude safety is ensured requires proof of a lack of harm or danger to a high degree of certainty.

The meaning and importance of this legislative mandate to ensure safety must be construed and understood with reference to the constitutional right to obtain safety and the judicial maxim that safety is supreme. “All people . . . have certain natural, inherent and unalienable rights, among which are those of . . . of *pursuing and obtaining safety* and happiness. *Me. Const. Art. I, §1* (emphasis added). Independently of this constitutional right, the Maine Law Court has long applied the judicial maxim *salus populi suprema lex*, (the safety of the people is the supreme law), when reviewing issues of public safety. *Seavey v. Preble*, 64 Me. 120, 121 (Me. 1874). Clearly, the protection of safety is a high priority in Maine law. Ensuring safety “is among the most basic obligations state government owes its people.” *State v. Letalien*, 2009 ME 130, P50 ; 985 A.2d 4; *Doe v. DA*, 2007 ME 139, P43;

932 A.2d 552 (concurring opinion discussing the constitutional right to obtain safety in the context of a statutory mandate “to ensure public safety”).

The police power of the State is co-extensive with self-protection, and is not inaptly termed the law of overruling necessity. It is that inherent and plenary power in the State which enables it to prohibit all things hurtful to the comfort, safety and welfare of society.

*State v. Old Tavern Farm, Inc.*, 133 Me. 468, 478 (Me. 1935) (quoting *State v. Starkey*, 112 Me. 8, 12, 90 A. 431).

To satisfy its obligation to ensure safety, the Commission must carefully scrutinize CMP’s evidence and test its proof in the context of cumulative exposures in worst case scenarios where the radiation levels are the highest and the most vulnerable are exposed.

**B. CMP has a heightened burden of proof.**

A person’s right to “obtain safety” is paramount in that place where the person can and should best exercise the right – the privacy of their home. Once CMP crosses the threshold and enters the home environment, its obligation to ensure the safety of its equipment is heightened. Those being exposed to the emission of RF radiation in their home environment include the most vulnerable members of our society, children, the elderly, and people with autoimmune disorders, toxin sensitivities and other health conditions that make them more susceptible to the adverse effects of RF radiation. As Dr. De-Kun Li testified:

Because of the nature of involuntary exposure, many susceptible populations including pregnant women, young children, and those who are sensitive to RF EMF are being equally exposed. Susceptible populations usually have much lower thresholds of exposure level.

*De Kun-Li Testimony (“Test.”)*, p. 6. CMP must provide sufficient evidence for the Commission to be able to assure all CMP customers they are not at risk from the RF

radiation permeating their homes, either directly from CMP's equipment *or in combination* with other RF sources. The measure of proof must be sufficient to ensure safety to an elderly CMP resident who has already suffered from one brain tumor and does not want to increase the risk of another; to ensure the safety of a CMP resident with an immune deficiency making her more vulnerable to the effects of low-level RF radiation; to ensure the safety of a CMP resident suffering from electro-hypersensitivity (EHS) to RF radiation; and to ensure safety for a cautious mother who has read the scientific literature and wants to obtain safety for her family by limiting exposure to all sources of RF radiation.

Accordingly, to prove safety is ensured, CMP must provide affirmative evidence demonstrating to a high degree of certainty there are no risks of harm to health.

### **III. CMP'S EVIDENCE FAILS TO SATISFY ITS BURDEN OF PROOF**

First, we briefly address CMP's contention that safety is ensured by FCC guidelines. Over a year ago, the Commission denied CMP's motion to limit the scope of the investigation to the question of FCC compliance. Nevertheless, CMP has continued to focus its evidence on FCC compliance. For all the reasons set forth in our pleadings in opposition to the motion, which we incorporate by reference, compliance with FCC guidelines does not and cannot ensure safety. The evidence entered into the record after the motion was denied confirms the FCC guidelines are not protective against adverse non-thermal effects. The evidence also demonstrates that even if FCC guidelines could ensure safety, CMP has failed to prove compliance.

**A. FCC guidelines do not protect against non-thermal effects and do not ensure safety.**

The Environmental Protection Agency (“EPA”) has played the “lead role in RF radiation health effects.” *Cellular Phone Taskforce v. FCC*, 205 F.3d 82, 91 (2d Cir. 2000)(citing 42 U.S.C. §2021(h). The EPA has explained the point clearly: “the generalization by many that the [FCC] guidelines protect human beings from harm by any or all mechanisms is not justified.” Norman Hankin, EPA Center for Science and Risk Assessment, Radiation Protection Division, July 16, 2002 letter at p. 2. *See also*, EPA 1993 Comments, p. 2. There is unanimity in the scientific and standard-setting community that current exposure guidelines “are based on the thermal effects of RF fields.” *AGNIR 2012*<sup>3</sup>, p. 3; *ICNIRP 2009*, p. 52-53.

Complainants’ experts testified that the FCC guidelines are not protective against non-thermal effects. *Carpenter Test.*, p. 20-22 (“standards provide no protection whatsoever against non-thermal effects of RF”); *De-Kun Li Test.*, p. 6 (involuntary exposures require more stringent safety standards); *Leszczyński Test.* p. 10, 16-17; *Hardell Test.*, p. 5 (“current safety limits and reference levels are not adequate to protect public health.”); *Morgan Test.* p. 17-18 (“‘safety’ standards are based only on immediate (acute) effects from excess heat averaged over 30 Minutes.”); *Kumar Test.*, p. 3. Even Exponent admits “the goal of the [FCC] standard is to limit warming of the tissues.” *Exponent Test.*, 11/16/2010, p. 24. Yet, Exponent has persistently made the illogical assertion that the FCC guidelines protect the public from non-thermal effects. “[T]he exposure limits in the FCC standard are protective of public health” (*Exponent Test*, 9/19/2012., p. 51); “the standard is set based on preventing

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<sup>3</sup> Scientific reports and studies are cited by author (at times abbreviated) and date with full citations provided in the attached list of studies and reports.

all adverse events, thermal or otherwise, based on the exposure.” *12/5/2012 Transcript*

(“*Tr.*”) p. 46. In response to a direct question on this point, Dr. Bailey would not provide a direct answer.

Mr. McGlaulin: So you are telling us that the FCC standard is designed to protect people from non-thermal effects?

Dr. Bailey: It doesn’t – it doesn’t—it’s – the standard is designed to prevent adverse effects (inaudible) specifies the limit that, above a certain exposure level, adverse effects would increase in probability and it doesn’t specify whether those are thermal or non-thermal effects.

*12/5/2012 Tr.* p. 46-47. Exponent stretches all credulity by failing to acknowledge to the Commission what is universally recognized by scientists in the field – that FCC guidelines are not protective of non-thermal effects -- and by providing evasive answers when questioned on the issue.

**B. CMP has failed to prove compliance with FCC requirements.**

Even if the guidelines could protect against all RF radiation health risks, CMP has not proven compliance. The applicable FCC guideline for 2.4GHz RF sets a maximum permissible exposure of 1 mW/cm<sup>2</sup> (“MPE”) for members of the public. CMP provides evidence of *averaged* exposures. The FCC allows averaging of the exposure under limited circumstances when the device has a fixed duty cycle, although it has cautioned:

*For general population/uncontrolled exposures, say in a residential neighborhood, it is seldom possible to have sufficient information or control regarding how long people are exposed, and averaging of exposure over the designated time period (30 minutes) is normally not appropriate.*

*FCC OET 56*, p. 14 (emphasis added). Under the complexity and ubiquity of the mesh network of RF radiation and given the lack of reliable data, CMP should not be allowed to average the exposures over time for FCC compliance.

If averaging is allowed, the hardwired 10% duty cycle of the smart meter must be used. *11/09/2012 Tr.* p. 27; *Exponent Test .11/16/2010*, p. 31. A worst case exposure is “a few inches away from the smart meter at ten percent duty cycle.” *11/09/2012 Tr.* p. 27. As discussed elsewhere at pp. 33-37, Exponent’s attempts to establish a measured average exposure and a calculated average exposure are unreliable. Based on continuous exposure, one smart meter would result in exposure close to the MPE, adjacent to the smart meter. Exponent has reported that with a 10% duty cycle, the averaged exposure for one smart meter at 2 inches is 0.99 mW/cm<sup>2</sup> and at 1 foot it is 0.028 mW/cm<sup>2</sup>. *Oral Data Request (“ODR”), 01-06 (Supp.)*, Att. 1, p.5.

But measuring exposures from one smart meter, averaged or peak, is not sufficient. FCC compliance also requires “consideration of multiple units or banks of meters in the same location.” *11/16/2010 Exponent Test.*, p. 31. Meters in a bank do not transmit at the same time, so it necessarily follows that they transmit in sequence, with the total number of transmissions in a day equaling the sum of transmissions from each meter in the bank. *See, EPRI Technical Rept. 2011*, p. 6-2. A bank of meters could have a very large collective duty cycle and a higher averaged exposure (more transmissions per unit of time). There is no information in the record indicating how many meters are collected in CMP’s largest bank of meters, or whether there is any limit on the number of meters in a bank. Compliance with FCC guidelines also requires consideration of exposures from other AMI devices in the vicinity. One CMP customer complained that a collector device was located 20 feet from his bedroom. *D.R.Fr. 01-01*, Att. 2, p.12. Exponent did not conduct any testing of collectors. *D.R.D.W. 01-077*. CMP has no information about the proximity of AMI devices to schools, playgrounds, sports fields and other public spaces. *D.R.D.W. 01-078*.

And, FCC compliance also requires consideration of other sources of RF, beyond AMI devices, in determining whether the maximum permissible limit has been reached. *FCC Local Govt. Official's Guide, 2000*, p. 6 (“FCC’s limits apply cumulatively to all sources of RF emissions affecting a given area.”). For compliance testing, field measurements must include all “nearby sources.” *FCC OET 65*, p. 49. The AMI mesh network will significantly increase the already existing exposures from cell towers, AM-FM radio towers; cell phones, Wi-Fi, microwaves, and many other devices. Exponent claims its testing was intended to capture RF radiation from all sources for purposes of FCC compliance, but it made no effort to find a testing location with high levels of RF from other sources. *11/9/2012 Tr.*, p. 31-33. And, the Office of Public Advocate (“OPA”) which also performed testing actually chose sites that did not have high levels of RF from other sources. *OPA Radiofrequency Exposure Report, Jan. 2013 (“OPA Rept.”)*, p.17 (priority two for site selection was “an uncongested RF environment”).

Dr. Shkolnikov readily admitted that their testing was not performed to show FCC compliance (*11/9/2012 Tr.* p. 29, l. 24- p. 30, l. 2.), and does not reflect a worst case scenario of exposures. *Id.*, p. 31-32. There is no evidence in the record that provides the Commission with an accounting of the total RF exposure in a worst case scenario from smart meters and other AMI devices. And, there is no evidence in the record of total exposures in a worst case scenario that includes RF exposures from non-AMI sources. Thus, even if compliance with FCC guidelines could be sufficient to ensure safety, the Commission cannot on this record conclude that CMP has provided affirmative proof of compliance.

**C. CMP provided no affirmative evidence of safety from non-thermal effects.**

CMP did not provide *in vivo* studies testing the effects of smart meter radiation on humans or animals. It did not provide epidemiological studies of exposures to smart meters. It did not provide *in vitro* studies testing the effects of smart meter exposures on human or animal cells or tissue. Dr. Bailey was unable to identify any studies conclusively establishing that cancer and other adverse health consequences are not caused by long-term exposure to low-level RF radiation. *D.R.Fr. 02-14 & 15*. In contrast, Complainants' experts, who are far more qualified than Drs. Bailey and Shkolnikov, have affirmatively established, with expert opinions supported by reliable scientific evidence, that low level RF radiation, at levels associated with smart meters, poses a significant risk of adverse health effects.

Exponent's opinions are stated in the negative, attempting to challenge the sufficiency of scientific evidence reporting adverse non-thermal effects. It contends the scientific evidence: 1) is not reliable or sufficient enough to prove causation of such effects, or 2) does not establish such effects at RF levels associated with smart meters, sufficient to prove specific causation. This strategy fails for a number of reasons. First and foremost, it misplaces the burden of proof. Complainants are not Plaintiffs in a tort case. Complainants do not have the burden of proving non-thermal effects to a scientific certainty; they do not have the burden of proving the specific levels of RF radiation produced by CMP's equipment; and they do not have the burden of proving specific causation between those levels and adverse non-thermal effects. CMP bears the burden of uncertainty with respect to each of these issues.

Exponent does not provide a meaningful or credible challenge to the reliability of the scientific evidence. It does not prove that the many hundreds of scientific studies reporting



adverse non-thermal effects are poorly designed or otherwise unreliable. It does not prove Dr. Hardell's studies showing a causal association between low-level RF and cancer are unreliable. It does not prove the many studies reporting genotoxic effects are unreliable. In its rebuttal testimony, it offers critiques of some of the studies relied on by Complainants' experts, but as discussed below, these critiques are often based on misleading and inconsistent assertions that render the rebuttal unconvincing.

Its challenge to the sufficiency of the evidence misses the mark because it erroneously uses the weight of the evidence ("W/E") process as applied by certain agency reviews to shift the burden of proof. And finally, Exponent's contention that there is no evidence in the record reporting adverse effects at RF levels associated with smart meters fails because the contention is based on Exponent's unreliable and irrelevant evidence of "typical" smart meter exposures. We address each of these contentions below.

**D. Exponent's reliance on agency reviews of the science is insufficient to satisfy CMP's burden.**

At times, Exponent claims non-thermal effects simply do not exist despite the many hundreds of studies reporting such effects. "Only possible consequence of low-level RF exposure is nerve excitation at low frequencies and heating at high frequencies." *D.R. Stone 01-13*, Att.2, p. 19 (joint presentation to the IEEE). At other times, Exponent acknowledges there is significant evidence of non-thermal effects including effects with adverse health consequences, but it then contends that such effects are not "confirmed" or "established" by the W/E process. For this conclusion, they primarily rely on reports by certain governmental or standard-setting agencies. In particular, they rely on a 2012 report by the Advisory Group on Non-ionizing Radiation (AGNIR 2012), a 2009 report by the International Commission

on Non-ionizing Radiation Protection (ICNIRP 2009), and a 2009 report by the Scientific Committee on Emerging and Newly Identified Health Risks (SCENIHR 2009) (referred to collectively at times as the “Agency Reviews”).

**1. The Agency Reviews do not provide a reliable basis for Exponent’s opinions.**

In rendering its opinions, Exponent may rely on “facts or data” to the extent that experts in the particular field would reasonably rely on those kinds of facts or data in forming an opinion on the subject. *Me. R.Evid. 703*. They may also rely upon the opinions of other experts to form their own conclusions, “if that is common practice in the field.” *United States v. McGhee*, 627 F.3d 454, 460 (1st Cir. 2010). To be persuasive or to carry weight in the final analysis, however, the other expert opinions must be reliable and material to the issue being decided. “An expert may rely on the *reliable* opinions of another expert in forming his own opinions.” *MasForce Europe v. Mastry Marine & Indus. Design, Inc.*, 2013 U.S. Dist. LEXIS 121916, 12-13 (M.D. Fla. Aug. 27, 2013). Experts may not “simply repeat or adopt the findings of other experts without investigating them.” *In re Polypropylene Carpet Antitrust Litig.*, 93 F.Supp.2d 1348 (N.D. Ga. 2000) (citing *In re TMI Litig.*, 193 F.3d 613, 715-16 (3d Cir. 1999) (finding blind reliance by expert on other expert opinions demonstrates flawed methodology under Daubert); *Tk-7 Corp. v. Estate of Barbouti*, 993 F.2d 722, 732-33 (10th Cir. 1993)(witness failed to demonstrate a basis for concluding report was reliable and showed no familiarity with methods and reasons underlying hearsay report)); *In re James Wilson Associates*, 965 F.2d 160, 172-173 (7<sup>th</sup> Cir. 1992) (“A scientist, however well credentialed he may be, is not permitted to be the mouthpiece of a scientist in a different specialty”).

Exponent makes clear that it relies on the Agency Reviews as distinct from the opinions of Drs. Bailey and Shkolnikov, presumably because the agencies have conducted the full W/E process, and the doctors have not. *Exponent Rebuttal Test. 04/17/2013* (“*Rebuttal*”), p. 105-106. Their reliance on these reports is problematic for many reasons. First, the reviews are the product of multiple individuals with no disclosure of the competence of the individuals to qualify as experts. The agency reviewers did not testify in this case, they were not available for cross-examination, and there is very little information in the record about the qualifications and interests of the scientists who performed these reviews. The reports disclose very little information about the reviewers, merely listing their titles, *e.g.* *AGNIR 2012*, p. ix.

What little information is available suggests some of the Agency Review scientists have conflicts of interest affecting their judgment when weighing the evidence. *Morgan Test.*, p. 9. Those with potential conflicts include: Prof. Anthony Swerdlow, Chairman of the AGNIR review committee and an ICNIRP Commissioner; Prof. Anders Ahlbom, one of three members on the SCENIHR review committee and a lead author of another agency review by the Swedish Council for Working Life and Social Research; Prof. Mats-Olof Mattsson, Chairman of the SCENIHR review committee; and Prof. Myrtill Simko, a contributor to the SCENIHR report. *Id.* p. 9-12. Prof. Ahlbom is a director of his brother’s consulting firm which represents telecom industry clients on regulatory issues, and was removed from the IARC review group for this conflict. *Id.* p. 10. Prof. Mattson serves on an advisory board for a cellphone company. *Id.*, p. 12. And, Prof. Simko is a consultant to a cellphone company. *Id.*

There has been extensive criticism within the scientific community about a lack of transparency in these Agency Reviews and a lack of impartiality in appointing the review committee members. *Id.*, Exhibit D. Dr. Carpenter testified these organizations have been dominated by physicists and engineers, often with close ties to industry. *Carpenter Test.*, p. 26; *see also Levis, et al, 2011; Hardell et al, 2006; Huss et al, 2007.* Dr. Leszczinski testified the AGNIR review is neither comprehensive nor unbiased. *Leszczinski Test.*, p. 13. Dr. Bailey himself revealed a somewhat cavalier attitude about reviewer conflicts of interest, stating that lobbying for the telecom industry may not present a significant conflict for an Agency Review scientist. *12/5/2012 Tr.* p. 90-91.

On cross-examination, it became clear Dr. Bailey has little knowledge of the specific review process employed by specific agencies. He was unable to verify what literature was considered by the reviewers. *11/8/2012 Tr.* p. 65. He was unable to verify that the reviewers considered all relevant studies. *Id.*, p. 66. Dr. Bailey assures us that the agencies faithfully apply a rigorous W/E process that considers all available scientific evidence and scrutinizes the strengths and weaknesses of all relevant studies. Dr. Phillips testified, however, that the W/E process is more often misused than rigorously followed. *Phillips Test.* p. 14-16.

A cursory review of the AGNIR and ICNIRP reports demonstrates Dr. Phillips' point and belies Dr. Bailey's assertions. The AGNIR 2012 report has a "scope of the review" section but it tells us little. *AGNIR 2012*, p. 7. It makes the bald assertion that it "take[s] account of the entire literature" (*Id.*), but does not identify the database or databases used to identify the "entire literature." The ICNIRP 2009 report contains no "scope of review" section, makes no assertions about reviewing all of the literature, does not identify the data base used for the literature reviewed, and offers no discussion of its review methodology or

the W/E process that Exponent claims is followed. AGNIR 2009 also fails to discuss the W/E process and provides only a very brief and vague discussion of its methodology:

The scientific papers reviewed here have been carefully examined to determine what weight should be given to individual findings. This includes consideration of scientific quality as well as expert judgement about each study and how it fits within the canon of work.

*AGNIR 2009*, p. 8.

Neither report discloses any information about the qualifications, interests or potential conflicts of the reviewers. And, neither report offers an overall W/E conclusion at the end of the report. They both provide separate summaries at the ends of individual chapters addressing different categories of scientific evidence, but fail to draw final conclusions based on all of the evidence. ICNIRP 2009 offers no overall conclusions at all, and the only overall conclusions offered by AGNIR at the end of the report are research recommendations.

*AGNIR 2009*, p. 321-323. Indeed, this is consistent with AGNIR's limited mission: "to review work on the biological effects of non-ionizing radiation relevant to human health and to advise on research priorities." *Id.*, p. 4. Curiously, whoever wrote the executive summary for AGNIR 2009 offers an overall conclusion not found elsewhere in the report:

In summary, although a substantial amount of research has been conducted in this area, there is no convincing evidence that RF field exposure below guideline levels causes health effects in adults or children.

*Id.*, p. 5.

Complainants' experts testified that these Agency Reviews do not consider all relevant studies and do not critically evaluate the design, methods, results, and authors' interpretations of each study. *Phillips Test.*, p. 12-13; *Leszczynski Test.*, p. 11, l.l. 20-23 and 14-16; *see also Carpenter Test.*, p. 23 ("not fair and balanced"). Dr. Leszczynski, a leading

scientist in the field of gene expression, testified that the 2012 AGNIR Report made no mention of five of seven studies published by Dr. Leszczynski and his research team between 2003 and 2009 on stress response, protein expression and gene expression. *Id.*, p. 12-13. Exponent acknowledges the omission but claims it is of no consequence, because ICNIRP considered *some* of them in its review. *Rebuttal*, p. 117. But, elsewhere Dr. Bailey stated: “if that body of research has only considered part of the evidence and neglected the rest, then the conclusion may not reflect all the evidence that we have available to us.” *12/5/2013 Tr.* p. 83-84. The AGNIR 2012 report also makes no mention of the 2011 IARC Report classifying RF as possibly carcinogenic to humans. *Leszczynski Test.*, p. 12. Upon a cursory review of the studies considered in the Bioinitiative Report (discussed below), the reader can quickly find many relevant studies not discussed in the Agency Reviews.

AGNIR and ICNIRP do not even claim to apply a W/E process and, to the extent they do, it is not transparent, rigorous or reliable. And, Exponent fails to cite any sources verifying that these agencies have properly used a reliable W/E process. While it is intuitively obvious that the more relevant science reviewed the better, there is no scientific consensus about the best methodology for “weighing” the evidence to draw reliable scientific conclusions.

[Application of the W/E process] by scientists to decide matters of science is often of questionable value. One of the reasons for this is that there generally is no discussion or characterization of what weight of evidence actually means in the context in which it is used. Additionally, the distinction between weight of evidence and strength of evidence often is lacking or not defined, and differences in methodologies between investigators are not considered.

*Phillips Test.*, p. 14-15. The process often amounts to “seat-of-the-pants qualitative assessment . . . that scientists use when they apply implicit, qualitative, and/or subjective criteria to evaluate a body of evidence.” *Id.* (quoting *S. Krimsky, 2005*).

Dr. Phillips recommends the Commission rely on the strength of well-designed studies to determine whether there is a risk of harm:

given the lack of rigor in adequately evaluating the strengths and weaknesses of studies, . . . [w]hat is more relevant is the existence of well-done studies that both show and don’t show biological effects that result from RFR exposure, and the existence of epidemiological studies that show changes in disease incidence associated with RFR exposure. Together these well done studies provide a link between RFR exposure, the incidence of disease in humans, and possible mechanisms by which disease incidence changes.

*Phillips Test.* p. 16. Instead, Exponent uses the W/E process to ignore or disregard the strength of much of the evidence; many well-done studies are disregarded or marginalized without any credible challenge to the quality or reliability of the study. *Leszczinski Test.*, p. 14-16.

Courts have questioned whether the “weight of the evidence” process is sufficiently reliable to prove causation, *Allen v. Pa. Eng’g Corp.*, 102 F.3d 194, 198 (5th Cir. 1996), although the First Circuit has accepted its use by an expert who utilized Hill’s Criteria to weigh the evidence. *Milward v. Acuity Specialty Prods. Group*, 639 F.3d 11, 23 (1<sup>st</sup> Cir. Mass. 2011). Where the process is accepted,” the application of that methodology also must be reliable.” *Magistrini v. One Hour Martinizing Dry Cleaning*, 180 F. Sup. 2d 584, 602 (D.N.J. 2002).

the single most serious flaw is the most basic: he simply has not set forth the methodology he used to weigh the evidence.

...

Where, as here, elements of judgment pervade the methodology, it is essential that the expert set forth the method for weighing the evidence

upon which his opinion is based. Absent that, this Court's role as gatekeeper to assess the reliability of the methodology applied in this case is nullified.

*Id.* at 606 and 608. The Agency Reviews fail to meet this most basic test of reliability. The Commission should be particularly skeptical of Exponent's reliance on the W/E process here, where there is a complete lack of transparency about the reviewers and their process.

A striking example of Exponent's own misuse of the W/E in its testimony is its dismissive critique of a recent study reporting substantial increases in oxidative stress in response to very low levels of RF, comparable to smart meter radiation. *Shahin et al, 2013*. To rebut this study's evidence, Exponent cites a four year old Agency Review (*ICNIRP, 2009*, Section II.3.3.3), which applied the W/E process to determine that there is insufficient evidence to conclude low level RF causes oxidative stress. *Rebuttal*, p. 81-82. Of course, ICNIRP's 2009 review could not have evaluated the 2013 Shahin study, and even if it had, the existence of other studies with differing results, do not remove from the scientific record the empirical results of the study. *See also*, our discussion of Exponent's critique of the Lai and Singh studies at pp. 43-46. This is a classic example of Exponent's approach: use the W/E process to filter out and marginalize the studies reporting non-thermal effects, without providing any basis for challenging the strength of the evidence represented by the studies.

Unless the Agency Reviews demonstrate that a study is of poor quality or otherwise unreliable, the strength of the study evidence stands. *Phillips Test.*, p. 9-10. Dr. Bailey admits that the results of a well-designed study reporting positive results are not negated by other studies reporting inconsistent negative results. *11/9/2012 Tr.*, p.98, ll. 12-13. He also admits that the need for replication applies equally to negative studies as well as positive



studies.<sup>4</sup> *Id.*, ll. 21-24. Despite Exponent's assertions, the Agency Reviews provide very little discussion of the strengths and weaknesses of studies, seldom discuss the replication of negative studies, and provide very little basis for preferring negative studies over positive ones. *Leszczynski Test.*, p. 14-15. It is instructive to search the AGNIR 2003 report for discussions of replicated studies: at p. 73 and 95-96 there is favorable discussion of negative studies being "replicated" by the same research group (compare to the multiple Lai and Singh studies with consistent positive results reporting DNA damage, which are not treated as replications); but then at p. 146 and 149, it admonishes the failure to replicate positive studies by independent research groups, even where most of the reported studies show positive effects. There are more discussions of replication in AGNIR 2012, but very little if any mention of the need to replicate negative studies and no discussion of the degree to which alleged efforts to replicate positive are true to the original study protocols. *See* our discussion of the Lai studies, at pp. 43-46.

The many well-designed studies reporting genotoxic and other non-thermal effects at low levels of RF radiation are not removed from the scientific record by inconsistent results from other studies. *Phillips Test.* p. 9-10; 12-13. Yet Exponent and the Agency Reviews treat them as if they don't exist.

**2. Even if the Agency Reviews were reliable, they are immaterial or uninformative to the question before the Commission.**

There is a more fundamental problem with Exponent's reliance on the Agency Reviews. Even if Agency Reviews properly and rigorously applied the W/E process, they apply it to the wrong question or hypothesis. The only question they seek to answer is

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<sup>4</sup> It is also the case that replication of positive studies "may be less likely to be published, even though they may strengthen the body of evidence." *AGNIR, 2012*, p. 8.

whether it has been established to a scientific certainty that low-level RF radiation causes adverse health effects. That is not the question to be resolved by the Commission in this proceeding. Asserting that the science fails to prove causation to a scientific certainty does not help the Commission determine whether CMP has provided enough reliable scientific evidence to conclude there is no risk of harm or that safety is ensured.

Exponent's use of these agency reviews serves its erroneous effort to shift the burden and risk of uncertainty from CMP to its customers. The W/E, to the extent it is applied by Exponent and the agencies, is designed to serve the question or hypothesis being considered – is the evidence sufficient to prove causation? Accordingly, any uncertainty or inconsistency in the studies is weighed against causation. When there are some studies reporting adverse effects and some reporting no effects, the tie goes to the proponent of no causation. When there are studies showing no effect, these are treated as failed attempts to replicate studies showing effects, yet multiple studies showing effects are never considered valid replications. This W/E process, as applied by the agencies and Exponent, is simply the wrong lens through which to view the evidence and to assess CMP's burden of proof in this investigation. It inappropriately filters out reliable evidence from well-designed studies.

“The hallmark of the weight of the evidence approach is reasoning to the best explanation for all of the available evidence.” *Milward v. Acuity Specialty Prods. Group*, 639 F.3d 11, 23 (1st Cir. Mass. 2011). But, Exponent and the Review Agencies do not seek a coherent “explanation of all of the evidence;” they merely seek to answer in the negative whether causation has been proven. They don't seek to explain the uncertainties; they merely fall back on their theory that non-thermal effects of RF simply cannot exist, and well-designed studies reporting anomalous results are disregarded as if they do not exist.

The process by which a new theory challenges the orthodoxy has been referred to as a "paradigm shift." Thomas Kuhn, *The Structure of Scientific Revolutions*, (Univ. Chicago Press 1962); *11/8/2012 Tr.*, p. 52. Exponent espouses the old paradigm: "Only possible consequence of low-level RF exposure is nerve excitation at low frequencies and heating at high frequencies." *D.R. Stone, 01-13, Att. 2*, p. 19 . Scientists who are committed to the old paradigm are engaged in a defense of their theory and may have no interest in explaining or resolving inconsistencies in studies that challenge the paradigm.

While understanding the role these variables play in determining experimental outcome could provide remarkable insights into defining mechanisms by which RFR produced biological effects, few seem interested in or willing to delve deeply into the science.

*Phillips Test.*, p 15, l. 20- p. 16, l. 2. Exponent and Dr. Ahlbom, a participant in the SCENIHR and other Agency Reviews who was removed from the IARC Working Group for a conflict of interest (*11/9/2012 Tr.*, p. 88), are good examples of fierce defenders of the paradigm and fierce critics of the new theory. As defenders of the old paradigm, they seek to impose an inappropriately high burden of consistency, coherence and replication on the studies that threaten the paradigm, a burden that is not consistent with ensuring safety.

So long as there are inconsistencies, uncertainties and incomplete explanations of the mechanism of action, defenders of the classic physics paradigm will "weigh the evidence" to deny the existence of non-thermal effects by saying such effect have not been established or proven to a certainty. Dr. Bailey testified that because some studies have flaws and there are conflicting results among other studies, the "mechanisms to account for adverse effects of radiofrequency fields -- at very low levels are *not confirmed by the weight of the scientific*

evidence.” 11/8/2012 Tr., p. 56 (emphasis added). A few citations to ICNIRP and AGNIR reviews demonstrate the same approach.

Because of the inconsistencies and methodological limitations of these studies, *final conclusions* regarding possible RF effects on the modulation of gene and/or protein expression are not possible at present. *ICNIRP 2009*, p. 145 (emphasis added).

There is insufficient research regarding RF effects on nitric oxide signaling, gap junctions and receptor clustering *to be conclusive*. *Id*, p. 260 (emphasis added).

There is insufficient research regarding RF effects on nitric oxide signaling, intercellular gap junction properties and receptor clustering behavior *to be conclusive*. *Id*, p. 145.

. . . replication of results by different research groups is needed before results can be considered *as established*. *Id*, p. 351 (emphasis added).

There are possible effects on EEG patterns, but these have not been conclusively established. *AGNIR 2012*, p. 4.

Inconsistent results are “normal in the research process . . . [they] indicate that biological systems are complex and that different variables need to be isolated in order to fully understand these systems.” *Carpenter Test.*, p. 26-27. Inconsistencies may be related to “the state of the biological system under investigation . . . the result of signal modulation, signal intensity, time of exposure, or state of the cells . . . [or] time- and signal-dependent changes in the balance between damage and repair because of direct or indirect effects of RFR exposure on repair mechanisms.” *Phillips Test.*, p. 11. “A lack of consistency between research results is not a strong reason for dismissing possible causal links; inconsistency is to be expected from complexity.” *Hardell, et al, 2013, (“Late Lessons”)* p. 706; *see also, Bioinitiative Report 2012, Section 11, Kundi, p. 39* (discussion of “causal association”).

The opinions rendered by Exponent and the Review Agencies about the sufficiency of the evidence to prove causation, cannot as a matter of law, satisfy CMP's burden to prove safety is ensured. These opinions are at worst legally immaterial and at best insufficient to meet CMP's burden of proof.

**E. The IARC classification of evidence and the Hill "criteria" provide more appropriate measures of proof, which CMP fails to satisfy.**

The International Agency for Research on Cancer ("IARC") provides a more useful framework or lens for the Commission to use in assessing the evidence. Unlike ICNIRP and AGNIR, IARC does not limit its analysis to the question of whether causation has been proven to a scientific certainty. IARC has created four categories of evidentiary findings recognizing that there are different measures of proof and that we need not wait for scientific certainty before acknowledging a health risk. The four categories are: 1) evidence suggesting lack of carcinogenicity, 2) inadequate evidence of carcinogenicity, 3) limited evidence of carcinogenicity, and 4) sufficient evidence of carcinogenicity. *IARC Monograph*, Vol. 102, p. 27-28. Within this framework, "a judgement is made concerning the strength of evidence that the agent in question is carcinogenic to humans." *Id.*, p. 19. Only the fourth category ("sufficient evidence") is comparable to the standard of proof employed by Review Agencies; it requires evidence that "a causal relationship has been established between exposure to the agent and human cancer." *Id.*, p. 27.

Applying IARC's hierarchy of evidentiary findings to CMP's burden would require proof of "evidence suggesting a lack of carcinogenicity" under the first classification, a standard CMP has not met. Indeed, IARC found "limited evidence of carcinogenicity." Two

of Complainants' experts, Drs. Hardell and Leszczynski, participated in the IARC Working Group. Dr. Leszczynski explained that "limited evidence" means:

A positive association has been observed between exposure to the agent and cancer *for which a causal interpretation is considered* by the working group to be *credible*, but chance, bias or confounding could not be ruled out with reasonable confidence.

*Leszczynski Test.*, p. 7 (emphasis added). This determination that a *causal interpretation is credible* stands on its own as reliable evidence of a serious health risk from exposure to low-level RF radiation, and as conclusive evidence that safety is not ensured.

Another framework for assessing scientific evidence that is even more appropriate to the Commission's determination in this case is that formulated by Professor Sir Austin Bradford Hill. Dr. Hill developed a list of nine factors for determining when there is sufficient evidence to infer or deduce, but not necessarily prove to a scientific certainty, a causal association between an agent and an adverse health condition. "Before deducing 'causation' and taking action we shall not invariably have to sit around awaiting the results" of decisive research. *Hill 1965*, p. 296. He refers to nine "aspects of that association" to be especially considered "before deciding that the most likely interpretation of it is causation." *Id.*

Dr. Bailey acknowledges the universal recognition of the Hill criteria. *11/9/2012 Tr.*, p. 79. He contends that the Agency Reviews utilize it in their W/E analyses (*Id.* p. 82), but there is no mention of Hill in AGNIR 2012 or 2003, ICNIRP 2009, or SCENIHR 2009. In contrast, IARC expressly utilizes the Hill criteria to weigh the "strength of the evidence" for causality.

a judgement is made concerning the *strength of evidence* that the agent in question is carcinogenic to humans. In making its judgement, the Working Group considers several criteria for causality (Hill, 1965).

*IARC Monograph*, Vo. 102, p. 19. Indeed the only agency review that appears to analyze RF safety using all nine Hill criteria is the Lawrence Berkeley National Laboratory (“LBNL”) report to the Michigan Public Service Commission. *LBNL* (4/18/2012). Although LBNL does not reach a final conclusion, it makes positive findings on most of the nine criteria with respect to RF radiation from cell phones. *Id.*, p. 2. It makes the erroneous assumption, however, that Hill’s criteria cannot be applied to smart meters because “there are no research related observational results” specific to smart meters. “Studies of a specific technology are not essential for determining possible health effects from its use.” *Exponent Test*, 11/16/2010., p. 43; *Exponent Test.*, 9/19/2012, p. 8; *see also*, *IARC Monograph* Vol. 102, p. 33 (IARC report considers the “general question of whether RF radiation causes cancer in humans or in experimental animals: it does not specifically or exclusively consider mobile phones.”).

Dr. Hardell recommended the Hill criteria in his initial testimony, and again in his supplemental testimony, which references his recent article applying “the Hill viewpoints.”<sup>5</sup> *Hardell Test.*, p. 8, 26-28; *Hardell Sup. Test.*, p. 3-4 and Exhibit D. Dr. Hardell’s opinion, based on the Hill criteria, is that glioma and acoustic neuroma can be caused by RF radiation from wireless phones. *Hardell Sup. Test*, p. 3 and Exhibit D; *10/30/2013 Tr.*, p. 11, ll. 18-21. He also testified a causal association between low-level RF radiation and adverse health effects can be inferred from the science and that exposure to low-level RF radiation

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<sup>5</sup> In his 1965 article, Dr. Hill refers to “nine viewpoints.” *Hill 1965*, p. 299. Dr Hill states in his article, only one of the nine factors, temporality, can be considered a requirement. Nevertheless, it has become common to refer to them as nine “criteria.” For that reason, we at times refer to them as the “Hill criteria.”

“including at levels and frequencies transmitted by smart meters, poses risks to human health.” *Id.* p. 4. *See*, further discussion of Dr. Hardell’s opinion at pp. 54-55.

**F. Decisions rendered by other administrative bodies are not a proper basis for Exponent’s expert opinions and are not a proper subject of administrative notice.**

CMP and Exponent have referenced a number of decisions by utility commissions and administrative bodies in other jurisdictions on the issue of RF health effects, including decisions by the British Columbia Utility Commission, the Michigan Public Service Commission, and the Texas Public Utility Commission. These administrative decisions are not “facts or data” that experts in the field can reasonably rely on in rendering expert opinions about scientific questions. These are legal determinations, and as such they are also no the proper subject of judicial notice under Rule of Evidence 201. *Taylor v. Charter Med. Corp.*, 162 F.3d 827, 831 (5th Cir. Tex. 1998). The legal conclusions of these bodies are not “adjudicative facts” under Rule 201. *Id.* And, the individual fact findings made by these bodies are not sufficiently reliable to be considered “matters which are of such verifiable certainty that they may be confirmed by reference to sources of indisputable accuracy.” *State v. Rush*, 324 A.2d 748 (Me. 1974). A court may not take judicial notice of findings of fact by other courts. *Gray v. Beverly Enterprises-Mississippi, Inc.*, 390 F.3d 400, 408 (5th Cir. Miss. 2004)(citing, *Taylor v. Charter Med. Corp.*, 162 F.3d 827, 831 (5th Cir. 1998)). “A court in one case may not take judicial notice of the truth of judicial findings of fact in another case.” *Amponsah v. Holder*, 709 F.3d 1318, 1327 n.5 (9th Cir. 2013) (emphasis in original). The same principle applies to administrative notice under Chapter 110, §10(E).



Even if the legal conclusions and findings of fact made by these administrative bodies are considered evidence, the Commission should give them no weight for the same reasons courts do not take judicial notice of them. The legal conclusions reached by administrative agencies are not material because the legal standards and legal issues decided in those proceedings are materially different from the standards and issues to be decided here. *See Complainants' Opposition to CMP's Request for Administrative Notice of British Columbia Utilities Commission Decision (8/27/2013)*, which is incorporated herein by reference. For the same reason, these decisions, as decisions not evidence, are readily distinguishable and have no precedential or persuasive value. And, individual findings of fact made by these bodies are dependent upon the vagaries of their procedures; the competence of the administrative decision-makers, who may be political appointees with unknown qualifications; the evidence submitted by the parties in those proceedings; and many other factors that are beyond the control of the parties in this case.

**G. Exponent's testimony is not reliable.**

**1. Exponent is a biased advocate for the industry.**

First, the opinions submitted through Exponent's direct and rebuttal testimony cannot be reliably ascribed to any particular individuals. Its direct testimony has been a collective process with only two of the contributors available for cross-examination and to the extent the testimony is ascribed to those individuals, as noted above, they rely on the opinions of faceless agencies, whose members were not available for cross-examination. CMP submitted the jointly written direct testimony of Drs. Bailey and Shkolnikov in September, 2012. It has also submitted testimony from the 2010 Opt-Out proceedings, which was co-written by Drs. Bailey and Shkolnikov as well as Dr. Linda Erdreich, who has not testified in

this proceeding or been available for cross-examination. The Rebuttal testimony submitted in April of 2013 was co-written with eleven other Exponent employees, including Dr. Erdreich. *ODR 05-01*, Att. 1; *Fr.D.R. 003-002*.

The other eleven employees contributed close to one-half the hours involved in writing the Rebuttal testimony; one of them, V. Perez, PhD, contributed more time than Dr. Shkolnikov. *ODR 05-01*, Att. 1. On cross-examination, Dr. Bailey testified that each of these employees participated directly in the drafting process and produced no other work product that could be reviewed by the parties. *5/23/2013 Tr.*, p. 7; *D.R.Fr. 03-14*. In addition to not being available for cross-examination, there is no information in the record about their knowledge, experience, or financial interests, or other information from which the Commission could determine their competence, reliability or bias. While there is background information about Dr. Erdreich in the record, we do not know to which portions of the testimony she contributed. This process of collective testimony precludes any meaningful assessment of its reliability. The fact that Drs. Shkolnikov and Bailey claim to adopt the collective testimony as their own does not cure the problem. It is impossible for the Commission to properly evaluate the credibility and competence of the opinions without full disclosure of the experience, education and interests of the individuals contributing to the opinions.

It is appropriate to refer to this collective testimony as “Exponent testimony” and to assess its credibility based on the reputation of Exponent, Inc., in addition to the reputation, knowledge and experience of the two Exponent employees who were available for cross-examination. We know that, unlike Complainants’ experts, Drs. Bailey and Shkolnikov have not performed any original research directly relevant to the issues in this case. *11/9/2012 Tr.*,

p. 204. We know they have testified extensively to promote the interests of utility companies. We know that, unlike Complainants' experts, they and Exponent have made a lot of money in this case, over \$225,000 on the written rebuttal testimony alone. *Fr. D.R. 003-001*. We know that Exponent, and by extension its employees including Drs. Bailey and Shkolnikov, depend on utility companies and other industry companies, e.g. mobile phone companies, for financial gain and success. We also know that their standard methodology in expert testimony is to sow doubt and uncertainty about the science to defeat claims against their industry clients. *Morgan Test.*, p. 7, referencing Dr. David Michaels, *Doubt Is Their Product, How Industry's Assault on Science Threatens Your Health*;<sup>6</sup> See also, *Hardell et al, Secret Ties to Industry and Conflicting Interests in Cancer Research*, p. 2 (2006).<sup>7</sup> Their efforts to sow doubt in this case rely primarily on the W/E process filter, as discussed above, and misleading testimony about exposure levels and the science as discussed below.

**2. Exponent's testimony about exposure levels is not based on reliable evidence and is not relevant to the issue to be decided.**

Exponent's biased advocacy is most apparent in its representations about smart meter radiation levels. Throughout its rebuttal testimony, Exponent repeatedly asserts that accurate data on actual exposure to RF is the most critical factor in determining the reliability of RF studies. "In the assessment of potential health risks to RF fields, the level of exposure is a critical factor." *Rebuttal*, p. 125. Yet, their assertions about exposure levels, whether measured or calculated, are not reliable and not directly relevant to the question before the

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<sup>6</sup> Dr. Michaels, author, epidemiologist and Assistant Secretary of Labor for OSHA, notes in his book: "I have yet to see an Exponent study that does not support the conclusion needed by the corporation or trade association that is paying the bill." *Id.*, p. 47. Chapter 5 of the book entitled *The Enronization of Science* is submitted contemporaneously with this brief.

<sup>7</sup> Cited by Dr. Hardell as *Hardell et al, 2007b. Hardell Test.*, p. 6.

Commission. Its “measured” exposures are based on an unreliable testing process, and its calculated exposures are based on data from 1,100 smart meters that is not statistically significant or representative of CMP’s 600,000 plus meters.

The data, both measured and calculated, is either not relevant or immaterial to the issue before the Commission because it relates to averaged exposures of typical or average smart meters. Data from allegedly typical smart meters cannot be used to prove FCC compliance, or safety from non-thermal effects, for which worst case scenario exposures are required. And, averaging may have some relevance to the question of whether the transmissions comply with FCC guidelines, it is irrelevant to non-thermal exposures and is uninformative and incomplete even for FCC compliance. The FCC chose a 30-minute time period for averaging exposures based on evidence of the physiological capacity of a body to adjust to thermal effects. *Exponent Test. 11/16/2010*, p. 24, l. 10-12; *12/5/2012 Tr.* p. 49, l. 18-25. There is no evidence that 30-minute averaging, or any averaging, is relevant to non-thermal effects. *Id.* p. 52-53; *Hardell Test.*, p. 26, l. 3-4. Indeed, Exponent testified in 2010 that averaging is not applicable to smart meters. *Exponent Test. 11/16/2010*, p. 24, l. 13-14.

**a. Exponent’s data about measured exposures are irrelevant and unreliable.**

Both Exponent and the OPA performed exposure measurements at smart meter sites, but there is no reliable basis for concluding that either Exponent or OPA actually measured any smart meter transmissions. Neither conducted tests designed to detect and measure the intensity of a single smart meter transmission. Both Exponent and OPA used broadband devices incapable of separately distinguishing the smart meter transmissions. Broadband probes do “not discriminate the frequency of the field . . . and they typically have response

times that are entirely too long to be able to accurately measure the RF field during the very brief pulses of RF energy produced by smart meters.” *Tell Associates, 2013*, p. 20. Even though Exponent’s express purpose was to validate its exposure predictions (*11/9/2012 Tr.* p. 28), it chose a measuring device incapable of detecting the predicted levels of exposure. Exponent predicted the averaged exposure would be 0.000015 mw/cm<sup>2</sup> but chose a device that could not detect transmissions below 0.00017 mW/cm<sup>2</sup>. *Validation Rept.*, p. 7.

OPA had no independent verification that transmissions were actually occurring during its testing period. *OPA Rept.*, p. 10; *ODR 04-03*.<sup>8</sup> It did not know the number of smart meter descendants or the number of transmissions that should have occurred. *OPA Rept.*, p. 8. Even if we assume that smart meter transmissions occurred during the testing, OPA may not have captured them all because it did not test for the entire active period. It stopped at 1:05 am, instead of 1:30 a.m. *Id.* p. 15; *see Validation Rept.*, p. 5. Exponent had no verification of transmissions at the first of three sites, and although the report suggests the number of transmissions was verified at the other two sites, this is difficult to verify from the record.<sup>9</sup> Both Exponent and OPA designed their tests to measure average exposures. Exponent used thirty minute averaging. *Validation Rept.*, p. 1; *ODR 05-04*. Its measurements tell us nothing about the number or intensity of individual exposure events at different times during the thirty minutes.

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<sup>8</sup> “CMP does not track the duration and timing of transmissions made by meters.” *ODR 04-03*

<sup>9</sup> In an email before the testing, Dr. Shkolnikov says the “the night measurement will be “blind” meaning that the traffic will be assumed to have been following previous 13 day averages. Traffic during the day will be logged by Trilliant.” *D.R. F.r. 02-04*, Att. 1, p. 28.

Both Exponent and OPA chose smart meters that were likely to produce a “typical”<sup>10</sup> number of transmissions. They did so by selecting meters expected to have “typical” numbers of descendants. This selection precluded the ability to measure a worst case scenario averaged exposure from smart meters with the maximum number of descendants and the maximum number of transmissions. Likewise, CMP cannot prove worst case exposures without considering exposures from other RF sources. *11/9/2012 Tr.* p. 31. Both OPA and Exponent used broadband testing devices capable of measuring RF from multiple sources. Yet, Exponent made no attempt to choose smart meters in locations with high levels of RF from other sources. *Id.*, p. 31-33. And, OPA specifically chose a smart meter site with minimal exposure from other sources. *OPA Rept.*, p. 17.

Dr. Shkolnikov admitted that there are likely to be far worse scenarios than those tested. “So – yes, if there’s other sources of transmitters besides a CMP, it is possible that the exposure will be above the measurement sensitivity of the instruments.” *11/9/2012 Tr.*, p. 33. Perhaps, this explains why Dr. Shkolnikov testified that the testing was not conducted to determine FCC compliance. *Id.* p. 29-30. Clearly, it was also not designed or conducted to show compliance with the obligation to ensure safety from non-thermal effects.

Accordingly, all Exponent testimony about the “measured” levels of smart meter exposure and its comparisons to exposures in scientific studies must be disregarded as misleading, unreliable, and not relevant or material to the issues.

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<sup>10</sup> Dr. Shkolnikov testified to his definition of “typical.” “Typical means that the majority of the devices over a short duration of time will produce exposure below this level.” *5/23/2013 Tr.*, p. 45.

**b. Exponent's data about calculated exposure levels are irrelevant and unreliable.**

Exponent may have abandoned its measurements as unreliable because it refers to its "measured" exposures only once in its rebuttal testimony. *Rebuttal*, p. 1. Instead, it relies solely on calculated exposure levels but does so without disclosing the calculations or data used to develop them. From information obtained in subsequent data responses and cross examination, it is now clear the calculated exposures referenced in the Rebuttal are based on data extrapolated from an unrepresentative sample of 1,100 smart meters.

In rebuttal testimony, for the first time in the case, Dr. Shkolnikov presents a calculated value of  $0.00000031 \text{ mW/cm}^2$  for the "typical" smart meter exposure. *Rebuttal*, p. 88. This appears to be a product of "the peak outdoor exposure from a CMP smart meter of  $0.031 \text{ mW/cm}^2$  [at 1 yard] and an alleged "typical duty cycle" of 0.001%." *D.R. Fr.* 03-08 (brackets added). The duty cycle is the percentage of time in a 24-hour period that a smart meter is transmitting. Dr. Shkolnikov extrapolates this percentage from data showing the number of descendent transmissions relayed by 1,100 smart meters during a 13-day period. *D.R.D.W.*, 01-088. Dr. Shkolnikov concludes that among the 1,100 smart meters, the typical smart meter transmitted 234 packets per day. *5/23/2013 Tr.* p. 49. Based on an expected 4.26 millisecond duration for each transmission, he calculated a 24-hour duty cycle of 0.001%. He then multiplied this percentage times the calculated power density at 1 yard to produce a calculated power density averaged over a 24 hour period.

Dr. Shkolnikov's use of 234 descendants for a "typical" smart meter was based on his assumption that the sample of 1,100 meters was statistically relevant and representative of all CMP smart meters. *5/23/2013 Tr.* p. 50, ll. 9-23. The assumption is false. On December 4,

2012, a data response confirmed the sample was not a statistically representative of CMP's meters. *See ODR 01-05.*<sup>11</sup> Yet, five months later Dr. Shkolnikov used these unrepresentative data as a dominant feature of Exponent's \$225,000 Rebuttal testimony.<sup>12</sup> Without a statistically representative sample, there is no reliable basis for any of Exponent's assertions about a "typical" smart meter duty cycle or typical exposures based on that duty cycle. Indeed, Dr. Shkolnikov admitted that if he did not have "statistical data," he would have selected several hundred smart meters to test. *11/08/2012 Tr. p. 183.*

Even if the sample of meters was statistically representative, there are inconsistencies suggesting the number of transmissions represented in the data is inaccurate. The data identify the number of transmissions received by each of the 1,100 smart meters from their descendants over a 13-day period. *See D.R.D.W. 01-088.* The data identify fewer than 10 transmissions per day for over 250 of the smart meters. *Id.* The existence of some transmissions necessarily means the smart meter had at least one descendant. But one descendant alone should have produced at least 442 transmissions during the 13-day period (34 x 13) with data showing fewer than 10 per day. It is reasonable to infer that some of the descendant smart meters may not have been transmitting as expected. Indeed, CMP reported the system as a whole was not fully operational when Exponent conducted its testing.<sup>13</sup> Accordingly, all Exponent testimony about calculated levels of typical smart meter exposures must be disregarded as misleading, unreliable and not relevant or material to the issues.

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<sup>11</sup> Compare this small sample to the sample of 100,000 smart meters performed for the EPRI study of smart meters. *EPRI 2011 Technical Rept.*, p. 5-1.

<sup>12</sup> Exponent was paid \$225,488.80 to prepare the rebuttal testimony. *D.R.Fr. 03-01.*

<sup>13</sup> On October 23, 2012, over five weeks after the testing was done, CMP reported that it had over 1,000 meters left to install and the "majority of CMP's network is installed but network tuning does continue." *D.R.F.R. 02-011.*



### 3. The only reliable evidence of duty cycle is the 10% fixed duty cycle.

The only relevant exposure is the worst case exposure, not a typical exposure. A true worst case scenario for one smart meter would reflect the cumulative, not averaged, exposure from the maximum number of repeated instantaneous exposures during a 24-hour period, and CMP has not established that averaging exposures is relevant to assessing the safety of non-thermal effects from low-level RF. But assuming *arguendo* that averaging is relevant, the averaged exposure must be based on the worst case duty cycle, not a typical duty cycle.

The only reliable information in the record for determining a worst case duty cycle is the 10% fixed duty cycle of the smart meter. Because the mesh network is dynamic, the number of descendants connected to a smart meter changes from day-to-day and hour-to-hour. *OPA Rept.*, p. 8. CMP cannot predict the number of descendants for any given smart meter on any given day, and therefore cannot predict the number of transmissions by any given smart meter on any given day. *Id.* CMP may argue the worst case duty cycle should be based on the maximum number of descendants, which is 4,998. A smart meter with that number of descendants would allegedly produce approximately at least 170,000 transmissions during a 24-hour period.<sup>14</sup> But this is a very conservative estimate because it does not take into account retry transmissions and daily maintenance command transmissions.<sup>15</sup> *Id.*, p. 9, n.18. There is no evidence in the record about the frequency of maintenance commands and there is no limit to the number of retries. *D.R.D.W.* 01-23.

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<sup>14</sup> The meter allegedly transmits at least 34 per packets per day for each descendant plus its own 34 packets, resulting in 169,932 packets per day for a smart meter with 4,998 descendants. *Validation Report*, p. 11.

<sup>15</sup> Even if each smart meter had only 2 retries and maintenance commands per day, that would add another 9,998 transmissions for a total of 179,930. There is no limit to the number of retries. *D.R. DW* 01-23.

Even if we had a level of confidence about the maximum number of transmissions, this would still be based on the current configuration of CMP's system. CMP's configuration appears to be quite conservative compared to other AMI systems around the country, and CMP could alter its configuration at any time.<sup>16</sup> We know that CMP will add in-home network capabilities, which could double or triple the daily transmissions.

Given all these uncertainties about the configuration of the system and duty cycle, the only reliable data for a worst case scenario, using averaged exposures to the extent they are relevant, is the 10% duty cycle that is hardwired into the smart meter design. Dr. Shkolnikov readily acknowledged this, stating that a worst case averaged exposure is "a few inches away from the smart meter at ten percent duty cycle." *11/09/2012 Tr.* p. 27. The "worst case scenario is ten percent duty cycle." *Id.* p.12. He also testified: "it is correct that to use the averaging for -- for compliance assessment, the device itself has to control the duty cycle." That means the 10% duty cycle, with an averaged exposure of approximately 0.1 mW/cm<sup>2</sup> adjacent to the meter. *ODR, 01-06*, Att. 1, p. 8; *11/16/2010 Exponent Test.*, p. 31; *Tell Assoc., 2010*, p. 8.

To the extent that averaged exposures are relevant to ensuring safety, both Exponent's measurements and its calculations of averaged exposures must be disregarded. As explained above, the measurement procedures were unreliable and the calculations are based on unreliable data. More fundamentally, they both pertain only to an alleged typical smart meter, providing no reliable information about worst case scenario exposures. The only reliable evidence in the record about exposure levels is the peak power density and the fixed

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<sup>16</sup> The information provided by Trilliant (the AMI system designer) predicting an average duty cycles has been a moving target over time as it is. *O.D.R. 01-06*, Att. 1 p.1 (.35% duty cycle), p. 7 (.05%). It is reasonable to infer the system will go through further changes in the future.

10% duty cycle. And, as discussed elsewhere, the potential health effects from smart meter and AMI exposures must be assessed in conjunction with exposures from all other RF sources, of which CMP has provided no meaningful evidence.

**H. Exponent’s testimony about the scientific evidence is unreliable.**

In addition to misleading testimony about exposures, Exponent’s biased advocacy is also made apparent by its misleading and inconsistent statements about the science of biological effects.

**1. Exponent’s comparisons to natural RF are misleading and irrelevant.**

Throughout its Rebuttal, Exponent makes numerous dismissive assertions about smart meter radiation by comparing it with natural RF, including the statement that exposure from a human body hug is “1,000 times greater than exposure from a smart meter one yard away.” *Rebuttal*, p. 7. First, as we know, the comparison is inaccurate and irrelevant because the smart meter exposure being referenced is the mythical “typical” smart meter, whose duty cycle is based on unreliable data. The comparison is also not relevant because there is no legitimate basis for equating the health and safety effects of man-made RF with the health and safety effects of natural RF emitted from the earth or from human bodies.

Exponent cites no authority for the proposition that natural RF poses any health or safety risks. The Commission can take administrative notice of the facts that human beings and their physiology have evolved in the presence of these natural RF exposures from the earth and other bodies. It may also take administrative notice of the fact that humans and their physiology have not evolved in the presence of the very recent and rapidly expanding exposures to man-made radio frequency radiation. Even Exponent acknowledges that the

two forms of radiation are different. Most of the EMF emitted by the human body is in the infrared frequency range; only a small portion is within the RF range, at “several gigahertz and higher.” *D.R.Fr. 03-04*, p. 2. A purpose of the Validation Report was to measure all *relevant* radiofrequency radiation in the area of the smart meters being tested, yet Dr. Shkolnikov acknowledged the testing device measured only up to 18 GHz, incapable of measuring most, if any, of the natural RF. *5/23/2013 Tr.*, p. 36-37.

Exponent unconvincingly attempts to claim a similarity by saying “natural RF background is also modulated.” *Rebuttal*, p. 3. But then it acknowledges that these natural variations in frequency are very different from smart meter modulations, which are virtually identical to cell phone modulations. *Id.*; *Rebuttal*, p. 9. When questioned on the issue, Dr. Shkolnikov acknowledged that natural RF modulation is “very different” from CMP smart meter or cell phone modulation. *5/23/2013 Tr.* p. 31, l. 8. Complainants have found no scientific authority that would support the notion of equating natural RF in our environment to smart meter radiation or any other man-made radiation for purposes of assessing health or safety effects. The type and character of RF modulation is a highly significant factor in the creation of non-thermal effects from RF radiation. *Morgan Test.*, p. 17-18, 20-21, 26 and Exhibit G; *Phillips Test.*, p. 11; *Carpenter Test.* p. 27; and *Bioinitiative 2012 and 2007*, Section 15.

Under cross-examination, Dr. Shkolnikov explained his basis for equating natural background RF and smart meter RF. He equates them because, he assumes, the only effect either can have on humans is “in heating the body.” *5/23/2013 Tr.*, p. 40. Ironically, neither natural RF nor individual smart meter RF are likely to have much thermal effect because generally speaking, they occur at levels that do not cause thermal effects. Because

Dr. Shkolnikov's rationale for equating them relates only to thermal effects, Exponent's comparisons between them are not relevant to the risk of adverse non-thermal effects. Accordingly, all Exponent references to background RF in comparison to smart meter and other manmade RF, including Figure 1 at page 8 of the Rebuttal, must be disregarded, not only because the representations about smart meter RF levels are unreliable, but also because the comparison to natural RF is misleading and not relevant to the primary issue in this investigation.

**2. Exponent's critique of incontrovertible evidence of DNA damage is not credible.**

Dr. Phillips, who is the Director of the Center for Excellence in Science, has been studying the biological effects of EMF since 1983, and the biological effects of RF radiation since 1998. He testified to his work and that of others, establishing certain genotoxic effects of low-level RF radiation. *Phillips Test.*, p. 12. (citing Phillips, 1998, De Iuliis, 2009, Huang 2008a, and Lai & Singh, 1995, 1996, 1997a, 1997b, 2004 and 2005). He testified these are well-done studies "in which changes in DNA damage are incontrovertible." *Id.*

Exponent attempts to challenge this statement by Dr. Phillips, not by questioning whether it is true and accurate, but by questioning whether it "reflects the weight of the evidence on this specific topic" (*Rebuttal*, p. 94), *i.e.*, whether one of the Agency Reviews might rely on other studies with inconsistent results to conclude DNA damage has not been proven to a scientific certainty. Exponent does not provide any evidence that the studies

cited by Dr. Phillips were poorly designed or otherwise produced unreliable results,<sup>17</sup> although it attempts to discredit the Lai studies claiming there have been failed attempts to replicate. Because of the importance of these studies, and because these claims are emblematic of Exponent's misinformation campaign, we discuss them at length here.

Exponent contends four unsuccessful attempts were made to replicate the Lai and Singh results (Malyapa, *et al*, 1998; Lagroye, *et al*, 2004; Verschaeve, *et al*, 2006; and Belyaev, *et al*, 2006). *Rebuttal* at p. 96. This is a classic example of claiming a failure to replicate when the alleged replications substantially varied the original study methodology. Scientists often “deviate from an original experimental protocol when repeating an experiment . . . Yet, even a small difference may lead to a failed replication.” *Bioinitiative 2007*, Section 7, p. 16. The Verschaeve study used a different exposure system (radial wave guide system)<sup>18</sup>; used GSM 900 MHz frequency instead of 2.45 GHz; combined the RF exposure with another carcinogen; used a completely different exposure regimen; killed the animals by bleeding them to death (exsanguination), instead of the Lai guillotine method; and made no mention of the Lai studies in the text of the paper. *Verschaeve*, 2006. The Belyaev study used 950 MHz GSM, used a different procedure (“PFGE”) for detecting DNA strand breaks, and expressly disavowed any replication of the Lai studies.

PFGE has lower sensitivity as compared to the comet assay that has shown DNA breaks under specific conditions of MW exposure [Lai and Singh, 1996, 1997; Diem *et al.*, 2005].

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<sup>17</sup> Exponent criticizes Dr. Phillips for including two studies that involved exposure to ELF, not RF (*Rebuttal*, p. 95), but this fact is clearly disclosed by Dr. Phillips, and is explained by his testimony that the mechanism of action is similar. *Dr. Phillips Test.*, p. 5-6; *see also* discussion at pp. 58-59. Exponent does correctly point out that Dr. Phillips mistakenly cited Huang, (2008a), which did not confirm DNA damage.

<sup>18</sup> *See Bioinitiative 2012*, Section 15, p. 27 for discussion of the different exposure systems used by studies purporting to “replicate” Lai and Singh.

. . . the data obtained here should be compared with care with the experimental data of others showing DNA damage under other conditions of exposure [Lai and Singh,1997; Diem *et al.*, 2005]. The absence of DNA breaks under specific parameters of exposure used in this study does not support a conclusion of absence of genotoxic effects of MWs in general and one-sided interpretations of the obtained results should be avoided.

*Belyaev*, 2006, p. 303-304. Although the Belyaev study did not report DNA strand breaks, it did report affected expression of genes in the rat brain cells. *Id.*, p. 304. Malyapa used a different comet assay process (the Olive method) to detect the DNA damage (*Malyapa*, p. 638) and used a different euthanasia methodology. Lagroye used both the Olive method and an “adapted” version of the Singh method used by Lai. *Lagroye*, p. 12-13.

Malyapa was the only study that purported to replicate Lai, and the IARC review confirms that Malyapa was *not* a replication of the Lai studies. *IARC Monograph*, Vol. 102, p. 299. Not only was Malyapa not a replication, it blatantly misrepresented the Lai euthanasia methodology to discredit the Lai studies. Malyapa claimed to determine the “combination of CO<sup>2</sup> asphyxia and decapitation” method of euthanasia used by Lai was partially responsible for the DNA damage reported. *Malyapa*, 1998, p. 638 “One could reasonably conclude that the effects they [Lai and Singh] observed after 2450 MHz radiation were confounded by the euthanasia procedure due to asphyxia of brain cells and/or are due to an unknown aspect of the comet assay in their hands.” *Id.*, p. 644. Exponent endorses this criticism. *Rebuttal*, p. 96. The problem is Lai and Singh did not asphyxiate their animals and Malyapa appears to have manufactured its theory of confounding. Lai and Singh briefly anesthetized and then guillotined their animals.

One rat at a time was anesthetized by placing it in a covered foam box containing dry ice for 65 seconds. (A cardboard was placed on top of the dry ice to prevent its direct contact with the animal), the rat was then decapitated and its brain was dissected out immediately for DNA strand break assay.

*Lai and Singh* (2005), p. 25. Malyapa claimed to replicate this process by killing (asphyxiating) its rats with CO<sub>2</sub> for 3-4 minutes and then suggests the delay created by asphyxiation caused the DNA damage in the Lai studies:

The results (Fig. 1c) indicate that at the time of brain dissection after CO<sub>2</sub> euthanasia influenced the outcome of the alkaline comet assay. *Since it took three to four minutes for death to occur by CO<sub>2</sub> asphyxia* and at least another 1.5 minutes before the brain was removed and immersed in cold Ames medium, we attributed the DNA damage to the time between death and removal of the brain.

*Malyapa*, p. 639 (emphasis added). Since Lai and Singh exposed their animals to the dry ice CO<sub>2</sub> for only 65 seconds and it took Malyapa 3 to 4 minutes to kill their animals with CO<sub>2</sub>, it is clear that the Lai animals were only anaesthetized not asphyxiated.<sup>19</sup> And since Lai's animals were immediately thereafter decapitated, the 5.5 minute delay, allegedly responsible for DNA damage, did not occur in the Lai studies. Malyapa's theory makes little sense in any case because Lai anaesthetized and guillotined their sham-exposed animals in the same manner as their exposed animals.

Exponent fails to mention any of this in its rebuttal. It also fails to mention the Malyapa study was funded by Motorola, *see Malyapa* at p. 644, or that the Lagroye study was also funded by Motorola. *Lagroye* at p. 19.

Exponent has no other basis for challenging Dr. Phillips' assertion that the Phillips, De Iuliis, and Lai and Singh studies provide incontrovertible evidence of DNA damage from low-level RF exposure. It doesn't even discuss the Phillips and De Iuliis studies. De Iuliis

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<sup>19</sup> Ironically, as Dr. Bailey testified, Malyapa reported that "the guillotine method resulted in a lower and more stable rate of DNA damage assessment" than asphyxiation. *05/23/2013 Tr.*, p. 127, ll. 19-23. In other words the Lai method, which guillotined without asphyxiation, is more reliable.



reported mitochondrial generation of reactive oxygen species and DNA fragmentation in human sperm exposed to low-level RF radiation. Yet, Exponent offers the opinion that *none* of these studies can “be taken at face value as evidence of non-thermal effects,” erroneously contending: 1) others “have not been able to independently replicate the results,” and 2) the studies “do not represent a valid weight of evidence evaluation.” *Rebuttal*, p. 97. This is only one of many instances where Exponent has used misleading statements to discredit studies and used the W/E filter to disregard them. These efforts to challenge the reliability of Complainant’s evidence are not credible.

**3. Exponent’s inconsistent testimony on brain cancer incidence data is misleading and lacks credibility.**

Dr. Carpenter testified to evidence showing an increase in brain cancer incidence rates in support of Dr. Hardell’s work showing an association between cell phones and brain cancer. Exponent criticized Dr. Carpenter contending such data is invalid to test a hypothesis:

Furthermore, trends in brain cancer incidence rates. . . are useful only for generating hypotheses rather than testing hypotheses.

*Exponent Rebuttal*, p. 58. Exponent’s statement directly contradicts its own prior testimony using different brain cancer incidence data to challenge the very same hypothesis, that mobile phone use causes cancer. Exponent suggested that evidence from Dr. Hardell’s studies showing an association between mobile phone use and brain cancer is not “real.” *Exponent Test. 9/19/2012*, p. 17. It claimed the incidence data showed the “higher rates predicted by the Swedish study (*Hardell, et al*, 2011) did not occur.” *Id.* Its statement in rebuttal criticizing Dr. Carpenter is either false, or proves false its prior statement

challenging Dr. Hardell's work. In either case, it serves as another example of Exponent making statements about the science without regard to their accuracy or truth, and only with regard to advocacy for its client's interests.

#### **4. Exponent's testimony about the Danish Cohort study lacks credibility.**

Throughout its rebuttal testimony, Exponent repeatedly asserts that accurate data on actual exposure to RF is the most critical factor in determining the reliability of RF studies. "In the assessment of potential health risks to RF fields, the level of exposure is a critical factor." *Rebuttal*, p. 125. Yet, they refer to the Danish Cohort Study, which contains no exposure data, as "the most methodologically well-designed study of mobile phones and brain tumor risks to date." *Rebuttal*, p. 79-80. As Dr. Bailey acknowledged, the study used cell phone subscriptions data as a surrogate for empirical data about cell phone use.

*12/5/2012 Tr.* p. 101. With subscription data only, there is no basis for even estimating the frequency and duration of use by individual subjects in the study. *See Hardell Test.*, p. 6.

This study has been extensively criticized for this and other design flaws. *Id.*, *Lezczynski Test.*, p.8-9; *IARC Monograph Vol. 102*, p. 408 ("considerable misclassification in exposure assessment"). Either the accuracy of exposure data is not so critically important, or Exponent's glowing recommendation of the Danish Cohort study is ill-founded.

#### **5. Exponent's testimony about thermal effects below FCC guidelines is misleading and lacks credibility.**

Exponent suggests or speculates, without citation to any studies, that some biological effects associated with low-intensity RF could be caused by thermal heating. *Rebuttal*, p. 26. Exponent goes so far as to suggest that studies cited by Complainants' experts cannot be relied upon unless they have eliminated the possibility of a thermal effect. *Rebuttal*, p. 7.

Many studies do clearly establish that the reported effects are not thermal, *See Bioinitiative 2012*, §7, p. 4 & 14, certainly enough studies to demonstrate that non-thermal mechanisms are occurring. To require every study address the issue is not reasonable or logical. Moreover, whether a few study results could possibly be explained by thermal effects from low level RF is beside the point. Adverse biological effects at low levels of RF intensity are adverse whether the mechanism is non-thermal or thermal. *See Bioinitiative 2012*, §9, p. 9 (discussing different means to confirm an effect is non-thermal, but noting that for “public exposure policy we only need to know at what level of exposure an effect occurs.”).

On cross-examination, Dr. Bailey also suggested that because certain proteins are called *heat shock proteins* (“hsp”), any effect on these proteins at low levels of RF must be the result of a thermal effect. *11/8/2012, Tr.* p. 91-92. He fails to explain that the protein is named hsp because heat happened to be the first stimulus identified, not because it is the only stimulus. *IARC Monograph*, Vol. 102, p. 349 (“HSPs are expressed in response to cold, heat and other environmental stress factors”); *Bionitiative 2012*, Section 7, p. 4 (“[T]he protective biological response to EMF occurs long before there is a significant change in temperature.”).

#### **I. Summary of CMP's failure to prove safety is ensured.**

To summarize, CMP’s failure to prove safety is confirmed by: 1) its failure to offer affirmative evidence of safety; 2) its erroneous attempt to shift the burden of proof with Exponent’s campaign to sow doubt and uncertainty, which depends on Agency Reviews that are both unreliable and not informative of the question before the Commission, and

3) Exponent's biased advocacy in the form of misleading, inconsistent and immaterial testimony about smart meter exposure levels (measured and calculated), about the science, and about Complainants' experts. On a fundamental level, CMP's evidence fails because it addresses the wrong question – whether Complainants' have proven causation, not whether CMP has proven safety.

All of the foregoing is further supported by the opinions of Complainants' experts concluding that a careful scientist could not reliably conclude there are no risks of adverse health consequences from exposures to low-level RF radiation, including the direct and cumulative effects of smart meter radiation. *See, Carpenter Test.*, p. 27-29; *De-Kun Li Test.*, p. 5; *Hardell Test.* p. 27-29 and *Sup. Test.*, p. 4; *Kumar Test.*, p. 4-5; *Leszczynski Test.*, p. 18-19; *Morgan Test.*, p. 30; *Phillips Test.*, p. 16-17; and *Rea Test.*, p. 8. In sum, CMP's failure to provide affirmative evidence of safety, to adequately rebut the strength of evidence showing adverse non-thermal effects, and to resolve or adequately explain the uncertainties in the science compels a finding against CMP before even considering Complainants' affirmative evidence of risk.

#### **IV. THE STRENGTH OF THE EVIDENCE PROVES A RISK OF SERIOUS ADVERSE HEALTH EFFECTS.**

Complainants presented expert testimony from nine scientists; each is highly qualified to testify with respect to an aspect of RF radiation and its potential health effects. Drs. Phillips and Leszczynski have decades of experience performing original laboratory experiments testing the biological effects of low-level RF radiation. Dr. Hardell, as well as Dr. De-Kun Li and Lloyd Morgan, have decades of experience performing epidemiological studies on the subject. Dr. Carpenter has decades of experience working on and studying public policy

issues related to EMF and health. Dr. Kumar is an electrical engineer with decades of experience both developing microwave antennas and studying RF radiation and associated health risks. Dr. Rea has decades of experience treating patients with electro-hypersensitivity (“EHS”). And, Richard Conrad has worked extensively with EHS sufferers, and has conducted a survey of people who have experienced EHS symptoms related to smart meters. Collectively, these scientists have written many hundreds of peer-reviewed articles as well as books and book chapters on non-thermal effects of EMF and RF radiation. From their different perspectives, each expert expressed their professional opinion that smart meter radiation poses a risk of serious harm. CMP failed to challenge any of Complainants experts by cross-examination.

The evidence of a causal association between smart meter radiation and adverse health risks is further confirmed by the sworn testimony of 65 lay witnesses describing the adverse health conditions they suffered after exposure to smart meter radiation and the reduction in symptoms after avoiding exposure.

The demonstration of a decline in risk after cessation of or reduction in exposure in individuals or in whole populations also supports a causal interpretation of the findings.

*IARC Monograph*, Vol. 102, p. 19. Further direct accounts of harm are provided by 141 of the 210 respondents to the Conrad Survey. *See Conrad Test.*, Ex. D, p. 65-96. Before summarizing the expert testimony, we summarize here highlights from the compelling accounts of adverse effects suffered by a few of the sworn lay witnesses.

G. D.<sup>20</sup>, a former CMP customer, testified on behalf of himself and his wife, who were residents of Maine until they were forced to move to escape the

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<sup>20</sup> We use first and last initials only for these lay witnesses to protect their confidentiality.

RF radiation in their home and their neighborhood. His wife had a compromised immune system from Lyme disease. They both experienced severe EHS symptoms after the installation of the smart meter in their home and on their neighbor's residence. Attached to their testimony are medical reports confirming their experience of these symptoms after the installation of the smart meters and in proximity of other EMF radiation. The symptoms were so severe that they abandoned their home and their local business to escape.

N. B., a CMP customer, is highly sensitive to EMF radiation and suffered a severe attack in proximity to smart meters, including vertigo, seizures, muscle paralysis, headaches and other symptoms. She receives acupuncture treatments, avoids all use of RF devices and has to limit the time she spends in any buildings with smart meters.

S. C., a CMP customer, was diagnosed with a brain tumor in 2010, which his doctor associates with Mr. C.'s 15+ years using a mobile phone. He experiences headaches, irritability and nausea in proximity to RF radiating devices, including smart meters, and is naturally fearful of developing another brain tumor.

B. G. testified about her 87 year old mother who has a pacemaker implant. Her mother's health sharply declined after a smart meter was installed in her house, experiencing lethargy, disorientation, loss of energy and spirit. Her energy and other symptoms dramatically improved whenever she visited her daughter in a neighborhood where smart meters had not yet been installed.

L. H., a CMP customer, has opted out because she is a well-informed and cautious mother. She experiences occasional symptoms with the use of a cell phone and wants to protect herself and her children from the health risks of RF radiation. She allows no wireless devices in their home and makes every effort to limit her family's exposure. Installing a smart meter on her home frustrates her efforts to obtain safety for her family.

J.H. and D. H., CMP customers, testified to Mrs. H.'s chronic heart condition and severely compromised immune system, which increases her risks of harm from environmental toxins. The infectious disease specialist treating her has advised that smart meters may pose a risk to her health. After CMP installed a smart meter Mrs. H. began experiencing dizziness and more fatigue than usual. After the smart meter was removed at their request, the symptoms disappeared.

Y. H., a CMP customer, testified that she began experiencing headaches, confusion and loss of memory after the smart meter was installed within

three feet of her living room chair. Two months later she was diagnosed with a fast growing brain tumor.

S.R. and N. R. testified to severe symptoms experienced by Mrs. R. and their daughter, who both have an illness that affects their immune systems. They testified about symptoms experienced by both mother and daughter in a rental house with a bedroom in close proximity to a smart meter, and then again in their own home after a smart meter had been installed without their knowledge. Because of Mrs. R.'s compromised immune system, she is particularly vulnerable to the RF radiation from the homes in their neighborhood. Removing the smart meter from her house does not remove this additional threat of harm.

D. Y., a CMP customer, testified to his concerns for his wife who was diagnosed with a brain tumor in 1983 and to his knowledge of the potential health effects of RF radiation. He also testified that, on their fixed retirement income, he and his wife cannot afford the special opt-out fees required to remove the smart meter.

C. K., a CMP customer testified that after the smart meter was installed on her home, she began experiencing headaches, fatigue and ringing in the ears whenever she was within a few feet of the smart meter for any duration of time. Since then she has developed hypersensitivity to all RF devices and has developed Fibromyalgia, face numbness and burning sensations in her head and face. Her life has become severely compromised as a result.

See further discussion of lay witness evidence of adverse effects in the discussion of EHS evidence at pp. 60-67.

We briefly summarize below some of the key scientific evidence from Complainants' experts.

#### **A. Evidence of cancer.**

##### **1. Epidemiology evidence of a positive association.**

Dr. Lennart Hardell stated his opinion of a causal association between low-level RF radiation and cancer. Dr. Hardell is a leading epidemiologist, if not the leading epidemiologist, in the world on the subject of cancer risks associated with RF exposure from wireless phones. He has been conducting research on environmental risk factors for cancer

since the 1980's, has conducted research on disease risks associated with electromagnetic fields since the 1990's, and has published over 300 scientific articles in peer-reviewed journals, chapters in books and commentary. *Hardell Test.*, p. 1-2 and Ex. A. Dr. Hardell testified about the many case control studies and meta-analyses performed by his research team. He also testified to his extensive knowledge of most of the peer-reviewed epidemiological studies that have been published since the 1990's and to his knowledge of laboratory studies showing genotoxic effects from low level RF exposures.

Dr. Hardell also served as a member of the IARC Working Group in May of 2011. Based on the Working Group's exhaustive evaluation of the science, IARC issued its classification of RF as a possible human carcinogen. *Hardell Test.*, p. 9. Thirty scientists with relevant expertise participated in the Working Group. *Id.*; *IARC Monograph*, p. 13. In selecting the scientists, IARC carefully considers any conflicts of interest that may warrant a limitation on a scientist's participation. *Id.* For instance, Professor Ahlbom (author of the Danish Cohort study and member of the SCENIHR review committee) was initially invited to participate, but was removed after his disclosure of an interest in his brother's company that has lobbied for the telecom industry. *Id.*, p. 6, n. 7; *Morgan Test.*, Exhibit C, ¶10.

Another Complainant expert, Darius Leszczynski, participated in the IARC Working Group. Dr. Leszczynski provided a summary of the evidence considered and the meaning of the conclusions reached. The Working Group found "limited evidence in humans" for the carcinogenicity of RF radiation based on the positive associations between glioma and acoustic neuroma cancers and exposures to RF from wireless phones. *Leszczynski Test.*, p. 6. The group also concluded that there is "limited evidence" in experimental animals for the carcinogenicity of RF. *Id.* The group relied heavily on the epidemiological studies by



Dr. Hardell's group, as well as the Interphone Study. *Id.*, p. 7. Dr. Leszczynski explained that "limited evidence of carcinogenicity" means:

A positive association has been observed between exposure to the agent and cancer for which a causal interpretation is considered by the working group to be credible, but chance, by a confounding could not be ruled out with reasonable confidence.

*Id.*, p. 7. A few members disagreed with the Working Group conclusions, relying in part on the "Danish Cohort Study" conducted by Dr. Ahlbom. *Id.*, p. 8; *IARC Monograph*, Vol. 102, p. 421. The extensive limitations of this study are discussed *supra* at p. 47. *See also Id.* at p. 194.

Dr. Leszczynski testified that the IARC classification supports three important conclusions:

- (1) non-thermal biological effects are induced by RF, that in time can lead to health risks;
- (2) the current safety standards are insufficiently supported by the scientific evidence; and
- (3) precautionary action should be taken to protect people exposed to low-level RF whenever possible and feasible.

*Leszczynski Test.*, p. 10. Dr. Bailey agrees with the IARC conclusion and agrees there is limited evidence of non-thermal effects and of a positive association between low-level RF and cancer. *11/8/2012 Tr.*, p. 112, ll. 2-8. The IARC evaluation, which CMP has failed to rebut or discredit, stands on its own as reliable evidence of a significant risk of serious health effects from low-level RF exposure.

Dr. Hardell differs with the IARC conclusion only by taking it a step further, stating that based on the Hill criteria, there is a causal association between glioma and acoustic neuroma and RF radiation from wireless phones. *Hardell Sup. Test.*, p. 3; *10/30/2013 Tr.*

p. 11. He also testified that exposure to RF radiation “at levels and frequencies transmitted by smart meters, poses risks to human health.” *Hardell Sup. Test*, p. 4.

## **2. Evidence of genotoxic mechanisms for causing cancer.**

Dr. Hardell’s opinion is based in part on substantial laboratory evidence supporting a plausible mechanism for causing cancer by low-level RF exposure. *Hardell Test*, p. 22. In particular, he described studies reporting reactive oxygen species (“ROS”) oxidation, which can lead to oxidative DNA base damage. *Id.*, p. 17-19. He describes a recent study performed by Liu, *et al* 2013, using a-tocopherol pretreatment of animals exposed to mobile phone radiation. The protective role of this pretreatment confirmed that ROS were involved in RF exposure-induced base damage. *Id.*, p. 18. Exhibit D attached to Dr. Hardell’s testimony provides a graphic illustration of the mechanism confirmed by Liu, *et al.*

Dr. Phillips testified to well-done studies “in which changes in DNA damage are incontrovertible.” *Phillips Test.*, p. 12. (*citing* Phillips, 1998, De Iuliis, 2009, Huang 2008a, [cited in error, *see* Note 16] and Lai & Singh, 1995, 1996, 1997a, 1997b, 2004 and 2005). As discussed at pp. 42-46, Exponent’s critique of this evidence is not credible. There are many other reliable studies beyond those identified by Dr. Phillips that have found DNA strand breaks after exposure to low level RF. In addition to the recent study by Liu, *et al* (*See, Hardell Test.*, p. 18), the following additional studies showing DNA strand breaks are reported by Dr. Lai in Section 6 of the 2012 Bioinitiative Report:

Avendano, *et al* (2012) (wireless internet-connected laptop induced DNA fragmentation by a nonthermal effect)

Cam, *et al* (2012) (short-term exposure to RFR (900-MHz) from a mobile phone caused a significant increase in DNA single-strand breaks in human hair root cells)

Campisi, *et al* (2010) (acute exposure to low intensity EMF induces ROS production and DNA fragmentation in astrocytes)

Paulraj, *et al* (2006) (chronic exposure to 2.45 GHz, SAR 1.0 W/kg caused statistically significant ( $p < 0.001$ ) increase in DNA single-strand breaks in brain cells of rat)

Wu, *et al* (2008) (DNA damage of human lens epithelial cells induced by 1800 MHz mobile phone radiation)

Yao, *et al* (2008) (DNA damage induced by 1.8 GHz radiofrequency field for 2 h, which was mainly single-strand breaks).

*Bioinitiative Report 2012*, Section 6.

Dr. Phillips also testified there are other possible mechanisms of genotoxicity that can have carcinogenic effects, including changes in gene expression, in stress-protein expression, in permeability of the blood-brain barrier, and in the level or movement of key cellular ions, such as calcium. *Phillips Test.*, p. 5-9. Dr. Leszczynski, who has been conducting original research on the biological effects of cell phone radiation for over 15 years, testified that his research group has identified a cellular signaling pathway activated by mobile phone radiation in human cells. *Leszczynski Test.*, p. 2. His studies provide evidence that mobile phone radiation can activate cellular stress responses in human endothelial cells that line blood vessels, which can affect the functioning of the blood-brain barrier. *Id.*, p. 3. His studies also provide evidence of effects on gene expression and protein expression by mobile phone radiation. *Id.*, p. 2-6 and 12-13.

A good review of the science on genotoxic effects is provided in Ruediger (2009).

The IARC Working Group noted there are:

well conducted studies showing aneuploidy, spindle disturbances, altered microtubule structures or induction of DNA damage. While RF radiation has insufficient energy to directly produce genetic damage, other changes such as

induction of oxidative stress and production of reactive oxygen species may explain these results. Indeed, several studies in vitro evaluated the possible role of RF radiation in altering levels of intracellular oxidants or activities of antioxidant enzymes.

*IARC Monograph*, Vol. 102, p. 35. In 2007, Dr. Lai summarized the results from 28 papers studying genetic effects from low-level RF exposure, reporting that 50% of them showed positive effects, and 50% showed no significant effect. *Bioinitiative* 2007, Section 6, p. 3. In 2012, Dr. Lai summarized the results of 86 studies published since 2007 with 63% reporting positive effects, and 37% reporting no effects. *Bioinitiative* 2012, Section 6, p. 2.

It should be noted that many of the studies reviewed by Ruediger and by Dr. Lai are not reviewed or considered in the reports issued by the Review Agencies. It should also be noted that most of the studies finding no genotoxic effects have been funded by the telecom industry. See *11/08/2012 Tr.*, p. 102-103 (discussing “*Radiation Research*” and the *Cult of Negative Results* article reporting 35 of 42 negative studies funded by industry or Air Force); see also, *Huss et al (2007)*.

#### **B. Evidence of other disease-related effects.**

RF radiation occurring at low levels of intensity has also been associated with numerous other physiological effects that pose a risk of disease. Dr. Carpenter testified about a number of studies reporting changes in male fertility and reproductive systems associated with low-level RF exposures. *Carpenter Test.*, p. 11-12. He also refers to Section 18 of the *Bioinitiative Report 2012* for further evidence of fertility and reproductive effects. *Id.* The authors of Section 18 confirm that many of these reported effects also

appear to arise from physiological responses causing oxidative stress and genotoxicity. The authors conclude:

Though causal evidence of one or more mechanism(s) are not yet fully refined, it is generally accepted that oxidative stress and free-radical action may be responsible for the recorded genotoxic effects of EMF's which may lead to impairments in fertility and reproduction. . . . Exposure to EMF's may constitute the biochemical actions leading to adverse changes in hormones essential in male and female reproduction, DNA damage, which in turn causes damage to sperm motility, viability, and sperm morphology. Such exposures are now common in men who use and who wear wireless devices on their body, or use wireless mode laptop computers. It may also account for damage to ovarian cells and female fertility, and miscarriage in women.

*Bioinitiative 2012*, Section 18, p. 29.

Dr. De-Kun Li, who is an epidemiologist and senior scientist at Kaiser Permanente Research Foundation in Northern California, testified to his prospective epidemiological studies related to pregnancy outcomes and early childhood diseases. His research group studied the effects of EMF on more than 1,000 pregnant women, following the women and their children for up to 13 years. Their results showed a clear dose-response relationship between higher levels of EMF during pregnancies leading to higher risks of childhood obesity and asthma (three to six times higher in some cases). *De-Kun Li Test.*, p. 4-5.

Dr. De-Kun Li testified:

It is now known that EMF's can interfere with human body through multiple mechanisms. For example, it has been demonstrated that communication between cells depends on internal EMF signals, likely at a very low level. External EMF's could conceivably interfere with normal cell communication, thus disrupting normal cell differentiation and proliferation. Such disturbance could interfere with fetal development and lead to miscarriage, birth defects, and cancer.

*Id.*, p. 5. Although Dr. De-Kun Li's research involved extremely low frequency ("ELF") radiation below the RF range, there is extensive evidence that the

mechanisms of physiological response to RF and ELF are similar. *Phillips Test.*, p. 5; *Bioinitiative 2012*, Section 6, p.2-3 (“basic interaction mechanism is independent of frequency”); *Blank and Goodman, 2010*, p. 1; *Blank and Goodman, 2011*, p. 6; *Bioinitiative 2012*, Section 7, p.14.

Dr. Phillips testified that RF radiation could lead to cumulative DNA damage in nerve cells of the brain, which “has been associated with neuro-degenerative diseases, such as Alzheimer’s, Huntington’s and Parkinson’s diseases.” *Phillips Test.*, p. 7. Evidence of an association between EMF exposure and autism is discussed at length in Section 20 of *Bioinitiative 2012*. The authors of Section 20 review the evidence showing genotoxic effects, stress protein responses, oxidative stress, effects on cell membranes, melatonin deregulation, immune system effects, brain cell damage and other physiological effects. They conclude:

All of this does not prove that EMF/RF exposures cause autism, but it does raise concerns that they could contribute by increasing risk and by making challenging biological problems and symptoms worse in these vulnerable individuals.

*Bioinitiative 2012*, Section 20, p. 51.

Dr. Phillips also testified that effects such as increased permeability of the blood-brain barrier and changes in gene expression and protein expression may contribute to other disease conditions over time. *Phillips Test.*, p. 8. Section 10 of *Bioinitiative 2012* provides a thorough review of studies examining the effects of RF radiation on the blood-brain barrier. The authors of Section 10 report that breakdown of the blood brain barrier might contribute to neurodegenerative disorders, such as Alzheimer’s disease (AD), Parkinson’s disease,

multiple sclerosis and amyotrophic lateral sclerosis. *Bioinitiative 2012*, Section 10, p 35.

The authors conclude:

A neuronal damage may not have immediately demonstrable consequences, even if repeated. It may, however, in the long run, result in reduced brain reserve capacity that might be unveiled by other later neuronal disease or even the wear and tear of ageing. We cannot exclude that after some decades of (often), daily use, a whole generation of users, may suffer negative effects such as autoimmune and neuro-degenerative diseases maybe already in their middle age.

*Id.*, p. 45.

### **C. Evidence of EHS and related effects.**

Electro-hypersensitivity is a well-established, but controversial phenomenon involving a variety of symptoms experienced in response to EMF exposure. Some of the major symptoms include headache, fatigue, tinnitus, disruption of sleep, mental dullness and a general feeling of ill health. *Carpenter Test.*, p. 13. Other symptoms include heart palpitations or arrhythmia, and burning skin. *Conrad Test.*, p. 6. While the etiology of the symptoms has not been scientifically established, there is consensus that EHS sufferers can experience severe, sometimes disabling and debilitating conditions. *Id.*, p. 4 & 10; *Rubin et al.*, 2011, p. 593-594; *Rebuttal*, p. 135. The prevalence of EHS in the population is steadily increasing over time. *Conrad Test.*, p. 13; Exhibit E, Table 1, Fig. 1. The Austrian Medical Association has issued guidelines for diagnosing and treating EHS, which the association refers to as “EMF Syndrome.” *Morgan Test.*, Exhibit O. In Sweden, EHS is recognized as a handicap. The Austrian guidelines, which were issued in March of 2012, summarize some of the scientific research related to EHS or EMF Syndrome and provide detailed procedures for diagnosing and treating EMF Syndrome, as well as preventing or reducing EMF exposure.

Exponent contends that EHS is a psychological, not a physical or physiological, problem, *i.e.* it is all in the heads of EHS sufferers. Yet, in a recent study of EHS sufferers in Finland, the study authors concluded that “the officially recommended psychotherapy treatment for EHS was not effective,” while avoidance or reduction of EMFs was effective in alleviating experienced symptoms. *Hagstrom, et al, 2013*, p. 6. While the topic is hotly debated, there is extensive scientific evidence supporting the conclusion that EHS is caused by exposure to RF and other ranges of EMF. Exponent and the Agency Reviews rely heavily on a few studies reporting many EHS study subjects are unable to accurately detect the presence of EMF. *Rebuttal*, p. 139. This erroneously assumes that all EHS sufferers experience immediate conscious effects in response to acute exposure, as opposed to delayed effects to cumulative exposures. It also fails to take into consideration the many variables affecting the EHS response including frequency levels, exposure levels, other environmental stressors and the person’s current state of homeostasis that could affect the immediacy of the response, or lack thereof. *See, Conrad Test.*, p. 5, ll. 14-20.

Dr. William Rea, Director of the Environmental Health Center in Dallas, Texas, and President of the American Environmental Health Foundation, testified to his treatment of individuals with EHS symptoms. He conducts “EMF challenge testing” based on procedures that he developed in a 1991 study. *Rea Test.*, p. 7. The study was designed to develop an effective method to evaluate EMF sensitivity of patients. He used a carefully controlled testing environment low in chemical, particulate, and EMF pollution. *Id.*, p. 3-4. The testing used ELF radiation in a single blind challenge of 100 patients who complained of EMF sensitivity. Twenty-five of them showed sensitivity responses to the fields with no reaction to blind challenges. In a subsequent phase, the 25 sensitive subjects and 25 volunteer



controls were tested again. Sixty-four percent of the sensitive patients had positive signs and symptoms scores plus autonomic nervous system changes, while none of the volunteer controls reacted to any challenge, active or blind. *Id.*, p. 4. In a fourth phase, the 16 sensitive patients were re-challenged to the frequencies to which they were most sensitive with 100% of the EMF challenges showing positive results while placebo tests were negative. *Id.*

Since 1991, Dr. Rea has tested hundreds of EMF sufferers using these procedures. *Id.* He has treated many people experiencing symptoms after smart meters were installed, many of them reporting that they began experiencing symptoms before they were aware that the smart meter had been installed. *Id.*, p. 7. He treats the patients with the avoidance of smart meters, vitamin and mineral supplementation and mineral intradermal neutralization. A high percentage of the patients experience positive results. *Id.* Dr. Rea further testified that in his opinion exposure to the emissions from smart meters over time could contribute to the development of EHS and other adverse health effects, particularly for children, the elderly and others with immune irregularities such low T-cells and low gamma-globulins. *Id.*, p. 8.

A recent blind study by McCarty, *et al*, demonstrated that a female physician EHS sufferer experienced temporal pain, headache, muscle twitching, and skipped heartbeats within 100 seconds of the application of EMF. *Carpenter Test.* p. 13-14; *McCarty et al*, 1991. Many studies report an association between particular symptoms and low-level RF exposure. Sleep disturbances have been reported in the vicinity of short-wave broadcast transmitters. *Carpenter Test.*, p. 14 (citing *Abelin, et al*, 2005). Sleeping problems and impaired cognitive performance has been reported in the vicinity of new mobile phone base stations. *Carpenter Test.*, p. 14 (citing *Hutter, et al*, 2006); Effects on cognitive function have

been associated with cellular phone radiation. *Carpenter Test.*, p. 14 (citing *Eliyahu, et al*, 2006). Another study reported that sleep quality improved and melatonin levels increased after a short-wave transmitting facility was shut down. *Carpenter Test.*, p. 14 (citing *Altpeter, et al*, 2006).

Other studies provide objective evidence of physiological effects that may be associated with EHS symptoms. One study of human subjects showed that cell phone exposure caused an increase in brain glucose metabolism in the region closest to the phone antenna. *Carpenter Test.* p. 11 (citing *Volkow, et al*, 2011). Another study of human volunteers showed changes in protein expression in human skin exposed to cell phone radiation. *Leszczynski Test.*, p. 4-5; *Karinen, et al*, 2008.

There are many other similar studies with positive effects for physiological responses to low-level RF. In Section 9 of *Bioinitiative 2012*, Dr. Henry Lai provides a summary of animal and human studies published between 2007 and 2012 on neurological effects of RF exposure. He summarizes the positive and negative studies related to both RF and ELF exposures, noting that among the 155 RF studies, 63% showed neurological effects, and among the 69 ELF studies, 93% showed effects. *Bioinitiative 2012*, Section 9, p. 2. He concludes that both RF and ELF “affect neurological functions and behavior in animals and humans,” although he concludes that the detrimental effect to human health has not been established, it is advisable that “one should limit one’s exposure to EMF.” *Id.* p. 13.

Section 8 of the *Bioinitiative 2007*, provides an exhaustive review of the immunological effects of EMF and their causal association with EHS symptoms. The author, professor Olle Johansson, who has been studying EHS since the 1970’s, reports that hypersensitivity reactions can be the result of excessive immune system responses to

environmental stressors. *Bioinitiative 2007*, Section 8, p. 5. He provides a working definition of EHS: “A phenomenon where individual experience adverse health effects while using or being in the vicinity of devices emanating electric, magnetic or electromagnetic fields (EMF’s).” *Id.*, p. 12 (*quoting Bergqvist, et al, 1997*). He concludes: “It is possible that chronic provocation by exposure to EMF can lead to immune dysfunction, chronic allergic responses, and inflammatory responses and ill-health if they occur on a continuing basis over time.” *Id.*, p. 41.

Dr. Richard Conrad, who has suffered from EHS himself for a number of years, conducted a survey of individuals who report having experienced EHS symptoms related to smart meter exposure. *Conrad Test.*, p. 6-8. A copy of Dr. Conrad’s report with a summary of survey results is attached to his testimony as Exhibit D. Many of the people responding to the survey had experienced no EHS symptoms until their smart meters were installed, despite the fact that they had previously been exposed to Wi-Fi and cell phone radiation. p. 10. Forty-two percent of the survey respondents began experiencing EHS symptoms after the smart meter was installed, but before they knew it had been installed. *Id.*, p. 11-12. Reporting symptoms after exposure and before awareness eliminates a psychosomatic origin. Following their experience with smart meters, the number of respondents who were able to use cell phones without symptoms dropped from 50% to 24% and those with symptoms from cell phone use more than doubled from 18% to 39%. *Conrad Test.*, Exhibit D., p. 2. The number of respondents who could not use Wi-Fi at all because of symptoms more than doubled from 17% to 41%. *Id.*

Most of the respondents reported they were in good or excellent health before smart meters were installed. *Id.*, p. 3. Eighty-three percent of the respondents reported that the

smart meter had been between 4 and 50 feet from a location in their home where they spent most of their time. *Id.*, p. 4. More than 2/3 of the respondents reported that symptoms lessened when they increased the distance from their smart meter and about 2/3 reported their symptoms increased when they got closer to the smart meter. *Id.*, p. 4. In 91.1% of the cases where all smart meters were removed, symptoms weakened or disappeared completely. *Id.*, p. 5. 77.1% of those who moved, did so because of smart meters and some of those are currently homeless and many others want to move because of smart meters but moving is not an option. *Id.* Compelling accounts of harm are provided by the Survey respondents. *Id.*, p. 65-96.

Sandy Maurer, Director of EMF Safety Network, testified to hundreds of smart meter health complaints that she has compiled on the EMF Safety Network website. *Maurer Test.*, p. 2. She also testified to the on-line survey conducted by her network to investigate the health and safety complaints of smart meters. *Id.*, p. 3. A summary statement of the results of the survey is attached to her testimony. *Id.*, Exhibit A. The most frequent health complaints reported in the survey were sleep problems, stress, anxiety and irritability, headaches, ringing in the ears, and heart problems. Joshua Hart, Director of Stop Smart Meters! testified to investigating hundreds of cases of reported health and environmental impacts from smart meters and other wireless facilities. *Hart Test.*, p. 2. Many of the people he interviewed have been forced from homes located in proximity to smart meters and/or have been forced from jobs because of RF in the workplace. *Id.*, p. 2-3. The Stop Smart Meters! website has received over 1,200 complaints about smart meters including a significant number of health-related complaints.

Mr. Hart attached to his testimony the statements of 22 individuals reporting their health-related complaints about smart meters declaring the truth and accuracy of their statements. We highlight a few of their compelling accounts:

M.K.H., a PG&E customer, suffered severe symptoms, took extreme measures to reduce toxins in her home, but nothing worked except removing herself from the home and proximity to smart meters; eventually had to move.

M.J.C., a PG&E customer, clear association of symptoms after installation and cessation of symptoms after removal.

E.L.H., a PG&E customer, suffered severe symptoms immediately after installation which led to a hospital ER visit; she had to move to escape the severe pain and is now sensitive to other EMF radiation sources.

J.O., a PG&E customer, suffers classic symptoms in proximity to the smart meters on her house, but the symptoms recede when she visits her father where there are no smart meters.

L.M.L., PG&E customer, suffered severe symptoms after meters installed on neighbor's home; having previously overcome a neurological condition and thyroid condition, she likely had immune deficiencies that made her vulnerable to smart meter RF.

C.J., a PG&E customer, had classic symptoms clearly associated with installation and had to move to escape.

It is highly significant that Exponent and other critics do not proffer any physiological mechanism to explain EHS symptoms other than vague speculations about psychological origins. The observation that some EHS sufferers are unable to consistently detect EMF may serve Exponent's mission to sow doubt and uncertainty, but it does not negate the many studies and personal accounts reporting a clear association between exposure and symptoms. Observed and suffered effects are clearly associated in time and space with exposure to EMF. Although the science has not yet confirmed the mechanism or proven causation to a

scientific certainty, the overwhelming evidence from individual EHS sufferers confirms a positive association.

Again, the burden has been shifted from the utility and telecom industry to those experiencing the symptoms, to prove causation and resolve uncertainties in the science. The admonitions of Dr. Hill are instructive. “Before deducing ‘causation’ and taking action we shall not invariably have to sit around awaiting the results of that research.” *Hill, 1965*, p. 295. “It will be helpful if the causation we suspect is biologically plausible. But this is a feature I am convinced we cannot demand.” *Id.*, p. 298. The sworn testimony of 65 witnesses stands unchallenged in the record. They deserve to be heard and counted as credible evidence of adverse health effects directly associated with smart meter RF radiation.

**D. The evidence confirms smart meter radiation levels create a direct risk of harm.**

As discussed above, CMP has failed to prove, under any kind of worst case scenario, the extent of RF exposure from CMP’s smart meters and AMI system. And, CMP has failed to prove, under any scenario whatsoever, the total exposure likely to be experienced by CMP customers from all sources of RF radiation. *See discussion supra*, pp. 11-12. “[T]he overall scientific question is the total exposure from smart meter and any other sources. . .” *5/23/2013 Tr.* p. 108, ll. 14-15. CMP’s evidence of alleged typical exposures must be disregarded. The only reliable evidence of exposure is the peak power density and, to the extent relevant, the averaged power density based on the 10% fixed duty cycle. There is extensive scientific evidence confirming that adverse health hazards can occur at these levels. Exponent itself acknowledges the peak power of CMP smart meters “is similar to a mobile phone.” *Exponent Test.*, 9/19/2012, p. 32.

Dr. Kumar testified to the evidence of health hazards at low levels, providing references to proposed exposure guidelines that are lower than these exposure levels. *Kumar Test.*, p. 3, Exhibit E. Attached to Lloyd Morgan's testimony as Exhibits G-P are many statements by scientists, public policy experts and physicians, all calling for avoidance of exposure to very low-level RF radiation, comparable to or below smart meter exposures.

Also attached to Lloyd Morgan's testimony is a list of studies showing adverse effects reported at very low RF levels between 0.002 and 6.0  $\mu\text{W}/\text{cm}^2$ . Attached to Dr. Carpenter's testimony as Exhibit B is a copy of the colored chart published in *Bioinitiative 2012*, entitled "Reported Biological Effects from Radiofrequency Radiation at Low Intensity Exposure (Cell Tower, Wi-Fi, Wireless Laptop and "Smart" Meter RF intensities)." The first five pages of this 11-page chart identifies 67 studies with RF exposures, most of which are below the peak exposures for CMP's smart meters *and* the averaged exposures using a 10% duty cycle. Each of these studies reported positive effects for one or more of eight categories of adverse biological effects, which are listed on the bottom of each page. Each category of effects is color coded. The next six pages identify 68 studies reporting exposures in Specific Absorption Rates ("SAR") (watts/kilogram instead of  $\text{mW}/\text{cm}^2$  or  $\mu\text{W}/\text{cm}^2$ ), at levels between 0.000064 and 2.0 W/Kg. A complete list of the 123 studies identified in Exhibit B is provided in alphabetical order along with the color-coded chart.<sup>21</sup> Most of these studies also report effects below CMP smart meter exposures.

A more recent study discussed by Dr. Hardell in his testimony reported oxidative stress responses in mice after an exposure to 2.4 GHz RF radiation at a power density of

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<sup>21</sup> Some studies apparently appear more than once to account for the difference between the list of 123 studies and the charts with identifying the exposures associated with 67 and 68 studies.

0.033549 mW/cm<sup>2</sup> and SAR of 0.023023 W/Kg. *Hardell Test.*, p 20; *Shahin et al, 2013*, p. 6<sup>22</sup>. This is the same frequency as CMP's smart meters with comparable exposure levels. The oxidative stress caused by this exposure affected the process of egg implantation and pregnancy. *Shahin, 2013*. The authors noted that "pregnant women and children are exposed to this low-level MW radiation (especially by microwaves, mobile phones, and Wi-Fi signals)." *Id.* They also observed highly significant DNA damage in the brains cells of mice, which they noted was supported by their previous study and also by Lai and Singh. *Id.*, p. Dr. Hardell discussed the Shahin study on cross-examination, also noting that the exposure level is similar to that for Wi-Fi's and smart meters. *10/30/2013 Tr.*, p. 15.

Dr. Hardell testified there is no known threshold "for cancer effects from radiofrequency radiation," *11/30/2013 Tr.*, p. 16, l. 21 – p. 17, l. 13, that a single hit can have negative effects, and that repeated exposures can affect a body's repair mechanics. *Id.*, p. 16-19. "Single peaks of radiation may have toxic effects and multiple peaks of radiation may have cumulative effects that are not accurately represented by averaged values." *Hardell Test.*, p. 25, l. 16-18; *see also Morgan Test.*, p. 19; ll. 1-7. There are "no well-done studies that show homeostasis in the human body for non-thermal effects." *Hardell Test.*, p. 26, l. 3-4. In a worst case scenario, one CMP smart meter emits many thousands of hits every day; banks of meters multiply that number; and other nearby AMI equipment can add many more hits in a day.

Dr. Hardell further testified that the IARC classification of RF carcinogenicity applies to all forms of RF radiation, including smart meters. *Id.*, p. 24. Although the averaged exposure levels may be less than that from cell phones, "the hazard still exists." *Id.* He

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<sup>22</sup> Page reference to un-numbered pages of on-line version.



cautioned that “children, pregnant mothers, the elderly, and those with immunity defects are more vulnerable to RF exposure” (*Id.*, p. 25); and that “exposures from smart meters will only increase in the future.” *Id.*, p. 37, l. 13-23. He concluded that “exposure to the public should be as low as possible.” *Id.*, p. 32, l. 19-21.

**E. The evidence confirms smart meter radiation levels create an incremental risk of harm.**

While there is sufficient evidence that smart meter and AMI system exposure creates a direct threat of adverse health effects, there is also sufficient evidence of an incremental threat when these exposures are combined with exposures from other RF radiation sources in the environment. Dr. Hardell cautioned that “any additional exposure can cause health effects.” *Id.*, p. 32, l. 5-6. Short-term exposures from multiple sources and cumulative lifetime exposure to RF are both relevant to the analysis of a person’s risk of adverse health consequences caused by RF radiation. *See, IARC Monograph*, Vol. 102, p. 177. DNA damage accumulating over time “can be the cause of slow onset of diseases” including cancer, Alzheimer’s disease, Huntington’s disease, Parkinson’s disease and cancer.” Lai and Singh, 1996, p. 519.

Dr. Bailey acknowledged that any adverse effects from RF “can become additive and have cumulative effects.” *12/5/2012 Tr.* p. 75-76. Cumulative exposures have been causally associated with increased cancer risks in the Hardell and Interphone epidemiological studies. Cumulative effects include not only cancer, but other disease conditions related to the continuous generation of a stress response.

Cumulative exposure from RF sources must be considered when assessing a public health risk. New sources of RF are continually being introduced into the environment and

exposure levels are multiplying on a daily basis. Yet, no regulatory body is monitoring the increased levels of cumulative exposures. Because there is no known safe threshold, and because any additional exposure can have incremental effects, each smart meter poses a serious risk of harm. And the AMI system as a whole with its mesh network of RF radiation poses a serious risk of harm even to those who may have opted out.

CMP has not provided any evidence to prove incremental effects from its RF devices do not pose a significant risk. And, the Commission cannot properly assess such a claim by CMP without having more reliable evidence about the cumulative effects created. CMP has made no meaningful effort to assess the total RF exposure in settings that already pose substantial exposure, *e.g.*, neighborhoods in close proximity to cell towers or AM-FM radio towers; or in homes with frequent use of Wi-Fi, cell phones, microwaves, and other household RF devices; or in work settings with high RF exposures.

The risk of not knowing the full extent of the additional exposure and/or the full extent of the total resulting exposure is heightened by the fact that “the effect is not immediately visible but acts as a silent killer.” *Bioinitiative 2012*, Section 18, p. 29. The risk is heightened further because the exposure is within the home environment of each CMP customer and is continuous in the sense that it creates a daily dose. As Dr. Hill prophetically stated, “we should need very strong evidence before we made people burn a fuel [or be exposed to RF radiation] in their homes that they do not like.” *Hill, 1965*, p. 296(*brackets added*).

**F. The only remedy supported by the record evidence is removal of the AMI system.**


When the potential for harm is widespread and serious, CMP must prove a lack of risk to a high degree of certainty. When the exposure is involuntary and takes place in the home environment, CMP must prove a lack of risk to a high degree of certainty. Because the threat of harm is very serious and potentially widespread, the risk must be removed to ensure safety. The fact that large sums of money have been spent by CMP before investigating safety may present a serious economic concern, but it is irrelevant to the question to be decided in this case. The remedy must be adequate to ensure safety. Because CMP chose a mesh system design with interdependent parts, it is difficult, if not impossible, to identify any practical remedy other than removal of the system. Again, the fact that CMP expended large sums of money on a mesh network design before investigating safety may present a serious economic concern, but it is not relevant to the limited question before the Commission.

The only remedy supported by the record evidence is removal of the AMI system. While this may seem severe to some, there is ample precedent in product recalls commonly required by regulatory bodies with similar or greater economic consequence. If there is to be a lesser remedy of any kind, it will be CMP's burden to prove that the result will ensure safety. On the record of evidence in this proceeding, there is insufficient information from which the Commission could make any determination about the degree of safety that might be ensured by an alternative remedy.

V. CONCLUSION.

CMP has failed to affirmatively prove that safety is ensured and has failed to effectively rebut Complainants' evidence of a significant and serious safety risk. CMP has failed to provide any reliable evidence of worst case scenario exposure levels, with or without consideration of exposures from other RF sources. It has provided insufficient evidence to prove compliance with outdated FCC guidelines. It has failed to prove no serious risk of harm from exposure to RF radiation from smart meter and AMI devices. When all of the evidence is reviewed through the correct lens or framework applying the correct legal standard and burden of proof (as opposed to the causation W/E process applied by Exponent and the Agency Reviews), the Commission must conclude that safety is not ensured.

Dated at Portland, Maine this 13<sup>th</sup> day of December, 2013.

  
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