

**BEFORE THE
PENNSYLVANIA UTILITY COMMISSION**

**Richard N. Myers
Complainant**

v

Docket No.C-2017-2620710

**PPL Electric Utilities Corporation
Respondent**

**MAIN BRIEF
OF
RICHARD N. MYERS
*PRO SE***

May 18, 2018

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INTRODUCTION

This BRIEF is by Richard N. Myers, Complainant in *Docket No. C-2017 -2620710*, and I am representing myself *PRO SE* without benefit of an attorney. I request to opt-out of a smart meter installation and be authorized to retain an analog non-digital meter that does not transmit electromagnetic radiation into my Lancaster residence. My opt-out request includes eleven rental properties I own in Lancaster County because some of the parents have infants and children. According to the Presidential Cancel Panel 2010 and the American Academy of Pediatrics children are at increased risk from RF radiation due to their smaller body mass. *Bionitiative 2012 Digital, p. 53; Paper SECTION 1, p. 9*

I provide here a preponderance of scientific evidence and expert testimony that proves non-thermal RF radiation emitted by PPL smart meters can have a negative and serious impact on my health and that of others. As an aging senior citizen I may be even more vulnerable as a subset of the general population.

I respectfully submit that I have a just and legal right to opt-out under **66 PA.C.S. § 1501** which requires public utility companies to provide “**safe and reasonable service**” (emphasis my own) for the safety of its patrons. HB2200/ACT 129 is ill-conceived, seriously flawed legislation that needlessly and foolishly puts my health at risk. The Commission should not violate its statutory responsibility under **§ 1501** but instead exercise its authority, rule in my favor and take whatever measures are necessary to allow me to opt-out of smart meter installations. Involuntarily subjecting me and others to adverse and serious health risks is in stark contrast with and an abandonment of government’s role in protecting the public safety and well-being of its citizens. The Russian and Chinese governments are more protective of their citizens’ health by setting exposure standards less than FCC’s 1996 Guidelines. *Id. Digital p. 136, Paper SECTION 3, p. 8*. I do not raise a fire hazard

concern with PPL's AMI smart meter in my Formal Complaint and Brief since I have no evidence to that effect.

History of the Proceedings

From PA PUC Website

Procedural History

Docket No. C-2017-2620710

Action Date	Description	Posted Date
8/22/2017	Case Created - C-2017-2620710 - Complaint filed against PPL.	8/22/2017
8/22/2017	Assigned Responsible Bureau - ALJ	8/22/2017
8/22/2017	Document Served - Other - See Comments - Assigned to ALJ & BIE Prosecution.	8/22/2017
8/22/2017	Private Document Published on Web - Document 'Formal Complaint' Restricted on Web - {229830D1-69E8-4220-A9E5-F1CD2E7EE339}	8/22/2017
8/22/2017	Document EServed to POR - Document 'Formal Complaint' is eServed - {229830D1-69E8-4220-A9E5-F1CD2E7EE339}	8/22/2017
8/23/2017	Document Served - Other - See Comments - Secretarial Letter and ex parte communication served 8/23/17.	8/23/2017
8/23/2017	Document Published on Web - Document 'C-2017-2620710 Ex Parte Letter.pdf' is made public	8/23/2017
8/23/2017	Document Published on Web - Document 'Secretarial Letter re Ex-parte communication - Gov's office C-2017-2620710.docx' is made public	8/23/2017
8/23/2017	Document EServed to POR - Document 'C-2017-2620710 Ex Parte Letter.pdf' is eServed - {825EEE99-1EC0-4603-9A21-6B515AA40129}	8/23/2017
8/23/2017	Document EServed to POR - Document 'Secretarial Letter re Ex-parte communication - Gov's office C-2017-2620710.docx' is eServed - {F45D26D0-CEAC-460C-9B37-A96D980E2D37}	8/23/2017
9/12/2017	Document Attached to Case - Answer to Formal Complaint-PPL Electric Utilities Corp - PPL Electric Utilities Corp filed answer to formal complaint	9/12/2017
9/12/2017	Private Document Published on Web - Document 'Answer to Formal Complaint-PPL Electric Utilities Corp' Restricted on Web - {D634D55A-4051-489F-9938-92B021B7B0D1}	9/12/2017
10/3/2017	Document Published on Web - Document 'C-2017-2620710 Initial Hearing Notice.doc' is made public	10/3/2017
10/3/2017	Document EServed to POR - Document 'C-2017-2620710 Initial Hearing Notice.doc' is eServed - {C036537A-1593-4E91-A27F-DAD67582968E}	10/3/2017
10/4/2017	Document Published on Web - Document 'C-2017-2620710 PREHEARING ORDER.doc' is made public	10/4/2017

10/4/2017	Document EServed to POR - Document 'C-2017-2620710 PREHEARING ORDER.doc' is eServed - {BDDA0CB8-2D65-46DA-A2F7-42E4A24F1808}	10/4/2017
10/6/2017	Document Attached to Case - Reply to Answer-Richard Myers - Richard Myers filed Reply to Answer	10/6/2017
10/6/2017	Document Published on Web - Document 'Reply to Answer-Richard Myers' is made public	10/6/2017
11/28/2017	Document Attached to Case - Certificate of Service - PPL Electric - PPL Electric Utilities Corp filed certificate of service.	11/28/2017
11/28/2017	Document Published on Web - Document 'Certificate of Service - PPL Electric' is made public	11/28/2017
12/18/2017	Document Attached to Case - Motion for Admission Pro Hac Vice of Curtis S Renner- Ryan /PPL - Devin Ryan filed Motion for Admission Pro Hac Vice of Curtis S Renner for PPL Electric Utilities Corporation	12/18/2017
12/18/2017	Document Published on Web - Document 'Motion for Admission Pro Hac Vice of Curtis S Renner- Ryan /PPL ' is made public	12/18/2017
12/20/2017	Document Attached to Case - Ltr Request 1/31/18 Hrg be rescheduled to 2/5/18 - PPL - PPL Electric Utilities Corporation filed letter requesting hearing of January 31, 2018 be rescheduled to February 5, 2018.	12/20/2017
12/20/2017	Document Published on Web - Document 'Ltr Request 1/31/18 Hrg be rescheduled to 2/5/18 - PPL' is made public	12/20/2017
12/27/2017	Document Attached to Case - Ltr request Expert Witness submit Written Dir Testi - PPL - PPL Electric Utilities Corporation filed Letter requesting all Expert Witnesses submit Written Direct testimony on or before January 15, 2018.	12/27/2017
12/27/2017	Document Published on Web - Document 'Ltr request Expert Witness submit Written Dir Testi - PPL' is made public	12/27/2017
12/27/2017	Document Attached to Case - Request for PUC Spokesperson to Attend Hearing-Richard Myers - Richard Myers filed Request for PUC Spokesperson to Attend Hearing	12/27/2017
12/27/2017	Document Published on Web - Document 'Request for PUC Spokesperson to Attend Hearing-Richard Myers' is made public	12/27/2017
1/2/2018	Document Attached to Case - Letter to PPL - Richard Myers - Richard Myers filed a letter to PPL, requesting for answers .	1/2/2018
1/2/2018	Document Published on Web - Document 'Letter to PPL - Richard Myers ' is made public	1/2/2018
1/3/2018	Document Published on Web - Document 'C-2017-2620710 Can Re Notice.doc' is made public	1/3/2018
1/3/2018	Document EServed to POR - Document 'C-2017-2620710 Can Re Notice.doc' is eServed - {BB3FDCF3-D5C8-4D77-843C-04A2B3DFB4AB}	1/3/2018
1/8/2018	Document Published on Web - Document 'C-2017-2620710 INTERIM ORDER .docx' is made public	1/8/2018
1/8/2018	Document EServed to POR - Document 'C-2017-2620710 INTERIM ORDER .docx' is eServed - {9EED325D-3435-47A6-8928-0DEA5B6E8E72}	1/8/2018
1/9/2018	Document Attached to Case - Letter re witnesses by telephone - Myers - Rich Myers filed Letter regarding telephonic examination of hearing witnesses.	1/9/2018

1/9/2018	Document Published on Web - Document 'Letter re witnesses by telephone - Myers' is made public	1/9/2018
1/11/2018	Document Attached to Case - Cert of Srvc - PPL Response Discovery Request Set I - PPL Electric Utilities Corporation filed Certificate of Service evidencing service of their responses to the informal discovery requests of Richard N. Myers - Set I.	1/11/2018
1/11/2018	Document Published on Web - Document 'Cert of Srvc - PPL Response Discovery Request Set I' is made public	1/11/2018
1/19/2018	Document Published on Web - Document 'C-2017-2620710 Second Prehearing Order .docx' is made public	1/19/2018
1/19/2018	Document EServed to POR - Document 'C-2017-2620710 Second Prehearing Order .docx' is eServed - {9D87F412-9DBC-4CDE-A30D-EC355AE51CC7}	1/19/2018
1/22/2018	Document Published on Web - Document 'C-2017-2620710 Amended Second Prehearing Order.doc' is made public	1/22/2018
1/22/2018	Document EServed to POR - Document 'C-2017-2620710 Amended Second Prehearing Order.doc' is eServed - {75966AF6-12F3-4E62-883E-DA2E23A8C20C}	1/22/2018
1/22/2018	Document Published on Web - Document 'C-2017-2620710 Can Re (2) Notice.doc' is made public	1/22/2018
1/22/2018	Document EServed to POR - Document 'C-2017-2620710 Can Re (2) Notice.doc' is eServed - {3B5C0B94-479A-4EF9-B40E-408082C90C42}	1/22/2018
1/23/2018	Document Attached to Case - Cert of Srvc witness info letter - Myers - Richard N. Myers filed Certificates of Service.	1/23/2018
1/23/2018	Document Attached to Case - Cert of Srvc direct testimony - Myers - Richard N. Myers filed Certificates of Service.	1/23/2018
1/23/2018	Document Published on Web - Document 'Cert of Srvc direct testimony - Myers' is made public	1/23/2018
1/23/2018	Document Published on Web - Document 'Cert of Srvc witness info letter - Myers' is made public	1/23/2018
2/14/2018	Document Attached to Case - Not of Appearance of Garrett Lent & Withdrawal of Christopher Wright - PPL - PPL Electric filed Notice of Appearance of Garrett Lent and Withdrawal of Appearance of Christopher Wright.	2/14/2018
2/14/2018	Document Published on Web - Document 'Not of Appearance of Garrett Lent & Withdrawal of Christopher Wright - PPL' is made public	2/14/2018
3/22/2018	Document Published on Web - Document 'Richard Myers Original Signature Request Letter' is made public	3/23/2018
3/27/2018	Document Attached to Case - Attach to Case - Cert of Srvc - PPL Exhibits	3/27/2018
3/27/2018	Document Published on Web - Document 'Cert of Srvc - PPL Exhibits' is made public	3/27/2018
4/2/2018	Document Attached to Case - Attach to Case - Motion in Limine to Exclude Myers Exhibits Testimony & Witness - PPL	4/2/2018
4/2/2018	Document Published on Web - Document 'Motion in Limine to Exclude Myers Exhibits Testimony & Witness - PPL' is made public	4/2/2018

4/4/2018	Document Published on Web - Document 'C-2017-2620710 Briefing Order.doc' is made public	4/4/2018
4/4/2018	Document EServed to POR - Document 'C-2017-2620710 Briefing Order.doc' is eServed - {3702FE70-D9D9-CE6A-84AC-6290D1A00000}	4/4/2018
4/4/2018	Document Attached to Case - Attach to Case - Cover Letter & Certificate of Service-Richard Myers	4/4/2018
4/4/2018	Document Published on Web - Document 'Cover Letter & Certificate of Service-Richard Myers' is made public	4/4/2018
4/24/2018	Document Attached to Case - Attach to Case - Exhibit No 11 - PPL Electric	4/24/2018
4/24/2018	Document Published on Web - Document 'Exhibit No 11 - PPL Electric' is made public	4/24/2018
4/27/2018	Document Attached to Case - Attach to Case - Exhibits No.29 and No.30-Richard Myers	4/27/2018
4/27/2018	Document Published on Web - Document 'Exhibits No.29 and No.30-Richard Myers' is made public	4/27/2018
4/27/2018	Document Attached to Case - Attach to Case - Electronic Transcript - Hrg 4/2/2018 (pgs 1-278)	4/27/2018
4/27/2018	Private Document Published on Web - Document 'Electronic Transcript - Hrg 4/2/2018 (pgs 1-278)' Restricted on Web - {2BC2E3F7-8DF8-C47B-85AA-630827900000}	4/27/2018
5/4/2018	Document Attached to Case - Attach to Case - Electronic Transcript-4/2/18-Pages 1-278	5/4/2018
5/4/2018	Private Document Published on Web - Document 'Electronic Transcript-4/2/18-Pages 1-278' Restricted on Web - {FC0F3FEB-2265-C296-8612-63268D900000}	5/4/2018

Proposed Findings of Fact from the Common Record

1. Dr. David O. Carpenter, expert witness for Complainant Myers

Dr. David O. Carpenter is a magna cum laude graduate of Harvard, a cum laude graduate of Harvard Medical School and an internationally recognized expert on environmental health and hazards of non-ionizing radiation. He has authored or co-authored 435 peer-reviewed studies and has written six books.

Dr. Carpenter was Dean, School of Public Health, University at Albany from 1985 to 1998 and is currently Professor of Environmental Health Sciences and Biomedical Sciences at the University at Albany. He has qualified and served as an expert witness at numerous legal proceedings addressing health risks from RF radiation. His distinguished career in research, the public health policy field, and as a Professor spans 57 years. *Exhibit No.2 of Myers Direct Testimony*

Dr. Carpenter testified on the precise issues at hand in this proceeding several of which I am highlighting below which are crucial in the Commission's decision.

- That the very brief but very intense burst of pulses from smart meters is more harmful to people and that there is something we don't quite understand that is particularly provocative about very rapid but very intense short bursts. *Hearing Transcript April 2, 2018 p. 93 at 3-24*

- That the weight of evidence is overwhelming and consistent with the conclusion that excessive exposure to radiofrequency like magnetic fields is associated with adverse health effects, including elevation of cancer of the nervous system. *Id. p. 79 at 14-15 and p. 78 at 6-12*

- That in biology, finding a mechanism of action is not a requirement for quality research, once you find a consistent pattern. *Id. p. 78 at 21 thru 79 at 4*
- That it is simply wrong and not scientific that a group of agencies and individuals are in denial of the multi-thousands of publications, many in first-rate peer-reviewed journals, that report adverse health effects at intensities that do not generate tissue heating. *Id. p. 83 at 2 - 12*
- Dr. Carpenter ***totally disagrees*** that the Bio-initiative Report is not a balanced selection of current scientific knowledge. He testified that it does quote articles that don't find optimum effects as well as those that do. *Id. p 76 at 2-7.*
- That the criticism the Bioinitiative Report has received is because of the awareness it has raised about the huge amount of scientific studies on biological and adverse health effects that exist. *Id. p. 74 at 17-21*
- That there are individuals with conflicts of interest and strong ties in the telecommunications industries who ignore evidence and are under some undue influence from industry. *Id. p.154 at 20 thru p.155 at 9*

2. 4,289 studies which report adverse or biological effects from non-thermal RF radiation

I identified 4,289 scientific studies which report biological and adverse health effects from non-thermal RF radiation. This is the regulated spectrum of non-thermal RF radiation emitted by the smart meter which PPL wants to install on my residence and rental properties. A breakdown of the 4,289 studies is as follows:

2,311 U.S. Naval Medical Research Institute Report, 1972. *Exhibit No. 4 of Myers Direct Testimony*

1,800 New studies between 2007 and 2012, *BioInitiative 2012, Digital, p. 47, Paper*

SECTION 1(2012 Supplemnet), p. 3. The number of new studies since 2012 continues to increase.
Hearing Transcript April 2, 2018 p. 91, at 13-25.

- 155 Dr. Martin Pall's List of 155 Reviews, *Exhibit No. 5 of Myers Direct Testimony*
 - 4 Enclosures to Myers's Ltr dtd September 29, 2017 to Post & Schell
 - 19 Abstracts of research papers I submitted to PPL on January 15, 2018
- 4,289 Total**

3. Appendix A Listing of 407 studies

Appendix A contains the titles of 407 studies, their author, year published and a concise description of their findings which are available from the scientific literature which reports adverse or biological effects from non-thermal RF radiation. I list these studies to show that my claim of studies is not fictitious and to show why I conclude that smart meter RF radiation can put my health and that of others at risk. PPL did not provide any evidence of tests being performed on humans to evaluate the safety of smart meters and their pulsed (frequency hopped spread spectrum) emissions.

4. There is conflicting information in how often PPL's AMI smart meter emits signals.

It is important that PPL clarify this extremely crucial point.

I measured emissions from smart meters in my neighborhood using a hand held meter. I observed signal bursts (peak spikes in amplitude) approximately every 15 to 20 seconds with nearly continuous signals in between. This equates 5,760 to 4,320 signal bursts (peak spikes in amplitude) per day.

PPL's Mr. Scott Larson stated that the PPL AMI smart signal emits signals on average about once every 1.19 minutes. This equates to approximately 1,720 times a day.¹

Dr. Davis stated that the smart meter has a signal duration from 46 to 63 milliseconds per day and that signal totals 84 seconds in a 24 hour day. *Davis Rebuttal Testimony,*

¹ Post & Schell letter dated January 10, 2018 in response to Complainant Myers' Discovery Request

March 26, 2018, p. 7 at 21-23. Dividing 84 seconds by 46 milliseconds equals 1,826 emissions per day. Dividing 84 seconds by 63 milliseconds equates to 1,333 emissions each day. Dr. Davis stated the smart meter also sends out sine wave signals that last for 10 milliseconds at a time. *Hearing Transcript April 2, 2018, p. 234 at 9-11.* If the duration of those signals totals 84 seconds divided by 10 milliseconds, this equals 8,400 bursts per day.

5. A global paradigm shift is taking place regarding RF radiation safety

Sixteen (16) nations have ruled that the thermal RF radiation levels set by the National Council of Radiation Protection (NCRP), the International Commission on Non-Ionizing Radiation Protection (ICNIRP), and the FCC are obsolete and do not adequately protect the public, and they are taking actions to mitigate public risk. The countries are: France, Belgium, Spain, Israel, Australia, Italy, Switzerland, Germany, Austria, United Kingdom, India, Russia, Canada, Finland, Namibia and Cyprus - *Exhibit No. 3 of Myers Direct Testimony (Bioinitiative 2012) Digital p. 1313-1326 ; Paper SECTION 22 p. 22-26*

The European Environmental Agency, the Parliamentary Assembly of the Council of Europe representing 800 million Europeans, and the Supreme Court of India have advocated and have taken precautionary measures to better protect the public. *Exhibit No. 3 of Myers Direct Testimony (Bioinitiative 2012) Digital p. 1307; Paper SECTION 22 p. 15-16*

In the United States, at least 10 federal, state, and municipal agencies or officials and professional organizations have concluded that the FCC's 1996 thermal Guidelines are obsolete and do not adequately protect the public. *Exhibit No. 22 of Myers Direct Testimony*

246 Leading Scientists who are experts in RF radiation research made an international appeal to the United Nations as recently as November 9, 2017 petitioning the United Nations, the United Nations Environmental Program (UNEP), and the World Health Organization to exert strong leadership to

implement protective measures against EMF-RF emissions and to educate the public about EMF-RF health risks. *Id. Exhibit No. 23*

6. Evidence of industry bias and undue influence regarding RF radiation safety

The communications/electronic sector spent nearly 800 million lobbying Washington officials in 2013-2014, according to the Center for Responsive Politics. *Exhibit No. 24, page 4, second to last paragraph of Myers Direct Testimony*

A revolving employment door exists between FCC Commissioners and executives of the wireless industry with resulting conflicts of interest. *Exhibit 24, page 6 of Myers Direct Testimony*

There are a number of instances where scientific research which reported adverse health effect from RF radiation has been suppressed and/or had funding cut off. Dr. Henry Lai and research scientists Jerry Phillips and George Carlo are examples. *Exhibit 25, p. 2, and Exhibit 24, Chapter 4 – fourth page of Myers Direct Testimony*

7. Adverse health effects are reported at levels way below what the FCC claims is safe

Research scientists documented adverse health effects from non-thermal RF radiation at extremely low power densities in the microwatt, nanowatt, pico watt and femtowatt ranges.

Biointiative 2012. Digital p.10; Paper SECTION 1 (2012 Supplement) –Table at end of SECTION.

A microwatt equals one millionth of a watt, a nanowatt equals one billionth of a watt, a picowatt equals one trillionth of a watt, and a femtowatt equals one quadrillionth of a watt². These extremely low levels where harm has been reported are dramatically lower than what FCC claims is too low to cause harm and what Dr. Davis asserts as harmless in his PPL Electric Exhibits CD-2 Myers through CD-7 Myers.

³ <https://en.wikipedia.org/wiki/Watt>

Summary of Argument

I submit that as Complainant I have borne the burden of proof by presenting an overwhelming and preponderant amount of scientific evidence which shows non-thermal RF radiation at the power densities and frequencies emitted by PPL's AMI smart meters can adversely and seriously impact my health. Specifically:

I cite **4,289** studies which attribute adverse or biological effects from non-thermal RF radiation. The majority of these studies were published in peer-reviewed journals and are available from medical and professional archives.

I list an additional **407** scientific studies in Appendix A by title, author and year and which contain a concise description of their findings. I provide this list of studies which contain findings in their headings as examples of published research, demonstrating that my studies claim is not fictional. The **4,289** studies I identified and the **407** studies I listed in Appendix A far exceeds the 14 studies Dr. Israel names in his Rebuttal Testimony of March 26 in which he stated that no harmful effects from non-thermal RF radiation. Am I to believe Dr. Israel and Dr. Davis know more than the hundreds, if not thousands, of researchers and authors who provide secondary citations to those studies?

It is an extreme and unreasonable position for PPL's expert witness Dr. Israel and Dr. Davis to claim there is no reliable scientific evidence that shows non-thermal RF radiation can be harmful or biologically active except for tissue heating. *That defies reason, reveals extraordinary bias and undermines their credibility.* It's business, not science, in my view.

In my Argument section, paragraph 2, under PPL Exhibits CD-2 Myers and CD-3Myers, I list **38** scientific studies which report adverse health effects from RF radiation which occurred at levels below the 0.0063 mW/cm^2 and $0.0000061 \text{ mW/cm}^2$ which Dr. Davis' implies are safe in his

exhibits. Those 38 studies show that at power densities as low as billionths, trillionths and quadrillionths of a watt, adverse effects have been reported. These include genetic changes, DNA problems, cognitive impairment, behavioral problems, sleep disturbances, cardiovascular problems, reduced sperm count, and others.

The Commission should not be swayed by PPL's subject matter experts who claim that negative studies are co-equal to and invalidate positive studies which report harm from non-thermal radiation. I provide expert written and oral testimony showing that that criteria is wrongly applied to this invisible universe within biological science.

The Commission should not be swayed by Public Utility Commission rulings in other states with no evidence of the information upon which they based their decision, or whether or not those rulings examined and considered the smart meter's unique feature of pulsed (frequency hopped spread spectrum) emissions. Smart meter pulsing is particularly significant considering the recent ruling by the Philadelphia ALJ that some other aspect of the Complainant's smart meter is "inimitably perceptible by and contrary to the health and well-being of the individual" (*Docket No. C-2015-2475023*).

The Commission does not have to resolve the scientific dispute over health risks from non-thermal RF radiation. The Commission's ruling should be based on *primary science* and whether that science shows that pulsed, non-thermal /frequency hopped spread spectrum radiation from PPL's smart meter can adversely affect a person's health and constitute unsafe and unreasonable service in violation of **66 PA.C.S. § 1501**.

A large, well established and profitable corporation such as PPL should not have their deployment and investment in smart meters fail if I and others with health concerns are permitted to opt-out. Other states allow it. Maryland, for example, charges opt-out customers a monthly fee of

\$5.50 and a one-time surcharge of \$75 to cover meter reading costs. Is not a person's health, quality of life, or life itself worth \$5.50 a month?

ACT 129 was ill-conceived, seriously flawed legislation. It was enacted on needlessly vague wording, on false testimony that smart meters were not mandatory, and without lawmaker's knowledge of the vast amount of scientific research which attribute adverse health effects to excessive exposure to non-thermal RF radiation. The PA General Assembly would not have enacted this law if lawmakers knew it put their constituents and their own family's health at risk.

I document a paradigm shift that is taking place within the U.S.A and other nations throughout the world in coming to recognize the hazards of RF radiation. The public, government officials, and professional organizations are embracing the Precautionary Principle and are taking measures to reduce public exposure to RF radiation. The Commission should adopt the Precautionary Principle approach with smart meter emissions, as my expert witness Dr. Carpenter advocates, and which I recommended on page 18 of my Direct Testimony.

I urge the Commission to exercise their authority under **66 PA.C.S. § 1501** and take whatever actions are necessary to allow me, the tenants in my rental properties, and others with health concerns to be exempt from smart meter installation. I urge the Commission to call for the release of opt-out bills stalled in Committees for years, and recommend that appropriate agencies initiate a public education campaign to raise awareness of the hazards of exposure to RF radiation. The science, the precedent of other government officials, the soundness of the Precautionary Principle approach, and **§ 1501** Statute provide justification for the Commission to act.

ARGUMENT

1. General.

A. The Commission should adopt the testimony of expert witness Dr. David O.

Carpenter. I call the Commission's attention in particular to Dr. Carpenter's expert opinion on the following points which address the precise issue at hand:

That the very intense bursts of pulses from smart meters is harmful to people rather than the average over a period of time. *Hearing Transcript April 2, 2018, p.93 at 3-20* I believe the Commission's consideration of the intense bursts of pulses is critical to this case.

That the weight of evidence is consistent that excessive exposure to radiofrequency is associated with adverse health effects, including elevation of cancer and the nervous system. *Id.p.78 at 6-12*

That in biology, finding a mechanism of action is not a requirement for quality research, once you find a consistent pattern. *Id. p.78 at 21 to p. 79 through 4*

That it is biased, wrong and not scientific that a group of agencies and individuals are in denial of the multi-thousands of publications, many in first-rate peer-reviewed journals that report adverse health effects. *Id. p. 83 at 1-18*

That the Bioinitiative Report has received criticism because of the awareness it has raised of the huge amount of scientific studies on biological and adverse health effects from non-thermal RF radiation. *Id. p. 74 at 17-21*

That there are individuals with conflicts of interest and strong ties in the telecommunications industries who ignore evidence and are under undue influence from industry. *Id. p. 154 at 20-25, p. 155 at 1-9*

B. The wireless technology industry has ignored and suppressed an abundance of scientific evidence that reports adverse health effects from non-thermal RF radiation.

Dr. David Lai, Emeritus Professor of Bioengineering at University of Washington, and his colleague Dr. Singh, are a few of many examples. In 1995, Dr. Lai discovered DNA damage in rat brains at RF radiation levels deemed safe by FCC. Motorola then launched a full scale effort to discredit his work. Others in the industry tried to have him fired. *Exhibit No. 25, p. 1-2 of Myers Direct Testimony*

Research scientist Jerry Phillips also found DNA damage in rat brains - whereupon Phillips had his funding cut off. In a subsequent interview Mr. Phillips went on to complain:

“There is no money to do research. It’s not going to come from government because government is controlled by industry” *Exhibit No.24, p.28 of Myers Direct Testimony*

And research scientist George Carlo, who was hand-picked by industry, concluded from his independent research that wireless radiation did raise the risk of brain cancer. Whereupon the cellular communications industry attempted to muffle his work. *Exhibit No.24, p. 5 of Myers Direct Testimony*

Devra Davis, Ph.D., toxicologist and public health expert, wrote a book entitled ***Disconnect: The Truth About Cell Phone Radiation***, in which she demonstrates a pattern of the cell phone industry’s scientific manipulation spanning decades. *Exhibit No.25, p. 4 of Myers Direct Testimony*

C. The National Toxicology Program (NTP) cell phone study provides clear evidence that cell phone radiation caused cancer in rats.³

Officials at the National Toxicology Program (NTP), an inter-agency program of the US Department of Health and Human Services, recently announced that there is clear evidence that exposure to cell phone radiation caused a rare cancer in the hearts of male rats. The conclusion was reached by an 8 to 3 vote of expert panelists who convened March 26-28, 2018 to analyze the draft technical reports from the NTP cell phone study. In seven instances, the expert group upgraded the evaluations of earlier evidence published by NTP staff in the draft technical reports. According to a former NTP scientist, "There was never a time when so many upgrades were recommended."⁴

³ I respectfully request the Commission accept the information in my Brief on the NTP cell phone study for two reasons. 1) At the April 2, 2018 hearing Counsel for PPL objected to my eliciting information from Dr. Carpenter on the March 26-28, 2018 expert panel analysis of the NTP cell phone study. The reason for objecting was that Dr. Carpenter did not identify the NTP study in his Direct Testimony letter as subject matter he intended to discuss at the hearing. *Exhibit No.1 of Myers Direct Testimony*. Dr. Carpenter's Direct Testimony letter was dated March 12 in compliance with the Pre-Hearing Order. The expert panel's findings were not made public until just before the April 2 hearing. So Dr. Carpenter would not have known to include the NTP panel's analysis in his letter. However, Dr. Carpenter's March 12 Direct Testimony letter reads that he would address "research relating to biological health effects from exposure to non-thermal radiation". Therefore, I submit the NTP's expert panel's findings were within fair scope for me to elicit oral testimony from Dr. Carpenter had Counsel for PPL not objected. 2) I provided NTP cell phone study information to Counsel for PPL in a letter I sent dated September 29, 2017. The information was Enclosure (1) and consisted of seven pages. My letter and Enclosure (1) were in response to PPL's letter to Secretary Chiavetta asking that my Complaint be denied. The 2016 NTP study linking cancer in rats exposed to non-thermal RF radiation was crucial in my decision to proceed with my Formal Complaint. The research which the expert panel evaluated was the same data in the 2016 study. The NTP cell phone study is highly relevant to my case. That is why I addressed the NTP study in my Brief since it is information I provided to PPL in 2017 and is part of the common record.

⁴ <https://www.saferemr.com/2018/01/national-toxicology-program-peer-public.html>

The NTP multi-year cell phone study was the world's largest, most thorough, most well-designed study of its type and cost \$25 million.⁵ It's the missing link in the RF radiation controversy - a U.S. government study that validates carcinogenic findings of independent researchers years ago.

The NTP cell phone study is a draft so it is not yet attributable as a statement or policy of the NTP. But the scientific panel's March 26-28, 2018 ruling is highly significant since it is an expert evaluation of primary science by government-appointed scientists. The ruling of these expert scientists is a fact and matter of record. It has been 19 years since the FDA called upon the NTP in 1999 to conduct high priority research on effects of wireless radiation,⁶ which produced the NTP cell phone study. Industrial and political pressures could delay the release of the expert panel's ruling for many more years.

D. The FCC's delay in reassessing and updating its 1996 Guidelines is putting the public's health at risk with the proliferation of wireless technologies and the unprecedented level of RF radiation to which people are now exposed, despite the large number of scientific studies attributing adverse health effects to non-thermal RF radiation.

In 2013 FCC began a project to update safe RF radiation exposure limits. This included technical issues dating back to 2003 which are still incomplete.⁷ NASA put a man on the moon 8 years after launching the Apollo Program. The United States defeated the Axis powers during World War II in 44-months. FCC's slow pace in reassessing its Guidelines raises the question as to whether the delay will continue on for more years because of undue influence and pressure by industry.

⁵ <https://ehtrust.org/wp-content/uploads/NIEHSNationalToxicologyProgramQandAontheRF-EMFStudy.pdf>

⁶ https://ntp.niehs.nih.gov/ntp/htdocs/chem_background/exsumpdf/wireless_051999_508.pdf

⁷ <https://www.fcc.gov/general/radio-frequency-safety-0>

E. The Commission should not be misled by PPL’s expert witnesses claim that negative studies invalidate positive studies and comprise the preponderance of scientific evidence.

Dr. Martin Blank is a leading researcher on non-thermal radiation and claims negative studies are being used in the wrong way:

“Although they [negative studies] cannot prove there is no positive effect, they do have an influence in the unscientific ‘weight of evidence approach’. In epidemiology, where it is difficult to compare studies done under different conditions, it is common to make a table of the positive and negative results. The simple listing has the effect of a tally, and the overall score substitutes for an evaluation. In any case, one can write that the evidence is ‘not consistent’, ‘not convincing’ or claims are ‘unsubstantiated’ and therefore ‘unproven’. The same is true in experimental studies. Funds are generally not available for an independent study to track down the causes of the differences in results, so the contradictory results are juxtaposed and a draw is implied. This is a relatively cheap but effective way to neutralize or negate a positive study”. *Bioinitiative 2012 – Digital p. 350-351; Paper SECTION 7(July 2007)p. 14-15*

F. Critically important wording in HB2200/ACT 129 was confusing and led law makers and others to believe smart meters were optional, not mandatory, for customers.

Quoting from page 70 of HB2200/ACT 129.⁸

“Electric distribution companies shall furnish smart meter technology as follows:

- (i) Upon request from a customer that agrees to pay the cost of the smart meter at the time of the request**
- (ii) In new building construction**
- (iii) In accordance with a depreciation schedule not to exceed 15 years”**

Lawmakers were presented with false and misleading statements prior to the vote that customers could opt out of smart meters because installation was not mandatory. Here are four examples from the Senate and House Legislative Journals⁹ and my Direct Testimony:

⁸ <http://www.legis.state.pa.us/cfdocs/Legis/LI/uconsCheck.cfm?txtType=HTM&yr=2008&sessInd=0&smthLwInd=0&act=129>

⁹ Senate Legislative Journal Oct 8, 2008, p 2677/2629,2626,

Senator Boscola to President pro tempore and fellow lawmakers: “We also made sure that smart meters would not be mandated for every single taxpayer.”

Senator Fumo to President pro tempore and fellow lawmakers:

“In addition, we did not mandate smart meters, but we made them optional.”

Senator Tomlinson to President pro tempore and fellow lawmakers:

“It is not mandated, but it allows for the deployment of smart meters through a depreciation process, through new home construction process, and through the depreciation of years, and for anyone who wants to purchase a smart meter which they feel will help them manage their electric load better.”

Representative Freeman to the Speaker:

“Keep in mind that opting in to this program is an optional opportunity for customers, and they would not be able to selectively pick certain customers to be blacked out versus others.”

Neither were lawmakers aware of the large numbers of scientific studies reporting adverse health effects from non-thermal RF radiation. They did not intend to endanger the public’s health and would not have made smart meters mandatory or passed the law if they knew.

G. Allowing Pennsylvanians with health concerns to opt out of smart meters need not disrupt PPL’s smart meter investment and deployment.

A well established and profitable corporation like PPL should be able to manage their smart meter program and deployment and still allow customers with health and safety concerns to opt-out. Other states allow opt-out and some utility companies simply recover that cost with a modest

surcharge. Maryland, for example, charges a monthly fee of \$5.50, plus a one-time surcharge of \$75.00.¹⁰

H. It is unreasonable for PPL to shift the burden on customers to prove conclusively that PPLs smart meters are safe.

The National Toxicology Program Study on cell phone safety cost \$25 million¹¹. Putting that expense burden and complex task on a private citizen is unreasonable, unjust and should not be required.

I. The Commission and state officials should be guided by the Precautionary Principle approach and take what measures are necessary to allow customers to opt-out of smart meters in the interest of public safety.

The European Court of Justice, the WHO, the European Environment Agency and the American Public Health Association are just a few examples of institutions which embrace the Precautionary Principle to protect the public in areas of scientific uncertainty. Here is a working definition which the European Environment Agency has developed and uses in matters of public safety and scientific uncertainty. *Biointiative 2012 Digital p.1,353; Paper SECTION 23, p. 12:*

“The Precautionary Principle provides justification for public policy actions in situations of scientific complexity, uncertainty and ignorance, where there may be a need to act in order to avoid, or reduce, potentially serious or irreversible threats to health or the environment, using an appropriate level of scientific evidence, and taking into account the likely pros and cons of action and inaction”

¹⁰ <https://www.bge.com/SmartEnergy/SmartMeterSmartGrid/Pages/SmartMeterOptOut.aspx>

¹¹ <https://ehtrust.org/wp-content/uploads/NIEHSNationalToxicologyProgramQandAontheRF-EMFStudy.pdf>

J. There is a paradigm shift taking place globally and in the United States. The public and officials are acknowledging and taking measures to reduce health risks from excessive, chronic and cumulative exposure to non-thermal RF radiation.

The landmark NTP cell phone study mentioned above is the latest scientific evidence. Sixteen (16) nations have concluded that RF radiation levels set by the FCC do not adequately protect the public and are taking independent actions to mitigate public risk.

Below are 10 Federal, state, municipal, and professional organizations which also concluded that FCC's 1999 Guidelines are obsolete and do not adequately protect the public. *Exhibits No. 12, 13, 14, 15, 16, 17, 18, 19, 20, 21 of Myers Direct Testimony:*

US Department of Interior

United States Environmental Protection Agency

The American Academy of Pediatrics

The American Academy of Environmental Medicine

Maryland's Children's Environmental Health and Protection Advisory Council

California Department of Public Health

The City and County of San Francisco

The City of Pembroke Pines, FL

The City of Jackson Hole

An International Appeal by 246 Scientists who are recognized experts in the biological and health effects of non-ionizing radiation. *Myers Direct Testimony, p. 13, Exhibit No. 23*

K. I have taken all reasonable steps to make my home as electromagnetically safe as I can.

I don't use Wi-Fi. Instead I use ethernet cable to connect my computer to the internet and printer. When using a cell phone I don't place it at my ear. I place the phone on speaker or use an

air tube headset to block the RF radiation. I don't use a wired headset or Bluetooth and I turn the phone off if I have to carry it in my pocket. I rarely use a microwave oven and if I do, I walk away from it until it shuts down.

2. Dr. Davis's written and oral testimonies are wrong on numerous and very crucial points.

A. Dr. Davis's Claim that PPL's Electric AMI smart meters do not produce pulsed RF fields is highly misleading.

It depends on what a person means by the word "pulse". Here are two dictionary definitions of pulse:

A short burst of electromagnetic energy:¹² https://en.wikipedia.org/wiki/Electromagnetic_pulse

An electromagnetic wave or modulation thereof of brief duration¹³

Dr. Davis described the AMI smart meter emissions as "frequency hopped spread spectrum". *Hearing Transcript April 2, 2018, p. 234 at 13-16.* One feature of frequency hopped spread spectrum is a signal which is transmitted in short bursts¹⁴. For brevity, I prefer to use the term "pulse" in this Brief when referring to AMI smart meters rather than "frequency hopped spread spectrum". The word "pulse" is commonly used by many researchers who conduct research and publish studies on pulse-modulated RF radiation.

PPL's Mr. Scott Larson stated that the PPL AMI smart meter emits signals on average about once every 1.19 minutes.¹⁵ This equates to 1,720 times a day. Dr. Davis stated that RF signals from PPL's AMI meters last only 46 to 63 milliseconds and their total duration is only 84 seconds over a 24-hour period. *Davis Rebuttal Testimony, March 26, 2018, p.7 at 21-23*

¹² www://en.wikipedia.org/wiki/Electromagnetic_pulse

¹³ Webster's Seventh New Collegiate Dictionary

¹⁴ <https://www.techopedia.com/definition/9509/spread-spectrum>

¹⁵ Post & Schell Discovery Letter dated January 10, 2018

That equates to many pulses in a 24-hour day.

Dr. Davis' claim that smart meters do not pulse energy in an intermittent or modulated sense should not be allowed to stand when ruling in this case. AMI smart meters do indeed emit intermittent bursts and intense peaks of RF energy thousands of times each day. I have concluded from reading peer reviewed studies in the scientific literature that smart meter's non-thermal RF radiation, their unique pulsing feature, and peak energy spikes could be harmful to my health. Here is just one of many references I can cite:

"There is increasing reason to believe that the critical factor for biologic significance is the intermittent pulse of RF, not the time-averaged SAR. This kind of signal is biologically active. *Bioinitiative 2012, Digital p. 68; paper SECTION 1 (2012 Supplement) p.24*

In a January, 2018 Decision ALJ Heep ruled that the preponderance of evidence does suggest that some other aspect of the smart meter is "inimitably perceptible by and contrary to the health and well-being" of the Complainant, Ms. Povac.¹⁶ As the PUC record shows there are increasing complaints from consumers that smart meters are making people sick. *Bervinchak vs. PPL Electric Utilities*¹⁷ and *Murphy vs PECO*¹⁸ are recent examples.

The American Academy of Environmental Medicine reported 92 cases of people in Australia who experienced adverse health effects after installation of smart meters in their homes. The author of the Case Study concludes that smart meters "may have unique characteristics that lower people's threshold for symptom development. *Exhibit 15 of Myers Direct Testimony*

¹⁶ *Docket No. C-2015-2475023 – Initial Decision, p. 28*

¹⁷ *Docket No. C-2016-2572824*

¹⁸ *Docket No. C-2105-2475726*

Further supporting my conclusion are 14 citations of scientific studies reporting adverse health effects from pulsed non-thermal RF radiation. They are:

1. Huber et al [2002] reported that exposure to pulsed modulated RFR prior to sleep affected EEG during sleep. However, effect was not seen with unmodulated field. They also found that the pulsed field altered regional blood flow in the brain of awake subjects.

2. Huber et al. [2005], which found altered cerebral blood flow in humans exposed to pulsed modulated cell phone radiation. They concluded that, "This finding supports our previous observation that pulse modulation of RF EMF is necessary to induce changes in the waking and sleep EEG, and substantiates the notion that pulse modulation is crucial for RF EMF-induced alterations in brain physiology."

3. Acherman P et al, 2000. Exposure to pulsed high-frequency electromagnetic field during waking affects human sleep EEG. *NeuroReport* 11(15):3321-3325.

4. Borbely, AA et al, 1999. Pulsed high-frequency electromagnetic field affects human sleep and sleep electroencephalogram. *Neuroscience Letters* 275(3): 207-210.

5. Leszczynski, D et al, 2004. Proteomics analysis of human endothelial cell line EA.hy926 after exposure to GSM 900 radiation. *Short Communication. Proteomics* 4, 1359-1365.

6. Lu, ST et al, 1999. Ultrawide-band electromagnetic pulses induced hypotension in rats. *Physiology and Behavior*, 67:753-761.

7. Mann, K et al, 1996. Effects of pulsed high-frequency electromagnetic fields on human sleep. *Neuropsychobiology* 33:41-47.

8. Mann, K et al, 1998. Effects of pulsed high-frequency electromagnetic fields on the neuroendocrine system. *Neuroendocrinology* 67: 139-144.

9. Repacholi, M. et al, 1997. Lymphomas in Eμ-Pim1 transgenic mice exposed to pulsed 900 MHz electromagnetic fields. *Radiation Research* 147:31-40.

10. Schmidt M Murbach M Inelustenberger C Maire M Kuster N Achermann P. s2012. Sleep EEG alterations: effects of pulsed magnetic fields versus pulse-modulated radio frequency electromagnetic fields. *J. Sleep Research, European Sleep Research Society* DOI: 10.1111/Seaman, RL et al, 1999.

11. Hyperactivity caused by nitric oxide synthase inhibitor is countered by ultra-wide band pulses. *Bioelectromagnetics* 20: 431-439.

12. Wolke, S et al, 1996. Calcium homeostasis of isolated heart muscle cells exposed to pulsed high-frequency electromagnetic fields. *Bioelectromagnetics* 17(2): 144-153.

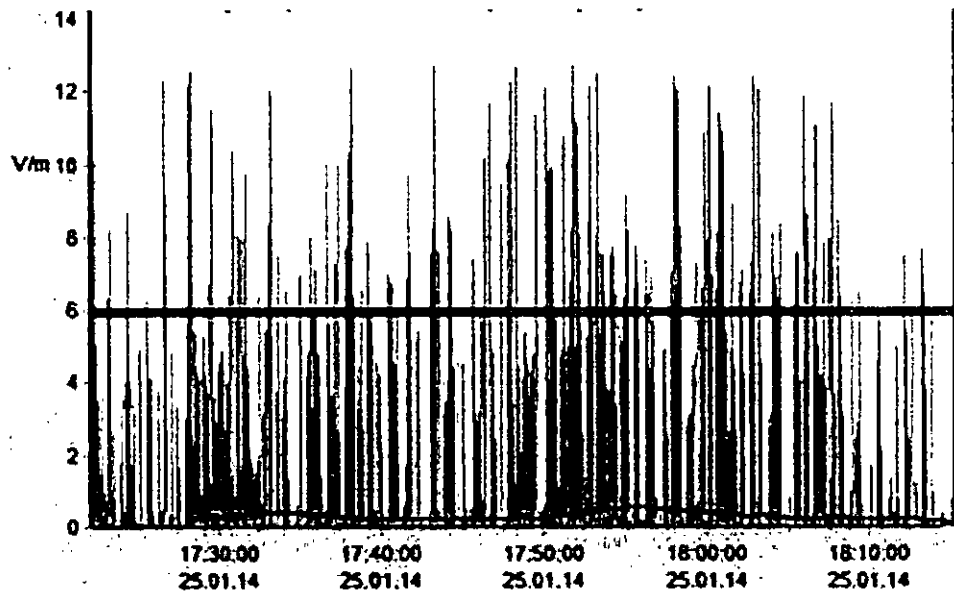
13. Czerska EM, Elson EC, Davis CC 1992. Swicord ML, Czerski P. Effects of continuous and pulsed 2450-MHz radiation on spontaneous lymphoblastoid transformation of human lymphocytes in vitro. *Bioelectromagnetics* 13(4):247-259.

14. Dabrowski et al (2003) – a study of the effects of low level pulse-modulated RF radiation.

B. Dr. Davis's testimony that PPL's AMI smart meter sends signals only 84 seconds a day is highly misleading. *Davis Rebuttal Testimony, March 26, 2018, p. 7 at 21-23*

This creates the false impression that the RF radiation is extremely low, infrequent, and harmless. But 84 seconds is based on time-averaging of many intense short signal bursts. Dividing the 84 second duration that Dr. Davis reports by 63 milliseconds equals 1,333 bursts per day. 84 seconds divided by 46 milliseconds equals 1,826 bursts per day. Dr. Davis also stated that the smart meter sends out a sine wave signal that lasts for 10 milliseconds at a time, but he did not state how many times in a 24 hour period. *Hearing Transcript April 2, 2018 p. 234 at 9-11* If that sine wave signal duration totals 84 seconds, that's 8,400 bursts a day.

My neighbors and I have measured emissions from recently installed PPL smart meters in our neighborhood. Using the hand held meter I brought to the April 2 hearing, I repeatedly timed smart meter signal spikes. They occurred approximately every 15 to 20 seconds. Bursts every 15 seconds equals 5,760 signals a day, and every 20 seconds equals 4,320 signals a day. In between those 15-20 second bursts I observed other spikes with small amplitudes. To better explain my observation below is an image which is representative of the intermittent bursts I observed from meters:



My safety concern stems from the adverse effects of intermittent spikes of peak energy, which is also reported in the scientific literature. For example, here is what one researcher wrote:

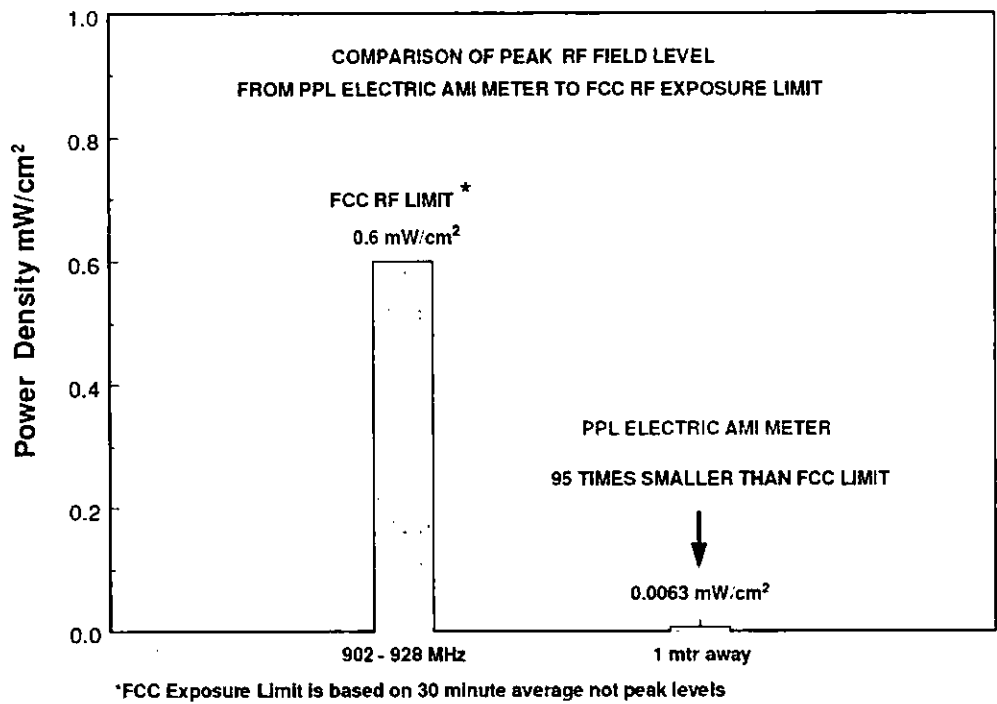
“Pulsed electromagnetic fields and radiofrequency Radiation (RFR) can have the devastating biological effect of disrupting homeostasis and desynchronizing normal biological rhythms that maintain health” Myers
Direct Testimony, Exhibit No. 8

Dr. David O. Carpenter, my expert witness at the April 2 hearing, testified that it is peak value and the on/off feature of AMI smart meters that is relevant, not the 84 second time averaging period provided by Dr. Davis. This could shed light on the “unknown aspect” of smart meters that have made people sick and file complaints before the PA PUC.

C. Dr. Davis’s PPL Exhibits CD-2-Myers through CD-7-Myers are highly misleading and share the same fatal flaws.

(continued, next page)

PPL Electric Exhibit CD-3 – Myers is irrelevant and meaningless for many reasons.



PPL Electric Exhibit CD-3 - Myers

It's an arithmetical distraction that offers no *biological* proof that 0.00063 mW/cm² emissions do not have adverse health effects on humans, such as infinitesimally small cells (85 million) or synapses (500 trillion) in the human brain.

It's a hypothesis that cannot stand against more than 4,000 scientific studies showing biological and adverse health effects from non-thermal RF radiation.

If FCC's RF limit of 0.6 mW/cm² is flawed, the 0.00063mW/cm² value is flawed.

It calculates RF exposure levels over a 30 minute period, not instantaneous bursts and peak intensities (spikes) of RF radiation. My concern with PPL's smart meter safety is the thousands of instantaneous, jack-hammer like intermittent peak values (spikes) of RF radiation over a 24 hour period.

The FCC 0.6 mW/cm² does not take into account simultaneous exposure from other smart meters and wireless devices and the cumulative effect of chronic exposure over many years, such as that from resting a laptop or tablet on one's lap while talking on a cell phone.

27 citations of scientific studies reporting adverse health effects at levels below the 0.00063 mW/cm² value shown in CD-3. When converted to mW/cm² the below values are all less than 0.00063 mW/cm² *Bioinitiative 2012 – Digital p. 101-10; Paper - Section I, 12-page Table*

As low as 10⁻¹³ or 100 femtowatts/cm²: Super-low intensity RFR effects at MW resonant frequencies resulted in changes in genes; problem with chromatin (DNA). Belyaev, 1997¹⁹

5 picowatts/cm² (10⁻¹²): Changed growth rates in yeast cells. Grundler, 1992

0.1 nanowatt/cm² (10⁻¹⁰) or 100 Super-low picowatts/cm² intensity: Super-low RFR effects at MW resonant frequencies resulted in changes in genes; problems with chromatin condensation (DNA) intensities comparable to base stations - Belyaev, 1997

0.00034 uW/cm²: Chronic exposure to mobile phone **pulsed RF** (my emphasis) significantly reduced sperm count. - Behari, 2006

0.0005 uW/cm²: RFR decreased cell proliferation at 960 MHz GSM 217 Hz for 30-min exposure Velizarov, 1999

0.0006 - 0.0128 uW/cm²: Fatigue, depressive tendency, sleeping disorders, concentration difficulties, cardio-vascular problems reported with exposure to GSM 900/1800 MHz cell phone signal at base station level exposures. - Oberfeld, 2004

0.003 - 0.02 uW/cm²: In children and adolescents (8-17 yrs.) short-term exposure caused headache, irritation, concentration difficulties in school. - Heinrich, 2010

¹⁹ A nanowatt is one billionth of a watt. A picowatt is one trillionth of a watt. A femtowatt is one quadrillionth of a watt. (Wikipedia - <https://en.wikipedia.org/wiki/Watt>)

0.003 to 0.05 $\mu\text{W}/\text{cm}^2$: In children and adolescents (8-17 yrs.) short-term exposure caused conduct problems in school (behavioral problems) - Thomas, 2010

0.005 $\mu\text{W}/\text{cm}^2$: In adults (30-60 yrs) chronic exposure caused sleep disturbances, (but not significantly increased across the entire population) - Mohler, 2010

0.005 - 0.04 $\mu\text{W}/\text{cm}^2$: Adults exposed to short-term cell phone radiation reported headaches, concentration difficulties (differences not significant, but elevated) - Thomas, 2008

0.006 - 0.01 $\mu\text{W}/\text{cm}^2$: Chronic exposure to base station RF (whole-body) in humans showed increased stress hormones; dopamine levels substantially decreased; higher levels of adrenaline and nor-adrenaline; dose-response seen; produced chronic physiological stress in cells even after 1.5 years. - Buchner, 2012

0.01 – 0.11 $\mu\text{W}/\text{cm}^2$: RFR from cell towers caused fatigue, headaches, sleeping problems – Navarro, 2003

0.01 – 0.05 $\mu\text{W}/\text{cm}^2$: Adults (18-91 years) with short-term exposure to GSM cell phone radiation reported headache, neurological problems, sleep and concentration problems Hutter, 2006

0.005-0.04 $\mu\text{W}/\text{cm}^2$: Adults exposed to short term-term cell phone radiation reported headaches, concentration difficulties (differences not significant, but elevated). Thomas, 2008

0.015 – 0.21 $\mu\text{W}/\text{cm}^2$: Adults exposed to short-term GSM 900 radiation reported changes in mental state (e.g. calmness) but limitations of study on language descriptors prevented refined word choices (stupefied, zoned –out) Augner, 2009

0.05-0.1 $\mu\text{W}/\text{cm}^2$: RFR linked to adverse neurological, cardio symptoms and cancer risk Khurana, 2010

0.05 – 0.1 $\mu\text{W}/\text{cm}^2$: RFR related to headache, concentration and sleeping problems, fatigue Kundi, 2009

0.07 – 0.1 $\mu\text{W}/\text{cm}^2$: Sperm head abnormalities in mice exposed for 6-months to base station level RF/MW. Sperm head abnormalities occurred in 39% to 46% exposed mice (only 2% in controls) abnormalities was also found to be dose dependent. The implications of pin-head and banana-shaped sperm head. The occurrence of sperm head observed increase occurrence of sperm head abnormalities on the reproductive health of humans living in close proximity to GSM base stations were discussed Otitoloju, 2010

0.38 $\mu\text{W}/\text{cm}^2$: RFR affected calcium metabolism in heart cells. Schwartz, 1990

0.08 – 10 $\mu\text{W}/\text{cm}^2$: RFR caused emotional behavior changes, free-radical damage by super-weak MWs Akoev, 2002

0.13 $\mu\text{W}/\text{cm}^2$: RFR from 3G cell towers decreased cognition, well-being. Zwamborn, 2003

0.16 $\mu\text{W}/\text{cm}^2$: Motor function, memory and attention of school children affected (Latvia). Kolodynski, 1996

0.168-1.053 $\mu\text{W}/\text{cm}^2$: Irreversible infertility in mice after 5 generations of exposure to RFR from an 'antenna park'. Magras & Zenos, 1997

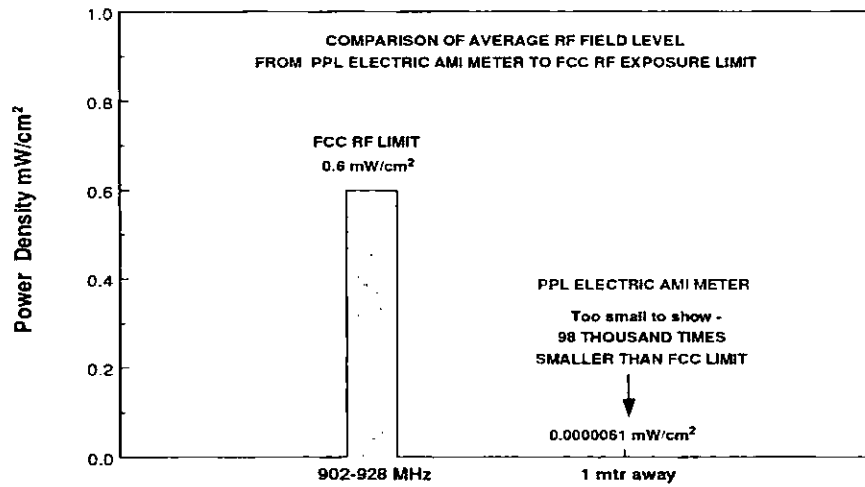
0.2 – 8 $\mu\text{W}/\text{cm}^2$: RFR caused a two-fold increase in leukemia in children Hocking, 1996

0.2 – 8 $\mu\text{W}/\text{cm}^2$: RFR decreased survival in children with leukemia Hocking 2000

0.21 – 1.28 $\mu\text{W}/\text{cm}^2$: Adolescents and adults exposed only 45 min to UMTS cell phone radiation reported increases in headaches. Riddervold, 2008

0.5 $\mu\text{W}/\text{cm}^2$: Significant degeneration of seminiferous epithelium in mice at 2.45 GHz, 3-40 min Saunders, 1981

D. Davis Exhibit CD-2 is irrelevant and meaningless for many reasons:



PPL Electric Exhibit CD-2 - Myers

It's an arithmetical distraction that offers no *biological* proof that 0.0000061 mW/cm² emissions do not have adverse health effects on humans, such as infinitesimally small cells (85 million) or synapses (500 trillion) in the human brain. *Myers Direct Testimony, p. 3 at 6-7*

It's a hypothesis that cannot stand against more than 4,000 scientific studies showing biological and adverse health effects from non-thermal RF radiation.

If FCC's RF limit of 0.6 mW/cm² is flawed, the 0.0000061mW/cm² value is flawed.

It calculates RF exposure levels over a 30 minute period, not instantaneous bursts & peak values (spikes) of RF radiation. My concern with PPL's smart meter safety in particular is the thousands of instantaneous, jack-hammer like intermittent peak values (spikes) of RF radiation over a 24 hour period.

The FCC 0.6 mW/cm² does not take into account simultaneous exposure from other smart meters and wireless devices and the cumulative effect of chronic exposure over many years.

Adverse health effects have been reported to occur at levels below the 0.0000061 mW/cm² value shown.

Below are 11 such studies:

When converted to mW/cm²

the values below are all less than 0.0000061 mW/cm²

As low as 100 femowatts/cm²: Super-low intensity RFR effects at MW resonant frequencies resulted in changes in genes; problems with chromatin conformation (DNA) Belyaev, 1997

5 picowatts/cm² : Changed growth rates in yeast cells. Grundler

nanowatt/cm²(10⁻¹⁰) or 100 Super-low picowatts/cm² intensity: Super-low RFR effects at MW resonant frequencies resulted in changes in genes; problems with chromatin condensation (DNA) intensities comparable to base stations - Belyaev, 1997

0.00034 uW/cm² : Chronic exposure to mobile phone pulsed RF significantly reduced sperm count – Behari, 2006

0.0005 uW/cm² : RFR decreased cell proliferation at 960 MHz GSM 217 Hz for 30-min exposure Velizarov, 1999

0.0006 - 0.0128 uW/cm² : Fatigue, depressive tendency, sleeping disorders, concentration difficulties, cardio-vascular problems reported with exposure to GSM 900/1800 MHz cell phone signal at base station level exposures. - Oberfeld, 2004

0.003 - 0.02 uW/cm²: In children and adolescents (8-17 yrs) short-term exposure caused headache, irritation, concentration difficulties in school. - Heinrich, 2010

0.003 to 0.05 uW/cm²: In children and adolescents (8-17 yrs) short-term exposure caused conduct problems in school (behavioral problems) - Thomas, 2010

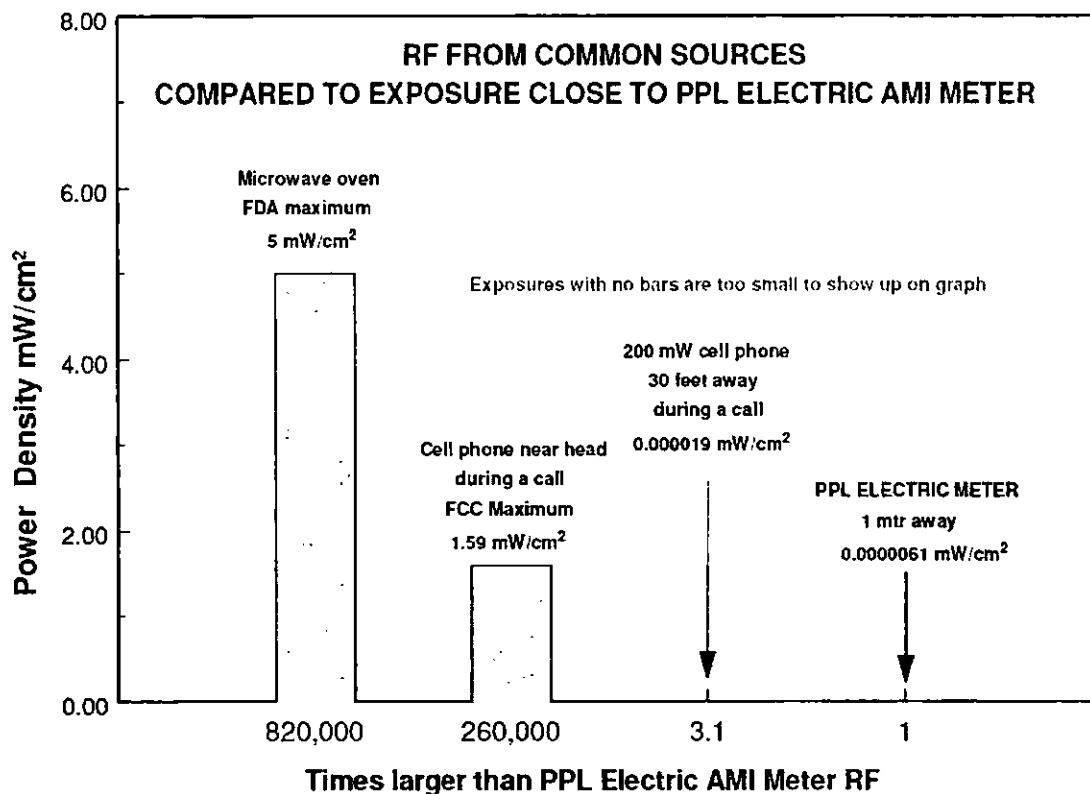
0.005 uW/cm²: In adults (30-60 yrs) chronic exposure caused sleep disturbances, (but not significantly increased across the entire population) - Mohler, 2010

0.005 - 0.04 uW/cm²: Adults exposed to short-term cell phone radiation reported headaches, concentration difficulties (differences not significant, but elevated) - Thomas, 2008

0.006 - 0.01 uW/cm²: Chronic exposure to base station RF (whole-body) in humans showed increased stress hormones; dopamine levels substantially decreased; higher levels of adrenaline and nor-adrenaline; dose-response seen; produced chronic physiological stress in cells even after 1.5 years. - Buchner, 2012

(continued, next page)

E. PPL Exhibit CD-4 is incorrect and meaningless for many reasons:



PPL Electric Exhibit CD-4 - Myers

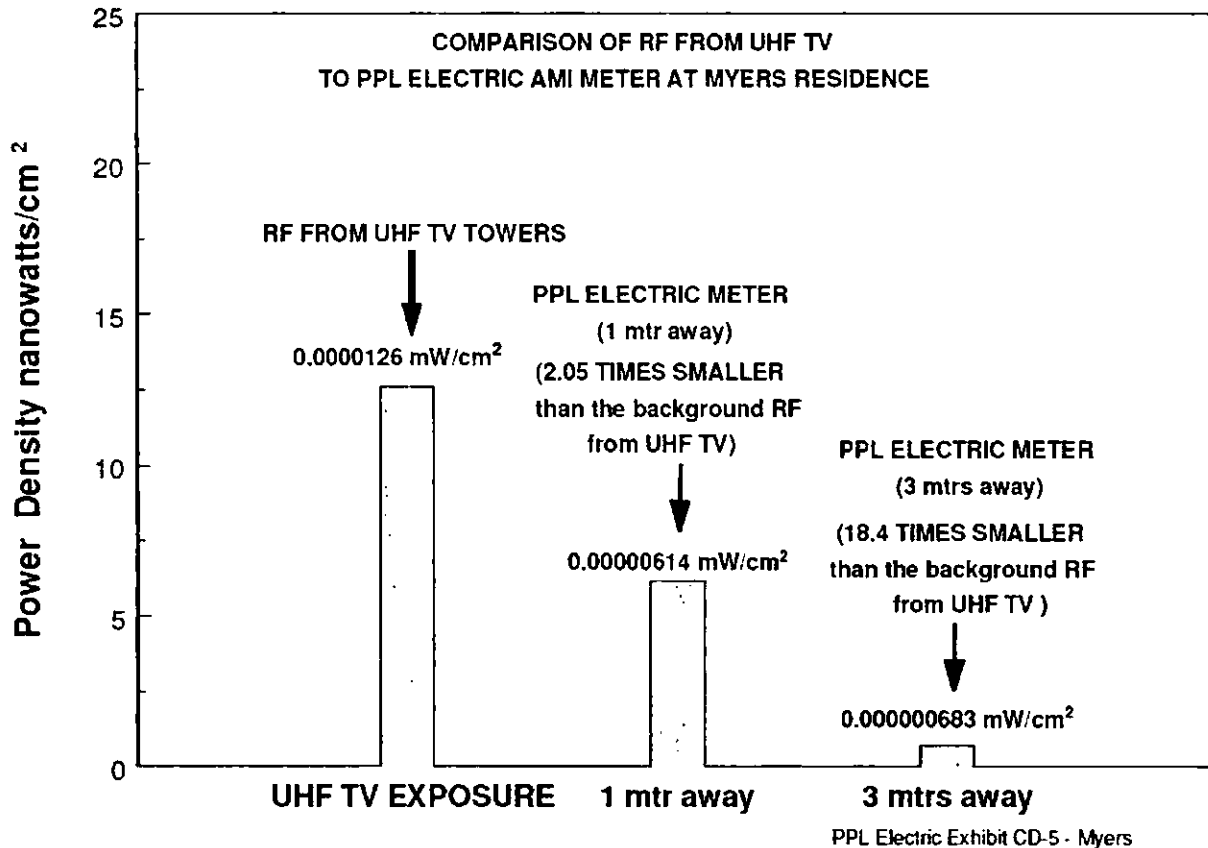
I do not own a microwave oven and rarely use one. If I do use a microwave oven I quickly walk away and don't approach it until the microwave oven has turned itself off.

I do not hold a cell phone to my head, ever. I do not use Bluetooth. I use the speaker phone or air-tube headset and keep the cell phone as far away from my body as feasible.

Adverse health effects have been reported to occur at levels below the 0.0000061 mW/cm² value shown. (See my studies listed in Exhibit CD-2-Myers above.)

(continued, next page)

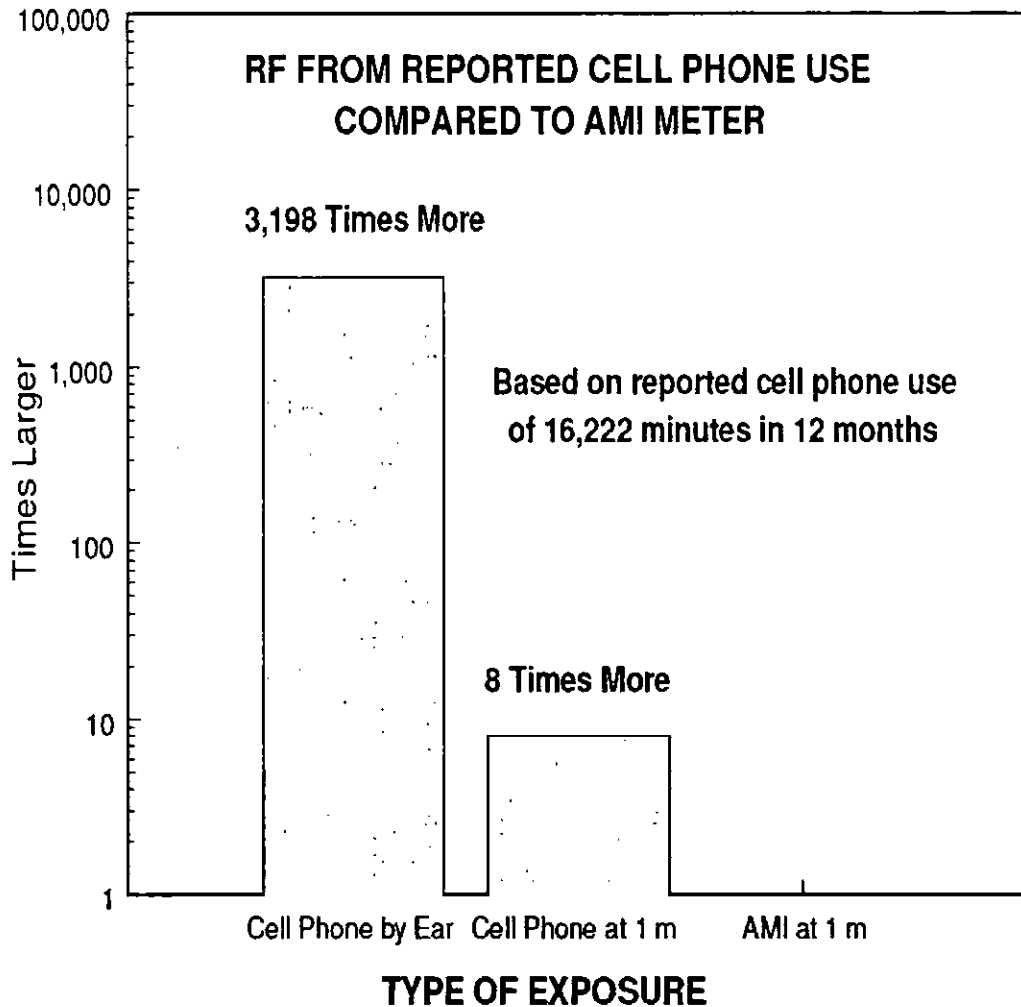
F. PPL Electric Exhibit CD-5-Myers provides more reason to reduce RF exposure



The UHF TV tower is one of many sources of the non-thermal RF radiation people are involuntarily exposed to every day. My living close to the TV tower gives me more reason to reduce my RF exposure from a smart meter which would send its signals into my home thousands of times each day, 365 days a year.

(continued, next page)

G. PPL Electric Exhibit CD-6 –Myers is based on erroneous information.



PPL Electric Exhibit CD-6 - Myers

I do not hold a cell phone to my head, ever. I do not use Bluetooth. I use the speaker phone or air-tube headset.

When using the air-tube headset or speaker phone I place the phone as far away from my body as feasible.

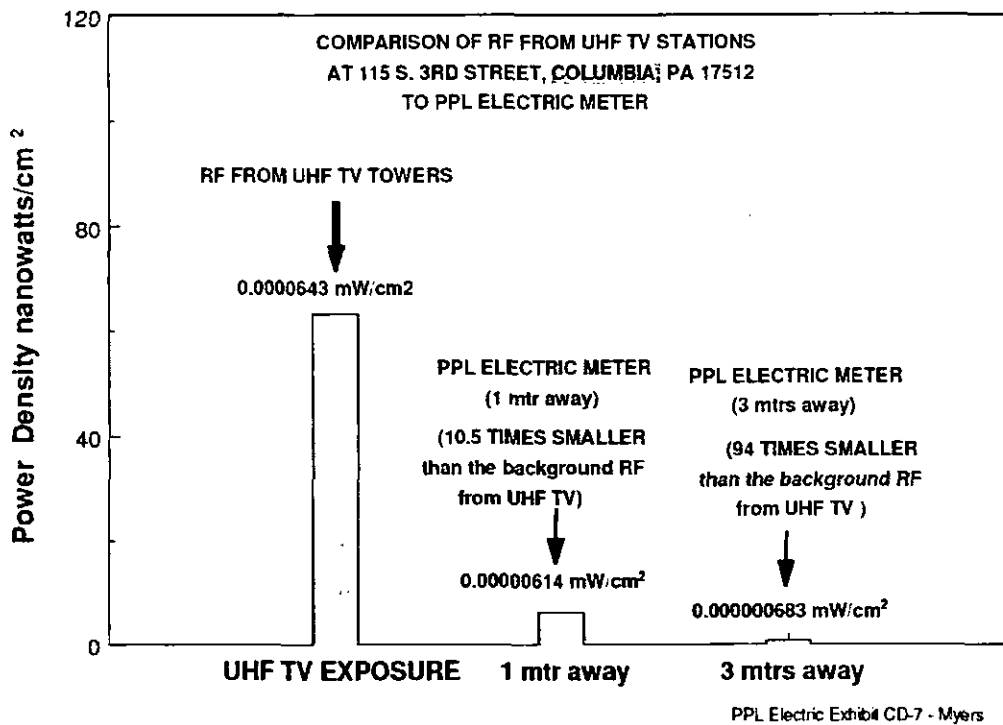
I do not carry my cell phone on my body. If I have to put it in my pocket I always turn it off.

I have made my home as EMF quiet as I know how. I do not have Wi-Fi and I use hard wire ethernet cable to connect to the internet. I do not use a microwave.

I have a hard wire connection from my computer to my printer.

I have silenced my remote sensors on my home security system

H. PPL Electric Exhibit CD-7 - Myers provides more reason to reduce RF exposure

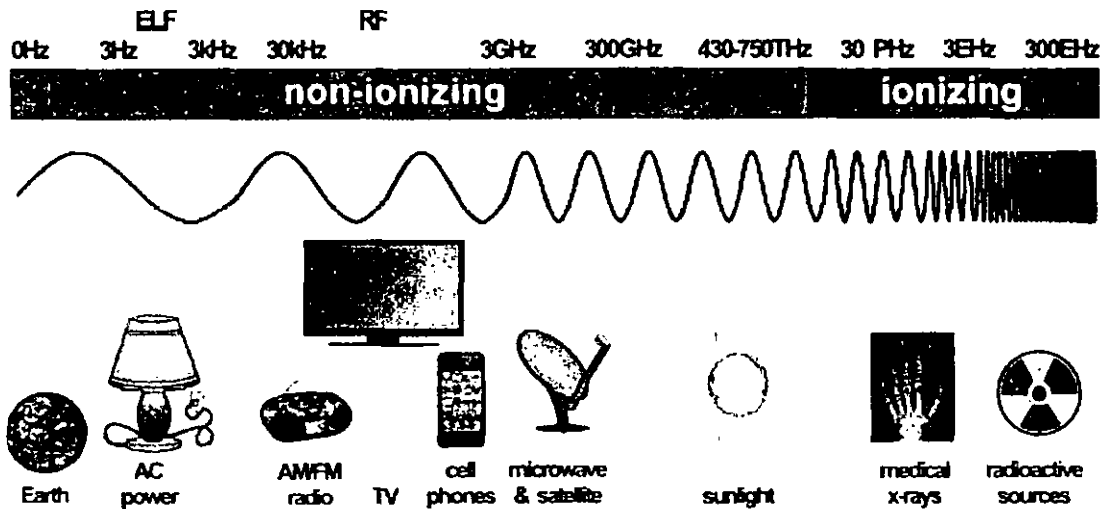


The UHF tower adds to the daily exposure of occupants.

CD-7 does not take into account the simultaneous exposure from other smart meters and wireless devices and the cumulative effect of chronic exposure over **many** years.

(continued, next page)

THE ELECTROMAGNETIC SPECTRUM



PPL Electric Exhibit CD-1 - Myers

I. PPL Electric Exhibit CD-1 - Myers

The natural resonance at the earth's surface is fundamentally 7.83 Hz (cycles per second)²⁰. In this low frequency range human beings and other living organism evolved and adapted, not in the 902 million to 928 million Hz frequencies from artificial man-made radiation emitted by AMI smart meters. The earth's 7.83 Hz value with its longer and smoother sine wave provides context when considering the health impact of pulsed 902-928 MHz

J. Dr. Davis's testimony that Mr. Myers has mischaracterized the 30-minute averaging component in the FCC exposure standard is a false statement. *Davis Rebuttal Testimony, March 26, 2018, p10 at 9-15*

I did not mischaracterize the FCC in my statement. Except for tissue heating, the FCC does NOT acknowledge adverse health effects from non-thermal RF radiation. Below is the FCC's 30-

²⁰ https://en.wikipedia.org/wiki/Schumann_resonances

minute limit for maximum permissible exposure which was the basis for my statement.²¹

Federal Communications Commission

Office of Engineering & Technology

OET BULLETIN 65

Edition 97-01

August 1997

Table 1. LIMITS FOR MAXIMUM PERMISSIBLE EXPOSURE (MPE)

(B) Limits for General Population/Uncontrolled Exposure

Frequency Range (MHz)	Electric Field Strength (E) (V/m)	Magnetic Field Strength (H) (A/m)	Power Density (S) (mW/cm ²)	Averaging Time E ² , H ² or S (minutes)
0.3-1.34	614	1.63	(100)*	30
1.34-30	824/f	2.19/f	(180/f ²)*	30
30-300	27.5	0.073	0.2	30
300-1500	--	--	f/1500	30
1500-100,000	--	--	1.0	30

I stand by my statement that the latency period for cancers and other illnesses is not 30-minutes.

I conclude that FCC's 30-minute maximum permissible exposure does not protect me from the cumulative exposure to non-thermal RF radiation over many years.

K. Dr. Davis testimony that Mr. Myers is incorrect when he claims FCC's RF exposure standard ignores exposures from cell phones and smart meters. *Hearing Transcript April 2, 2018, p.10 at 16-20.*

²¹ http://transition.fcc.gov/Bureaus/Engineering_Technology/Documents/bulletins/oet65/oet65.pdf

Dr. Davis appears to be missing my point. My point is that the RF radiation emitted by cell phone towers, cell phones, wi-fi, lap tops, tablets, security systems, baby monitors, smart meters, smart meter banks, and other wireless technologies in the last 25 years has immersed us in a sea of artificial, man-made RF radiation vastly greater than existed when the Guidelines were adopted in 1996 .

Quoting a passage from Bioinitiative 2012:

“Original extra-planetary sources of microwave radiation were infinitesimally small, on the order of a billionth of a microwatt per centimeter squared (10 –12uW/cm2). Human evolution took place without any appreciable exposure to microwave radiation from background sources. The human body has no evolutionary protection against microwave radiation, as it does for ultraviolet radiation from the sun (Johannson, 2000). Wireless voice and communications have introduced unprecedented levels of public exposure in the last decade.”Bionitiative 2012, SECTION 1, 2014 Supplement, Article 1C, Digital page 1,473

L. Dr. Davis' testimony that Mr. Myers claims that Federal Agencies in the U.S. have concluded that the FCC's RF exposure guidelines are not adequate to protect the public. Health is flawed. *Davis Rebuttal Testimony, March 26, 2018 p.11 at 1-12*

To be accurate, my statement reads:

“In the United States an ever increasing number of Federal, state and municipal officials, agencies and professional organizations have concluded that FCC's 1996 thermal Guidelines are obsolete and do not adequately protect the public.”
(*underlining is my own*) *Myers Direct Testimony, April 2, 2018 Hearing p.12 at 1-16*

The Federal officials are from the Department of the Interior and the EPA. *Myers Direct Testimony, April 2, 2018 Hearing, Exhibit 12 and Exhibit 13.* Other authorities include the American Academy of Pediatrics, the American Academy of Environmental Medicine, Maryland's Children's Environmental Health and Protection Advisory Council, the California

Department of Public Health, the City and County of San Francisco, the City and County of Pembroke Pines, FL, and the city of Jackson Hole, WY. *Myers Direct Testimony, April 2, 2018 Hearing, Exhibits 14, 15, 16, 17, 18, 19, 20, 21*

Additionally, on that point:

The US Government Accountability Office published a report in 2012 urging the US Federal Communications Commission to revisit the outdated safety standards for the exposure from wireless devices. *Bioinitiative 2012 – Digital p. 139; Paper Section 4, p. 2*

As long ago as December, 1979, NIOSH and OSHA recommended that precautionary measures be instituted to minimize the risk to workers from unwarranted exposure to RF energy.²²

In 2007, The U.S. Food and Drug Administration (FDA) of the Department of Health and Human Services asked the National Academies of Sciences to organize a workshop of national and international experts to identify research needs and gaps in knowledge of biological effects and adverse health outcomes of exposure to radiofrequency (RF) energy from wireless communications devices. *Bionitiative 2012 Digital p. 162; Paper SECTION 24, p. 25*

In February 2000 the FDA made a recommendation to the NIH/NTP urging that RF be tested for carcinogenicity. *Bioinitiative 2012 – Digital p. 162; Paper Section 4, p.25*

M. Dr. Davis stated that FCC's position on the safety of RF radiation reflects the consensus of independent scientists who are experts in radio frequency bioelectromagnetics. *Davis Rebuttal Testimony dated March 26, 2018, pages 10, at 6-8*

²² <https://www.cdc.gov/niosh/doc/80-107/default.html>

This statement is patently false. The safety of non-thermal RF radiation safety is one of the most hotly contested issues of our time. It is just plain wrong to claim that there is scientific consensus on the safety of non-thermal RF radiation when there is overwhelming scientific evidence to the contrary.

Thousands of research scientists have reported adverse effects from non-thermal RF radiation:

2,311 published studies in the U.S. Navy's 1972 Bibliography (footnote) reporting approximately 145 adverse effects and clinical manifestations from RF radiation. *Myers Direct Testimony, Exhibit No. 4 of Myers Direct Testimony*

1800 new studies reporting adverse health effects from non-thermal RF radiation in the 5-year period 2007-2012 *Myers Direct Testimony, Exhibit No. 3 of Myers Direct Testimony*

Dr. Martin Pall's list of 15 studies. *Myers Direct Testimony, Exhibit No. 5 of Myers Direct Testimony*

16 nations have concluded NCRP, ICNIRP and FCC guidelines do not adequately protect the public and are taking actions to mitigate public risk. *Exhibit No. 22 of Myers Direct Testimony*

Those countries are: France, Belgium, Spain, Israel, Australia, Italy, Switzerland, Germany, Austria, United Kingdom, India, Russia, Canada, Finland, Namibia and Cyprus

Here are some more examples since 2007 in which countless studies have repeatedly shown effects from non-thermal radiation more often than studies showing no effects. *Bioinitiative 2012 – Digital p. 60-61 ; Paper Section 1, p. 16-17*

Eighty six (86) new papers on genotoxic effects of RFR published between 2007 and mid-2012 are profiled. Of these, 54 (63%) showed effects and 32 (37%) showed no effects (Lai, 2012)

Forty three (43) new ELF-EMF papers and two static magnetic field papers that report on genotoxic effects of ELF-EMF published between 2007 and mid-2012 are profiled. Of these, 35 (81%) show effects and 8 (19%) show no effect. (Lai, 2012 – Section 6).

One hundred fifty five (155) new papers that report on neurological effects of RFR published between 2007 and mid-2012 are profiled. Of these, 98 (63%) showed effects and 57 (37%) showed no effects.

Sixty nine (69) new ELF-EMF papers (including two static field papers) that report on genotoxic effects of ELF-EMF published between 2007 and mid-2012 are profiled. Of these, 64 (93%) show effects and 5 (7%) show no effect. (Lai, 2012)

And two more examples from my Direct Testimony for the April 2 hearing.

50% of 326 studies showed a biological effect from RF radiation and 50% did not. *Exhibit No.25, Myers Direct Testimony*

One-third of industry studies showed harmful effects from microwave radiation beyond skin-heating and 70% of non-industry studies showed definitive non-thermal damage to humans. *Exhibit No.26 Myers Direct Testimony*

Professional bodies from technical societies like IEEE and ICNIRP conduct scientific reviews with panels heavily burdened with industry experts and under-represented by public health experts and independent scientists *Bioinitiative 2012 – Digital p.136; Paper Section 3, p. 8.*

If independent peer reviewed studies reporting adverse health effects due to non-thermal RF radiation are censored by pro-industry members, the conclusions of those voting members will be skewed.

N. Dr. Davis quoted FDA as saying “The weight of scientific evidence has not linked cell phones with any health problems”. *Davis Rebuttal Testimony, March 26, 2018, p.11 at 19-20*

I totally disagree because evidence shows otherwise:

In March 2018 it was announced that eleven experts convened by the National Toxicology Program made another review of the NTP cell phone study. They concluded there was “clear” evidence that exposure to cell phone radiation caused cancer in rats. Quoting from the government site:²³

“Panel 2 voted to recommend (8 yes, 3 no, 0 abstentions) the conclusion, clear evidence of carcinogenic activity of male Hsd:Sprague Dawley SD rats based on incidences of malignant schwannoma in the heart.”

In seven instances this expert group of government appointed scientists upgraded evaluations of evidence from earlier reviews of the draft. According to a former NTP scientist, “There was never a time when so many upgrades were recommended.”²⁴

IARC classified non-thermal RF radiation from cell phone use as a Group 2B possible carcinogen. *Biointiative 2012 – Digital p. 49 and 141; Paper Section 1 (2012 Supplement) p.5 and Section 1(2014 Supplement) Part III A, Recommendations*

If the weight of evidence was that cell phone use was not carcinogenic, IARC would have classified it as Group 3 (no evidence of it being a carcinogen) or Group 4 (strong evidence it is not a carcinogen)

The FDA statement pertains to cell phones and is not relevant. *My issue before the PUC is smart meters and the thousands of intermittent pulses they emit with spikes of peak intensity they emit in a 24-hour period.*

²³ https://ntp.niehs.nih.gov/ntp/about_ntp/trpanel/2018/march/actions20180328_508.pdf

²⁴ <https://www.saferemr.com/2018/01/national-toxicology-program-peer-public.html>

O. Dr. Davis stated that: 1) there is no reliable scientific basis for a mechanism by which RF fields could cause effects in the human body other than heating, i.e. thermal effect, and 2) there is no generally accepted mechanism by which RF fields could cause biological effects on the human body other than through heating. *Davis Rebuttal Testimony, March 26, 2018*

p. 12 at 20-22, p. 13 at 4-5.

This is a very weak argument. Just because a mechanism is invisible to a researcher, *does not mean it is invisible to the human body.*

One of many researchers who would disagree with Dr. Davis is Dr. Martin Blank, a world-renowned researcher and authority on health effects of electromagnetic radiation and a Professor at Columbia University from 1959 to 2011²⁵. He has published over 200 papers and reviews, as well as twelve edited books on electrical properties of biological systems. He also authored Bioinitiative Report 2012 Supplement SECTION 7 entitled *The Cellular Response: EMF-DNA Interaction* and provided over 60 citations to support his conclusions.

One of Dr. Blank's conclusions in SECTION 7 regards mechanism and I quote it as follows
Bioinitiative 2012, Digital p.391; Paper SECTION 7, p.16:

“Research has shown that EMF-activated cellular stress response mechanism involves direct interaction of EMF with the DNA molecule (claims that there are no known mechanisms of interaction are patently false)” *Bioinitiative 2012, Digital p. 391, Paper SECTION 7, p. 16*

Additionally, I cite two other arguments from authors of Bioinitiative 2012:

²⁵ <http://www.physiology.columbia.edu/MartinBlank.html>

We know mechanisms of action for some carcinogenic substances, but for most cancers we know neither the environmental trigger nor the mechanism of action. So there is no reason to negate the evidence that EMFs cause cancer just because we do not know a single mechanism to explain it's mode of action.” *Id. Digital p. 1,392; Paper SECTION 24, p. 19*

Finally, factual evidence of adverse health effects from thousands of studies trump the argument that the mechanism of action is unknown. As my expert witness Dr. Carpenter stated at the April 2 hearing:

“It’s, of course, desirable to have a clear understanding of the mechanism of action. But that is not a requirement for quality research, once you demonstrate a consistent effect”. *Hearing Transcript April 2, 2018 p. 78 at 21 to n. 79 at 4*

P. Dr. Davis’ testified that while some researchers have reported biological changes associated with RF energy, these studies have failed to be replicated. *Id. Page 247 at 22-24*

This sweeping statement is false. The more than 4,000 studies I cited replicate the finding of biological or adverse effects from RF radiation. That is the central question on which to be ruled upon in this proceeding: Does non-thermal RF radiation emitted by PPL’s AMI smart meter have adverse health effect that could damage my health. Many studies which report adverse health effects from non-thermal RF radiation have replicated earlier studies.

The Hardell studies (Hardell et al, 2002, 2003, Hardell et al 2005, 2006a) reported brain cancer glioma and acoustic neuroma from cell phone use and which IARC used to categorize non-thermal RF energy from as a Group 2B possible human carcinogen. Also, several international laboratories have replicated studies showing adverse effects on sperm quality, motility and pathology in men who use and particularly those who wear a cell phone, PDA or pager on their belt or in a pocket - Agarwal et al, 2008; Agarwal et al, 2009; Wdowiaket al,

2007; De Iuliis et al, 2009; Fejes et al, 2005; Aitken et al, 2005; Kumar, 2012 *Bioinitiative 2012* – *Digital p. 51, Paper SECTION 1, p.7*

But even more important is the fact that if a particular study is not reproducible through a follow up study, that should not automatically invalidate the original study. Quoting from Bioinitiative 2012:

“There are several levels of proof for adverse effects of environmental exposures. The most rigorous is a scientific standard, where virtual proof of causation is typically required by scientists to arrive at consensus about an effect. This approach works best in physics and chemistry. In biological systems this is rarely possible”. *Id. Disc p. 1,475; Paper Appendix 20-B, page 7.*

“Unlike drugs, EMFs are absorbed in a variety of different, diverse and non-linear ways depending on the “microenvironment” receiving the radiation, the orientation of the molecular targets and their shape, the metabolic state at the moment of exposure, the energy absorbance at the microscale of the cell and the modulation of the waves. On this basis, it is rather difficult to replicate experiments under different conditions and cell systems, which may explain the discrepancy of the results among research groups.” *Id. Disc p. 208; Paper SECTION 5 (2012 Supplement) - Conclusions, Part 1.*

Q. Dr. Davis testified that in adopting its exposure limits, the FCC consulted with the FDA, EPA, OSHA and NIOSH and each supported the FCC setting its exposure limits based on the exposure guidelines issued by these expert organizations. *Davis Rebuttal Testimony, March 26, 2018, p. 11 at 1-12*

However, FCC’s 1996 Guidelines and these organization endorsements are woefully obsolete. They were based on old radar research conducted more than 25 years ago or longer. That was before the proliferation of wireless devices such as cell phones, cell phone towers, laptops, i-pads,

WiFi, Bluetooth, automobile radars, security monitors, baby monitors, etc. In endorsing the FCC Guidelines those Agencies, like the FCC, ignore the fact that people today are immersed in a ubiquitous sea of man- made RF radiations much greater than existed in 1996.

The GAO acknowledges the obsolescence problem and published a report in 2012 which stated the following²⁶:

“The Federal Communications Commissions (FCC) RF energy exposure limit may not reflect the latest research, and testing requirements may not identify maximum exposure in all possible usage conditions. FCC set an RF energy exposure limit for mobile phones in 1996, based on recommendations from federal health and safety agencies and international organizations. These international organizations have updated their exposure limit recommendation in recent years, based on new research, and this new limit has been widely adopted by other countries, including countries in the European Union. (underlining my own) FCC should formally reassess and, if appropriate, change its current RF energy exposure limit and mobile phone testing requirements related to likely usage configurations, particularly when phones are held against the body.”

Quoting further from the Report:

FCC told GAO that it relies on the guidance of federal health and safety agencies when determining the RF energy exposure limit, and to date, none of these agencies have advised FCC to change the limit. However, FCC has not formally asked these agencies for a reassessment. By not formally reassessing it's current limit, FCC cannot ensure it is using a limit that reflects the latest research on RF energy exposure”¹ *Id. Digital, p. 139-140; Paper SECTION 4, p. 2-3*

²⁶ <https://www.gao.gov/products/GAO-12-771>

3. Dr. Israel's written and oral testimonies are wrong on numerous and very crucial points.

A. Dr. Israel's testimony that a particular study is not considered scientifically reliable in the absence of robust results that can be reproduced by other laboratories *Israel Rebuttal Testimony, March 26, 2018, p. 8 at 11-13.*

“**That is simply not true**”, according to Dr. David O. Carpenter, who was my expert witness at the April 2 hearing. Dr. Carpenter states that the Bioinitiative Report does show that observations have been replicated “**again and again and again**”. *Hearing Transcript April 2, 2018, p. 79 at 7-12* Dr. Carpenter is a graduate of Harvard Medical School and has many more years' experience evaluating research studies and editing scientific journals than does Dr. Israel. Dr. Carpenter authored or co-authored approximately 435 research papers, *Myers Direct Testimony, Exhibit No.2* nearly 200 more than the 245 Dr. research papers that Dr. Israel reports.”

I identified in my written and oral testimonies over 4,000 scientific studies which report biological or adverse health effects from non-thermal RF radiation. *Hearing Transcript April 2, 2018, p.11 at 12-13*

That is replication and a central question in this proceeding - does non-thermal RF radiation create adverse health effects and can it damage a person's health? The studies I cite and the 407 I listed in Appendix A is unequivocal proof.

Many other independent scientists in RF radiation research do not agree that failure to replicate a biological study invalidates a positive study as Dr. Israel (and Dr. Davis) assert. This is especially the situation in biology involving living organism, particularly when you are studying infinitesimally small cells – 85 million in the human brain alone. *Myers Direct Testimony p. 3 at 6.*

According to Dr. Martin Blank, a renowned Columbia University researcher and expert on the health-related effects of electromagnetic fields **“it is very difficult to actually replicate a biological experiment.”** *Bioinitiative 2012, Digital p 351, Paper SECTION 7, p. 15* Dr. Blank cites examples of peer reviewed research studies which do not replicate but asserts that is not uncommon in biological research. *Id. p.370-375 Table 1; Paper SECTION 7, p. 34-39.*

Quoting Dr. Blank:

“We should be reminded that ‘scientific proof’ is not symmetric (Popper, 1959). One cannot prove that EMF is harmless no matter how many negative results one presents. One single reproducible (significant) harmful effect would outweigh all the negative results.” *Id. Digital p. 350; Paper SECTION 7, p.*

Carrying Dr. Israel’s point to its logical conclusion, suppose after Columbus discovered the New World a subsequent explorer tried but could not find the New World, gave up and returned to Spain. Would Spain invalidate Columbus’ discovery because the second explorer did not replicate it?

B. Dr. Israel writes that hundreds of studies have been conducted which do not show that RF radiation causes or contributes to diseases and conditions. He also cites 14 studies from the period 2003 to 2010. *Israel Rebuttal Testimony, March 26, 2018, p. 8 at 16 through p. 13 at 16.*

The number of negative studies Dr. Israel cites is far less than the more than 4,000 positive studies I identified in my Direct Testimony. *Myers Direct Testimony, Exhibits 3, 4, 5, 8)* But more importantly, Dr. Israel’s does not state if the studies he cited pertained to smart meters and frequency hopped spread spectrum emissions. Dr. Israel’s refusal to acknowledge the results of thousands of scientific studies reporting adverse health effects from non-thermal RF radiation is

an extreme view and undermines his credibility.

C. Dr. Israel testified that the Bioinitiative Report lacks balance and scientific objectivity.

Israel Rebuttal Testimony, March 26, 2018 p.14 at 21 to p. 15 at 3

Dr. Carpenter, co-editor of the Bioinitiative Report responded: ***“I totally disagree with that.”*** *Hearing Transcript April 2, 2018, p. 76 at 5.* Dr. Carpenter testified that the numerous scientists cited in the Bioinitiative Report are the ***“active investigators in the field of non-thermal RF radiation research”***. *Id. p.75 at 15-17.* So it is entirely proper to publish positive results if those were the results. But the authors of the Bioinitiative Report also cite research that doesn't find positive effects as well. Dr. Carpenter testified that in the Bioinitiative Report ***“the weight of evidence is consistent with the conclusion that excessive exposure to radiofrequency and frequency like magnetic fields is associated with adverse health effects, including elevation of cancer of the nervous system and so forth”***. *Id. p.78 at 6-12*

If lawmakers knew the large numbers of compelling peer reviewed research studies that report harm from non-thermal RF radiation the PA Legislature would never have enacted HB 2200/Act 129 or made smart meters mandatory.

I respectfully request that the PA PUC officials ruling on my complaint please examine the Bioinitiative 2012 report and decide for yourselves whether the Report is an honest and fair presentation of the scientific literature on the safety of non-thermal radiation. SECTION 6 contains over 60 pages which list both positive and negative studies. SECTION 1 (2014 Supplement) and SECTION 24 (Public Health Policy Recommendations) are highly relevant and warrant consideration by the PA PUC for making a ruling on my case.

D. Dr. Israel's testimony that the Bioinitiative has been criticized by a number of public health authorities and expert groups. *Israel Exhibit MI 2 – Myers, p.4*

Dr. Carpenter states that the intensity with which the Bioinitiative Report has been criticized is an indication of how important the Report has been in raising the awareness from this huge amount of literature. *Hearing Transcript April 2, 2018, p. 74 at 17-23.*

I submit that the significance of the Bioinitiative Report is not unlike the famous Pentagon Papers which caused the public and many officials to change their views on the Vietnam War. For similar reasons the Bioinitiative 2012 report is criticized by industry advocates. Science is supposed to be a cooperative effort in reaching scientific truth. The Bioinitiative Report should not be rejected by scientists for providing evidence essential for officials to make public health decisions. The Bioinitiative Report has been read and received praise worldwide and provided information that guided officials in 16 countries and the USA to take precautionary measures to reduce the public's exposure to non-thermal RF radiation *Myers Direct Testimony p.12 at 1-23*

E. Dr. Israel testified that Dr. Martin Pall's 155 studies do not show that RF fields from smart meters can cause adverse health effects. *Israel Rebuttal Testimony, March 26, 2018 p.16 at 11-23*

This statement is highly misleading. Dr. Pall's studies were not about smart meters. His 155 studies documented various health effects from non-thermal radiation from wireless devices in general. The studies cite thousands upon thousands of references with supporting evidence. Are we to believe that Dr. Israel knows more than these 155 researchers and the authors of the thousand or more supporting citations? I respectfully submit that Dr. Israel's blithe dismissal of these 155 studies, the 2,311 studies in the Navy Bibliography, and 1,800 new studies that the Bioinitiative 2012 reports were published between 2007 and 2012 is evidence of bias and an extreme view.

Dr. Israel also discredited the 155 studies because I did not include any information about the design of the studies and their research criteria. *Israel Rebuttal Testimony, March 26, p. 16 at 19-*

23. That does not invalidate the studies, particularly those which were peer reviewed. The purpose of my citing the 155 studies was to provide a list of peer reviewed studies reporting non-thermal effects from RF radiation rather than a lengthy analysis.

Dr. Martin Pall is Professor Emeritus of Biochemistry and Basic Medical Sciences at Washington State University and is a recognized expert on how wireless radiation impacts electrical systems in our bodies.²⁷ If Dr. Pall's studies are flawed, Dr. Israel should present evidence of such.

F. Dr. Israel testified that the report on electro-hypersensitivity (EHS) and multiple chemical sensitivity (MCS) does not provide any data to show that exposure to RF fields can cause MCS. *Israel Rebuttal Testimony, March 26, 2018 p.18 at 10-18. Note: Dr. Israel is referring to Exhibit 8 of Myers Direct Testimony*

This statement is false. I count over 30 citations that the author cites from a list of 58 references on page 302 of the study. For example, Reference No. 11- *Belpomme D, Irigary P. Electro-hypersensitivity and multiple chemical sensitivity: two clinic-biological entities of the same disorder?* One conclusion of this study addresses pulsed RF and is quoted below:

“Standards must regulate pulsed RF in a fashion that does not include time averaging, but recognizes that pulsed RF, even at very low intensities, is biologically active and harmful to health.”

G. Dr. Israel testified that neither the IARC or WHO concluded that RF fields from smart meters caused cancer. *Id. p. 19 at 5-7*

This statement is misleading. The IARC did not study smart meters and their pulsed/frequency hopping spread spectrum. The study being discussed focused on cell phone risks. WHO/IARC

²⁷ <https://ehtrust.org/wp-content/uploads/Pall-Letter-to-CalLegis-FINAL-8-7-17.pdf>

classified RF fields as possibly carcinogenic to humans (Group 2B) “based on an increased risk for glioma, a malignant type of brain cancer, associated with wireless phone use.” *Bioinitiative 2012, Digital p.49; Paper SECTION 1 (2012 Supplement) p.5*

H. Dr. Israel’s testimony that there is no basis for Mr. Myers to conclude there is an impending health crisis. *Hearing Transcript April 2, 2018, p. 266 at 5-10*

I did not state there is an “impending” health crisis. I said there is a “potential” for a health crisis (*Myers Direct Testimony p. 17 at 7*) and that it could be 5, 10 or 15 years for those illnesses to develop. *Hearing Transcript April 2, 2018, p. 187 at 8 – 11* If non-thermal radiation from smart meters and other wireless devices can cause adverse health effects as I have concluded from reading research studies and writings of subject matter experts, then a large number of illnesses caused by non-thermal RF would have a financial impact on the healthcare system and the Pennsylvania budget. I think that statement is correct.

I. Dr. Israel testified that the American Academy of Environmental Medicine Statement on Smart Meters (Myers Exhibit 15) is not a scientific study *Israel Rebuttal Testimony, March 26, 2018, p. 20 at 3-7*

The American Academy of Environment Medicine (AAEM) never claimed it was a scientific study. The AAEM identified it as a “Wireless Smart Meter Case Study”. A medical dictionary defines case study as “*a detailed analysis of a person or group with a particular disease or condition, noting characteristics of the disease or condition. Case studies are often used to call attention to new diseases or to diseases entering new populations*”²⁸

This is what the FDA does when it seeks public feedback on harmful effects of FDA approved drugs and devices. The public feedback is important for FDA to ensure public safety This was the purpose of the author’s case study and why AAEM reported it.

²⁸ <https://medical-dictionary.thefreedictionary.com/case+study>.

J. Dr. Israel testified that the AAEM Case Study does not say which website it was from or for what purpose the website was established. Also that the website may have had a “legal” and not a scientific basis. *Israel Rebuttal Testimony, March 26, 2108, p. 20 at 15-17*

The AAEM posted their website address at the top of their Wireless Smart Meter Case Studies. The Case Studies can be readily accessed from their site. The AAEM Case Studies is also posted on *PubMed*²⁹. *PubMed* is the U.S. National Institutes of Health's National Library of Medicine free full-text archive of biomedical and life sciences journal literature. Instead of accessing these professional websites Dr. Israel cites an anonymous website which unfairly casts the study in a negative light.

K. Dr. Israel testified that the AAEM Case Study has no valid scientific basis

Israel Rebuttal Testimony, March 26, 2018, p.21 at 10-19. Note: Dr. Israel is referring to Exhibit 15 of Myers Direct Testimony

The eight physicians on the AAEM Board who reported the study obviously disagree. The AAEM letter states that the 92 cases Dr. Federica Lamech reported are well documented and scientifically valid. Quoting from the Case Study:

AAEM physicians and physicians world-wide are treating patients who report adverse, debilitating health effects following the installation of smart meters, which emit electromagnetic frequencies (EMF) and radiofrequencies (RF).

It is critically important to note that the data in this case series indicates that the “vast majority of cases” were not electromagnetically hypersensitive until after installation of smart meters. Dr. Lamech concludes that smart meters “may have unique characteristics that lower people’s threshold for symptom development.

²⁹ <https://www.ncbi.nlm.nih.gov/pubmed/?term=lamech+smart+meters>

Discrediting a Case Study that bridges an information gap reveals a biased mindset, not a scientific one in my opinion.

The AAEM case study is very relevant because it is consistent with the complaints filed by other Pennsylvania utility customers who report adverse health effects from their smart meters. Recently in the Maria Povacz case (Docket No. C-2015-2475023) the ALJ ruled that the preponderance of evidence does suggest that some other aspect of the smart meter is *“inimitably perceptible by and contrary to the health and well-being of the individual Ms. Povacz. (Judge Heep’s Initial Decision. p. 28*

Similar complaints have been filed with the PA PUC. Docket No. C-2016-257-2824 (Bervinchak), Docket No. C-2015-2475726 (Murphy) and others. AAEM calls for further research regarding smart meter health effects, the option for consumers to maintain analog meters, a moratorium on smart meters, and implementation of safer technology.

L. Dr. Israel testified that the International Appeal by 246 Scientists is not a scientific study published in a peer-reviewed scientific journal. *Israel Rebuttal Testimony, March 26,2018, p. 22 at 1-4*

The scientists titled it as an Appeal, and did not claim it to be a scientific study. The 246 independent scientists are some of the world’s foremost experts in the study of biological health effects from non-ionizing electromagnetic fields (EMFs). The scientists urge the United Nations to fund an independent multidisciplinary committee to explore ways to reduce human exposure and not allow industry to bias conclusions. The Appeal specifically lists smart meters as one of their wireless device concerns.

M. Dr. Israel testified that Dr. Carpenter’s paper on “Electromagnetic Fields and Cancer: The Cost of Doing Nothing” does not report experimental data from studies that Dr. Carpenter conducted. *Israel Rebuttal Testimony, March 26, 2018, p. 22 at 9-18*

There is no requirement that an expert witness as Dr. Carpenter must speak to data from only his own research. Federal Rule of Evidence 702, (sub-part 1) - Testimony by Expert Witnesses, does not require a subject matter expert to generate data with his or her own hands. The term “data” is intended to encompass the reliable opinions of other experts³⁰. To support his claims of RF safety Dr. Israel himself cited approximately 14 studies by other researchers. The same standard should apply without prejudice to Dr. Carpenter in this proceeding. Dr. Carpenter’s recommendations included having industry develop safer wireless products and for people to make informed safety decisions to reduce exposures, a perfectly reasonable conclusion in my view.

N. Dr. Israel’s list of Public Health Reviews - RF Fields and Claimed Health Effects

Israel Rebuttal Testimony, March 26, 2018, Exhibits MI 1- Myers and MI 3 - Myers

Dr. Israel lists a number of international organizations which claim that non-thermal RF fields do not adversely affect people’s health. His list includes WHO/IARC, Canada, and Europe. But within those organizations and countries are officials and subject matter experts who express totally different points of view. For example:

WHO/IARC: The IARC classified cell phone RF energy as a Group2B possible carcinogen in 2011. *Bioinitiative 2012, Digital p. 49; Paper SECTION 1 (2012 Supplement), p.5*

Health Canada - this is the Canadian government organization responsible for helping Canadians to maintain and improve their health. Health Canada officials recommend limiting the length of cell phone calls, using hands free devices, and encouraging children under 18 to

³⁰ https://www.law.cornell.edu/rules/fre/rule_702

limit cell phone usage in order to reduce exposure to non-thermal RF radiation. *Myers Direct Testimony, Exhibit 22*

European Commission Scientific Committee SCENIHR 2015 – The Parliamentary Assembly of the Council of Europe representing 800 million Europeans from 47 member states holds an opposite point of view. The Parliamentary Assembly issued Resolution 1815 which calls for member states to reconsider the scientific basis for present RF exposure standards and implement other measures to reduce exposure to RF radiation. *Myers Direct Testimony, Exhibit No.22*

UK National Health Services (England, Scotland, Wales and Northern Ireland) – issued guidelines for people to reduce exposure to cell phone radiation. *Exhibit No. 22 of Myers Direct Testimony*

O. Dr. Israel's list of State Health Agency & PUC Reviews of Smart Meters and Health

Israel Rebuttal Testimony, March 26, 2018, Exhibit MI 2- Myers

Smart meter endorsements by these State Health Agencies & PUCs do not constitute prima facie evidence or justification for PA PUC to rule against my smart meter opt-out request. The question that should be asked is what was the evidence on which those endorsements were made? The rulings by those states may have been based on erroneous or incomplete information. Specifically:

What was the primary science presented to these health agencies and PUCs that led them to conclude that smart meters were safe? Were officials provided with only industry studies that reported smart meter RF safety? Did officials consider independent, non-industry studies which reported adverse health effects smart meters?

Did these officials know and understand that smart meters emitted unique frequency hopping spread spectrum thousands of times per day?

All but one of these agency rulings were made 4 to 8 years ago. How many complaints did those officials receive from customers who became sick after smart meter installation?

Dr. Israel cites the Massachusetts Department of Public Utilities Commission as having endorsed smart meters in 2014 *Id. Exhibit MI- 2 – Myers*. But in 2017 Massachusetts lawmakers introduced 7 bills to protect the public from non-thermal RF radiation³¹. One bill, S-1268, calls for **non-industry-funded science** and another bill, S.184, allows consumers to opt-out of smart meters.

P. Dr. Israel’s negative portrayal of Dr. David Carpenter’s professionalism and qualifications is unwarranted. *Id. Exhibit MI – 2, p. 4*

Dr. Carpenter is a magna cum laude graduate of Harvard, an honors graduate of Harvard Medical School, and an internationally recognized expert on environmental health and hazards of non-ionizing radiation. He has authored or co-authored 435 peer reviewed studies. This is nearly 200 more than the 245 studies that Dr. Israel authored or co-authored.

Dr. Carpenter was Dean, School of Public Health, University at Albany from 1985 to 1998 and is Professor of Environmental Health Sciences and Biomedical Sciences at the University. He has qualified and served as an expert witness at numerous legal proceedings concerning health risks from RF radiation.

Dr. Carpenter would not accept any payment from me to testify on my behalf and traveled from Albany to the Harrisburg hearing on Easter Sunday, April 1. Neither Dr. Carpenter nor the authors

³¹ <https://sites.google.com/site/understandingemfs/ma-emf-bills>

of the Bioinitiative 2012 received any compensation for writing this seminal report. This attests to Dr. Carpenters genuinely held beliefs in the health risks of pulsed/frequency hopping spread spectrum smart meters, the dangers of non-thermal RF radiation, and his desire that people not be harmed. It would be interesting to know what Dr. Israel charges PPL for his written rebuttals and oral testimonies on smart meter safety.

Proposed Conclusions of Law

That the Complainant has met his burden of proof with a preponderance of scientific evidence that attributes adverse health effects from exposure to non-thermal RF radiation and which can put the Complainant's health at risk.

That Pennsylvania law requires PPL Electric Utilities Corporation to provide service which is safe and reasonable. **66 PA.C.S. § 1501**

Proposed Ordering Paragraphs

Pursuant to **66 PA.C.S. § 1501** the Commission directs PPL Utilities Corporation to allow the Complainant to keep his existing analog meter which does not emit radio frequency electromagnetic energy and not replace it with any device that emits radio frequency electromagnetic energy.

Pursuant to **66 PA.C.S. § 1501** the Commission directs PPL Utilities Corporation to replace electric meters that emit radio frequency electromagnetic energy on Complainant's eleven rental properties with meters that do not emit radio frequency electromagnetic energy if the account customers so request.

Appendix A

Below is a sampling of 407 scientific studies which report biological or adverse health effects from non-thermal RF radiation. The studies can be found using the U.S. Government's Pub Med website ³² or in many instances online searches using author, study title, journal information, year, etc. Many of the studies are referenced or cited in Bionitiative 2012.

I invite PPL subject matter experts to explain why these authors' research and findings are wrong and why I should not conclude from these and thousands of other studies that non-thermal RF radiation does not produce adverse health effects that can put my health to risk.

In approximately 50 of the studies below the researchers use the term "pulse", "pulse modulation" or variation thereof to describe their research. I have highlighted in bold font the word "pulse" for ready reference.

Acherman P et al., 2000. Exposure to **pulsed** high-frequency electromagnetic field during waking affects human sleep EEG. *NeuroReport* 11(15):3321-3325.

Huber et al. [2005] found altered cerebral blood flow in humans exposed to **pulsed** modulated cell phone radiation. They concluded that, "This finding supports our previous observation that **pulse** modulation of RF EMF is necessary to induce changes in the waking and sleep EEG, and substantiates the notion that **pulse** modulation is crucial for RF EMF-induced alterations in brain physiology."

López-Martín E, Bregains J, Relova-Quinteiro JL, Cadarso-Suárez C, Jorge-Barreiro FJ, Ares-Pena FJ. The action of **pulse**-modulated GSM radiation increases regional changes in brain activity and c-Fos expression in cortical and subcortical areas in a rat model of picrotoxin-induced seizure proneness. *J Neurosci Res.* 87(6):1484-1499, 2009.

Aitken et al. [2005] exposed mice to 900-MHz RFR at a specific absorption rate (SAR) of 0.09 W/kg for 7 days at 12 h per day. DNA damage in caudal epididymal spermatozoa was assessed by quantitative PCR (QPCR) as well as alkaline and **pulsed**-field gel electrophoresis post exposure. Gel electrophoresis revealed no significant change in single- or double-DNA strand breakage in spermatozoa. However, QPCR revealed statistically significant damage to both the mitochondrial genome ($p < 0.05$) and the nuclear -globin locus ($p < 0.01$).

³² <https://www.ncbi.nlm.nih.gov/pmc/>. Pub-Med is a U.S. Government full-text archive of biomedical and life sciences journal literature provided by the U.S. National Institutes of Health's National Library of Medicine (NIH/NLM).

Diem et al [2005] exposed human fibroblasts and rat granulosa cells to mobile phone signals (1800 MHz; SAR 1.2 or 2 W/kg; different modulations; during 4, 16 and 24 h; intermittent 5 min on/10min off or continuous). RFR exposure induced DNA single- and double-strand breaks as measured by the comet assay. Effects occurred after 16 h exposure in both cell types and after different mobile-phone modulations. The intermittent exposure showed a stronger effect than the continuous exposure.

Huber et al [2002] reported that exposure to **pulsed** modulated RFR prior to sleep affected EEG during sleep. However, effect was not seen with unmodulated field. They also found that the **pulsed** field altered regional blood flow in the brain of awake subjects.

Borbely, AA et al, 1999. **Pulsed** high-frequency electromagnetic field affects human sleep and sleep electroencephalogram. *Neuroscience Letters* 275(3): 207-210.

Czerska EM, Elson EC, Davis CC 1992. Swicord ML, Czerski P, Effects of continuous and **pulsed** 2450-MHz radiation on spontaneous lymphoblastoid transformation of human lymphocytes in vitro. *Bioelectromagnetics* 13(4):247-259. (Important)

Belyaev et al. [2006] investigated whether exposure of rat brain to microwaves of global system for mobile communication (GSM) induces DNA breaks, changes in chromatin conformation and in gene expression at a specific absorption rate (SAR) of 0.4 mW/g for 2 h. Data showed that GSM MWs at 915 MHz did not induce DNA double stranded breaks detectable by **pulsed**-field gel electrophoresis or changes in chromatin conformation, but affected expression of genes in rat brain cells

One review of the Russian/Soviet studies on the role of modulation on MW effects is available in English (Pakhomov and Muhy 2000). The authors conclude that “a number of good-quality studies have convincingly demonstrated significant bio-effects of **pulsed** MW. Modulation often was the factor that determined the biological response to irradiation, and reactions to **pulsed** and CW emissions at equal time-averaged intensities in many cases were substantially different”, Since that time, more studies have been published in Russian which show the role of modulation in experiments with animals (Dolgacheva, Semenova et al. 2000; Pashovkina and Akoev 2000; Pashovkina and Akoev 2001; Pashovkina and Akoev 2001; Akoev, Pashovkina et al. 2002). In conclusion, significant amount of in vitro and in vivo studies from different research groups, although not universally reported, clearly indicated dependence of the NT MW effects on modulation.

Dabrowski MP, Stankiewicz W, Sobiczewska E, Szmigielski S. 2001. [Immunotropic effects of electromagnetic fields in the range of radio- and microwave frequencies] *Pol Merkur Lekarski Nov.* 11(65): 447-51. (Important)

Gandhi and Anita [2005] reported increases in DNA strand breaks and micronucleation in lymphocytes obtained from cell phone users.

Garaj-Vrhovac et al [1990] reported changes in DNA synthesis and structure in Chinese

hamster cells after various durations of exposure to 7.7 GHz field at 30 mW/cm².

Lai and Singh [1995; 1996; 1997a; 2005] and Lai et al. [1997] reported increases in single- and double-strand DNA breaks in brain cells of rats exposed for 2 hrs. to 2450-MHz field at 0.6-1.2 W/kg.

Lixia et al. [2006] reported an increase in DNA damage in human lens epithelial cells at 0 and 30 min after 2 hrs. of exposure to 1.8 GHz field at 3 W/kg.

Markova et al. [2005] reported that GSM signals affected chromatin conformation and gamma-H2AX foci that colocalized in distinct foci with DNA double strand breaks in human lymphocytes.

Narasimhan and Huh [1991] reported changes in lambda phage DNA suggesting single strand breaks and strand separation.

Nikolova et al. [2005] reported a low and transient increase in DNA double strand break in mouse embryonic stem cells after acute exposure to 1.7- GHz field

Paulraj and Behari [2006] reported an increased in single strand breaks in brain cells of rats after 35 days of exposure to 2.45 and 16.5 GHz fields at 1 and 2.01 W/kg.

Schmid MR, Loughran SP, Regel SJ, Murbach M, Bratic Grunauer A, Rusterholz T, Bersagliere A, Kuster N, Achermann P. Sleep EEG alterations: effects of different **pulse**-modulated radio frequency electromagnetic fields. *J Sleep Res.* 2(1):50-58, 2012a. Results provide further evidence that **pulse**-modulated RF EMF alter brain physiology,

Schmid MR, Murbach M, Lustenberger C, Maire M, Kuster N, Achermann P, Loughran SP. Sleep EEG alterations: effects of **pulsed** magnetic fields versus **pulse**-modulated radio frequency electromagnetic fields. *J Sleep Res* 2012b Jun 22 doi: 10.1111/j.1365-2869.2012.01025.x. [Epub ahead of print] These results demonstrate that both **pulse**-modulated radio frequency and **pulsed** magnetic fields affect brain physiology.

Phillips et al. [1998] found increase and decrease in DNA strand breaks in cells exposure to various forms of cell phone radiation.

Sun et al. [2006] reported an increase in DNA single strand breaks in human lens epithelial cells after 2 hrs. of exposure to 1.8 GHz field at 3 and 4 W/kg. The DNA damages caused by 4 W/kg field were irreversible.

Zhang et al. [2002] reported that 2450-MHz field at 5 mW/cm² did not induce DNA and chromosome damage in human blood cells after 2 hrs. of exposure, but could increase DNA damage effect induced by Mitomycin-C.

Zhang et al. [2006] reported that 1800-MHz field at 3.0 W/kg induced DNA damage in Chinese hamster lung cells after 24 hrs. of exposure.

Balode [1996] obtained blood samples from female Latvian Brown cows from a farm close to and in front of the Skrunda Radar and from cows in a control area. Micronuclei in peripheral erythrocytes were significantly higher in the exposed cows.

Busljeta et al. [2004] exposed male rats to 2.45 GHz RFR fields for 2 hours daily, 7 days a week, at 5-10 mW/cm² for up to 30 days. Erythrocyte count, haemoglobin and haematocrit were increased in peripheral blood on irradiation days 8 and 15. Anuclear cells and erythropoietic precursor cells were significantly decreased in the bone marrow on day 15, but micronucleated cells were increased.

D'Ambrosio et al. [2002] exposed human peripheral blood to 1.748 GHz continuous wave (CW) or phase-modulated wave (GMSK) for 15 min at a maximum specific absorption rate of 5 W/kg. No changes were found in cell proliferation kinetics after exposure to either CW or GMSK fields. Micronucleus frequency result was not affected by CW exposure but a statistically significant increase in micronucleus was found following GMSK exposure.

Ferreira et al. [2006] found that rat offspring exposed to radiation from a cellular phone during their embryogenesis showed a significant increase in micronucleus frequency. Fucic et al. [1992] reported increase in frequencies of micronuclei in the lymphocytes of humans exposed to microwaves.

Gandhi and Singh [2005] analyzed short term peripheral lymphocyte cultures for chromosomal aberrations and the buccal mucosal cells for micronuclei. They reported an increase in the number of micronucleated buccal cells and cytological abnormalities in cultured lymphocytes.

Garaj-Vrhovac et al [1992] exposed human whole-blood samples to continuous-wave 7.7 GHz radiation at power density of 0.5, 10 and 30 mW/cm² for 10, 30 and 60 min. In all experimental conditions, the frequencies of all types of chromosomal aberrations (dicentric and ring chromosomes) and micronucleus were significantly higher than in the control samples.

Garaj-Vrhovac et al [1992] exposed human whole-blood samples to continuous-wave 7.7 GHz radiation at power density of 0.5, 10 and 30 mW/cm² for 10, 30 and 60 min. In all experimental conditions, the frequencies of all types of chromosomal aberrations the control samples.

Garaj-Vrhovac et al. [1999] investigated peripheral blood lymphocytes of 12 subjects occupationally-exposed to microwave radiation. Results showed an increase in the frequency of micronuclei as well as disturbances in the distribution of cells over the first, second and third mitotic division in exposed subjects compared to controls.

Haider et al. [1994] exposed plant cuttings bearing young flower buds for 30 h on both sides of a slewable curtain antenna (300/500 kW, 40-170 V/m) and 15 m (90 V/m) and 30 m (70 V/m) distant from a vertical cage antenna (100 kW) as well as at the neighbors living near the broadcasting station (200 m, 1-3 V/m). Laboratory controls were maintained for

comparison. Higher micronucleus frequencies than in laboratory controls were found for all exposure sites in the immediate vicinity of the antennae,

Tice et al. [2002] measured micronucleus frequency in human leukocytes using the comet assay after exposure to various forms of cell phone signals. Cells were exposed at $37 \pm 1^\circ\text{C}$, for 3 or 24 h at average specific absorption rates (SARs) of 1.0-10.0 W/kg. Exposure for 3 h did not induce a significant increase in micronucleated lymphocytes. However, exposure to each of the signals for 24 h at an average SAR of 5.0 or 10.0 W/kg resulted in a significant and reproducible increase in the frequency of micronucleated lymphocytes. The magnitude of the response (approximately four fold) was independent of the technology, the presence or absence of voice modulation, and the frequency.

Trosic et al. [2001] investigated the effect of a 2450-MHz microwave irradiation on alveolar macrophage kinetics and formation of multinucleated giant cells after whole body irradiation of rats at 5-15 mW/cm². A group of experimental animals was divided in four subgroups that received 2, 8, 13 and 22 irradiation treatments of two hours each. The animals were killed on experimental days 1, 8, 16, and 30. Multinucleated cells were significantly increased in treated animals. The increase in number of nuclei per cell was time- and dose-dependent. Macrophages with two nucleoli were more common in animals treated twice or eight times. Polynucleation was frequently observed after 13 or 22 treatments.

Trosic et al. [2002] exposed adult male Wistar for 2 h a day, 7 days a week for up to 30 days to continuous 2450-MHz microwaves at a power density of 5-10mW/cm². Frequency of micronuclei in polychromatic erythrocytes showed a significant increase in the exposed animals after 2, 8 and 15 days of exposure compared to sham-exposed control.

Trosic et al. [2004] investigated micronucleus frequency in bone marrow red cells of rats exposed to a 2450-MHz continuous-wave microwaves for 2 h daily, 7 days a week, at a power density of 5-10 mW/cm² (whole body SAR 1.25 +/- 0.36 (SE) W/kg). The frequency of micronucleated polychromatic erythrocytes was significantly increased on experimental day 15.

Trosic et al. [2006] exposed rats 2 h/day, 7 days/week to 2450-MHz microwaves at a whole-body SAR of 1.25 +/- 0.36W/kg. Control animals were included in the study. Bone marrow micronucleus frequency was increased on experimental day 15, and polychromatic erythrocytes micronucleus frequency in the peripheral blood was increased on day 8.

Zotti-Martelli et al. [2000] exposed human peripheral blood lymphocytes in G(0) phase to electromagnetic fields at different frequencies (2.45 and 7.7 GHz) and power densities (10, 20 and 30 mW/cm²) for 15, 30 or 60min. The results showed for both radiation frequencies an induction of micronuclei as compared to control cultures at a power density of 30mW/cm² and after an exposure of 30 and 60 min.

Zotti-Martelli et al. [2005] exposed whole blood samples from nine different healthy donors for 60, 120 and 180 min to continuous-wave 1800-MHz microwaves at power densities of 5, 10 and 20 mW/cm². A statistically significant increase of micronucleus in lymphocytes was observed

dependent on exposure time and power density. A considerable decrease in spontaneous and induced MN frequencies was measured in a second experiment.

Belyaev et al. [1992] studied the effect of low intensity microwaves on the conformational state of the genome of X-irradiated *E. coli* cells by the method of viscosity anomalous time dependencies. A power density of 1 microW/cm² is sufficient to suppress radiation-induced repair of the genome conformational state.

Belyaev et al. [1996] studied the effect of millimeter waves on the genome conformational state of *E. coli* AB1157 by the method of anomalous viscosity time dependencies in the frequency range of 51.64-51.85 GHz. Results indicate an electron-conformational interactions.

Belyaev et al. [2005] investigated response of lymphocytes from healthy subjects and from persons reporting hypersensitivity to microwaves from GSM mobile phone (915 MHz, specific absorption rate 37 mW/kg), and power frequency magnetic field (50 Hz, 15 microT peak value). Changes in chromatin conformation were measured with the method of anomalous viscosity time dependencies (AVTD). Exposure at room temperature to either 915 MHz or 50 Hz resulted in significant condensation of chromatin, shown as AVTD changes, which was similar to the effect of heat shock at 41 degrees C. No significant differences in responses between normal and hypersensitive subjects were detected.

Gadhia et al. [2003] reported a significant increase in dicentric chromosomes in blood cells among mobile users who were smoker-alcoholic as compared to nonsmoker-nonalcoholic; the same held true for controls of both types.

Garaj-Vrhovac et al. [1990] exposed V79 Chinese hamster cells to continuous-wave 7.7 GHz RFR at power density of 30 mW/cm² for 15, 30, and 60 min. Results suggest that the radiation causes changes in the synthesis as well as in the structure of DNA molecules.

Garaj-Vrhovac et al. [1991] exposed V79 Chinese hamster fibroblast cells to continuous wave 7.7 GHz radiation at power density of 0.5 mW/cm² for 15, 30 and 60 min. There was a significantly higher frequency of specific chromosome aberrations such as dicentric and ring chromosomes in irradiated cells.

Mashevich et al. [2003] found that human peripheral blood lymphocytes exposed to continuous 830-MHz electromagnetic fields (1.6-8.8 W/kg for 72 hr) showed a SAR-dependent chromosome aneuploidy, a major "somatic mutation leading to genomic instability and thereby to cancer. The aneuploidy was accompanied by an abnormal mode of replication of the chromosome 17 region engaged in segregation (repetitive DNA arrays associated with the centromere), suggesting that epigenetic alterations are involved in the SAR dependent genetic toxicity. The effects were non-thermal.

Ono et al. (2004) exposed pregnant mice intermittently at a whole-body averaged specific absorption rate of 0.71 W/kg (10 seconds on, 50 seconds off which is 4.3 W/kg during the 10

seconds exposure) for 16 hours a day, from the embryonic age of 0 to 15 days. At 10 weeks of age, mutation frequencies at the lacZ gene in spleen, liver, brain, and testis were examined. Quality of mutation assessed by sequencing the nucleotides of mutant DNAs revealed no appreciable difference between exposed and non-exposed samples.

Sarimov et al. [2004] reported that exposure to microwaves of 895-915 MHz at 5.4 mW/kg resulted in statistically significant changes in condensation of chromatin in human lymphocytes. Effects are similar to stress response, differ at various frequencies, and vary among donors.

Sarkar et al. [1994] exposed mice to 2450-MHz microwaves at a power density of 1 mW/cm² for 2 h/day over a period of 120, 150 and 200 days. Rearrangement of DNA segments were observed in testis and brain of exposed animals.

Semin et al. [1995] exposed DNA samples at 18°C at 10 different microwave frequencies (4- to 8 GHz, 25 ms **pulses**, 0.4 to 0.7 mW/cm² peak power, 1- to 6-Hz repetition rate, no heating). Irradiation at 3 or 4 Hz and 0.6 mW/cm² peak power clearly increased the accumulated damage to the DNA secondary structure (P< .00001). However, changing the **pulse** repetition rate to 1, 5, 6 Hz, as well as changing the peak power to 0.4 or 0.7 mW/cm² did not induce significant effect. Thus, the effect occurred only within narrow 'windows' of the peak intensities and modulation frequencies.

Sykes et al. [2001] exposed mice daily for 30 min to plane-wave fields of 900 MHz with a **pulse** repetition frequency of 217 Hz and a **pulse** width of 0.6 ms for 1, 5 or 25 days. Three days after the last exposure, spleen sections were screened for DNA inversion events. There was no significant difference between the control and treated groups in the 1- and 5-day exposure groups, but there was a significant reduction in inversions below the spontaneous frequency in the 25-day exposure group. This observation suggests that exposure to RF radiation can lead to a perturbation in recombination frequency which may have implications for recombination repair of DNA.

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CONCLUSION: We evaluated the effect of high-frequency EMF on gene expression and we identified functional pathways influenced by 900 MHz MW-EMF exposure.

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Von Klitzing et al. [1995] were the first to report that cell phone radiation affected EEG alpha activity during and after exposure to cell phone radiation.

Mann and Roschke [1996] reported that cell phone radiation modified REM sleep EEG and shortened sleep onset latency.

Eulitz et al. [1998] reported that cell phone radiation affected brain activity when subjects were processing task-relevant target stimuli and not for irrelevant standard stimuli.

Freude et al. [1998] found that preparatory slow brain potential was significantly affected by cellular phone radiation in certain regions of the brain when the subjects were performing a

cognitive complex visual task. The same effects were not observed when subjects were performing a simple task .

Borbely et al. [1999] reported that the exposure induced sleep and also modified sleep EEG during the non-rapid eye movement (NREM) stage.

Freude et al. [2000] confirmed their previous report that cellular phone radiation affected slow brain potentials when subjects are performing a complex task. However, they also reported that the exposure did not significantly affect the subjects in performing the behavioral task .

Huber et al. [2000] reported that exposure for 30 minutes to a 900-MHz field at 1 W/kg peak SAR during waking modified EEG during subsequent sleep.

Krause et al. [2000a] reported that cell phone radiation did not affect resting EEG but modified brain activity in subjects performing an auditory memory task.

Krause et al. [2000b] reported that cell phone radiation affected EEG oscillatory activity during a cognitive test. The visual memory task had three different working memory load conditions. The effect was found to be dependent on memory load.

Lebedeva et al. [2000] reported that cell phone radiation affected EEG.

Jech et al. [2001] reported that exposure to cell phone radiation affected visual event-related potentials in narcolepsy patient performing a visual task.

Lebedeva et al. [2001] reported that cell phone radiation affected sleep EEG.

Croft et al. [2002] reported that radiation from cellular phone altered resting EEG and induced changes differentially at different spectral frequencies as a function of exposure duration.

D'Costa et al. [2003] found EEG effect affected by the radiation within the alpha and beta bands of EEG spectrum.

Huber et al. [2003] reported EEG effect during NREM sleep and the effect was not dependent on the side of the head irradiated. They concluded that the effect involves subcortical areas of the brain that project to both sides of the brain. Dosimetry study shows that the SAR in those area during cell phone use is relatively very low, e.g., 0.1 W/kg at the thalamus. Recently, Aalta et al. [2006], using PET scan imaging, reported a local decrease in regional cerebral blood flow under the antenna in the inferior temporal cortex, but an increase was found in the prefrontal cortex.

Kramarenko et al. [2003] reported abnormal EEG slow waves in awake subjects exposed to cell phone radiation.

Marino et al. [2003] reported an increased randomness of EEG in rabbits.

Hamblin et al. [2004] reported changes in event-related auditory evoked potential in subjects exposed to cellular phone radiation when performing an auditory task. They also found an increase in reaction time in the subjects, but no change in accuracy in the performance.

Hinrich and Heinze [2004] reported a change in early task-specific component of event-related magnetic field in the brain of exposed subjects during a verbal memory encoding task.

Krause et al. [2004] repeated the experiment with auditory memory task [Krause et al., 2000b] and found different effects.

Papageorgiou et al. [2004] reported that cell phone radiation affected male and female EEG differently.

Vorobyov et al. [2004] reported that repeated exposure to modulated microwaves affected baseline and scopolamine-modified EEG in freely moving rats.

Curcio et al. [2005] reported that EEG spectral power affected in the alpha band and the effect was greater when the field was on during EEG recording than when applied before recording.

Hamblin et al. [2005] stated that they could not replicate their previous results on auditory evoked potentials.

Loughran et al. [2005] reported that exposure to cell phone radiation prior to sleep promoted REM sleep and modified sleep in the first NREM sleep period.

Ferreri et al. [2006] tested excitability of each brain hemisphere by transcranial magnetic stimulation and found that, after 45 minutes of exposure to cellular phone radiation, intracortical excitability was significantly modified with a reduction of inhibition and enhancement in facilitation.

Krause et al. [2006] reported that cell phone radiation affected brain oscillatory activity in children doing an auditory memory task.

Papageorgiou et al. [2006] reported that the radiation emitted by cell phone affects pre-attentive working memory information processing as reflected by changes in P50 evoked potential.

Krause et al. [2007] report on effects on brain oscillatory responses during memory task performance. But, they concluded that "The effects on the EEG were, however, varying, unsystematic and inconsistent with previous reports. We conclude that the effects of EMF on brain oscillatory responses may be subtle, variable and difficult to replicate for unknown reasons."

Vecchio et al. [2007] report on the exposure to GSM signal for 45 min modified interhemispheric EEG coherence in cerebral cortical areas. Hung et al. [2007] reported that after 30 min of exposure to talk-mode mobile phone radiation, sleep latency was markedly and significantly delayed beyond listen and sham modes in healthy human subjects. This condition effect over time was also quite

evident in 1-4Hz EEG frontal power, which is a frequency range particularly sensitive to sleep onset.

Hung et al. [2007] report on exposure to talk-mode mobile phone radiation, sleep latency was markedly and significantly delayed beyond listen and sham modes in healthy human subjects. This condition effect over time was also quite evident in 1-4Hz EEG frontal power, which is a frequency range particularly sensitive to sleep onset.

Cao et al. [2000] showed that the average reaction time in cell phone users was significantly longer than that in control group in psychological tests. The time of use was negatively associated with corrected reaction number.

Koivisto et al. [2000a, b] reported a facilitation of reaction in reaction time tasks during cell phone radiation exposure. In a working memory test, exposure speeded up response times when the memory load was three items but no significant effect was observed with lower loads.

Jech et al. [2001] reported that cell phone radiation may suppress the excessive sleepiness and improve performance while solving a monotonous cognitive task requiring sustained attention and vigilance in narcolepsy patients.

Lee et al. [2001] reported a facilitation effect of cell phone radiation in attention functions.

Edelstyn and Oldershaw [2002] found in subjects given 6 psychological tests a significant difference in three tests after 5 min of exposure. In all cases, performance was facilitated following cell phone radiation exposure.

Lee et al. [2003] reported that the facilitation effect of cell phone radiation on attention functions is dose (exposure duration)-dependent.

Smythe and Costall [2003] using a word learning task, found that male subjects made significantly less error than unexposed subject. However, the effect was not found in female subjects.

(Papageorgiou et al. [2004] reported that cell phone radiation affected male and female EEG differently.)

Curcio et al. [2004] found in subjects tested on four performance tasks an improvement of both simple- and choice-reaction times. Performance needed a minimum of 25 min of EMF exposure to show significant changes.

Maier et al. [2004] found that subjects exposed to GSM signal showed worse results in their auditory discrimination performance as compared with control conditions.

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