April 12, 2012

To: Patrick Hudson, Michigan Public Service Commission

From: Roger Levy and Janie Page, Smart Grid Technical Advisory Project, Lawrence Berkeley National Laboratory[1]

Subject: Review of the January 13, 2012 County of Santa Cruz Health Services Agency memorandum: Health Risks Associated with Smart Meters[2]

In response to your request on March 20, 2012, we reviewed and include comments in the remainder of this memo regarding the substance and accuracy of the Santa Cruz Health Services Agency (Agency) memorandum. Our review focused on the primary objective of the Agency memorandum, the consistency of the cited references with Agency established peer review criteria, and clarification of several technical claims or assumptions. We did not review or comment on the subject matter, relevance, or accuracy of any references cited in the Agency memorandum with the exception of what is referred to as the Hirsch document. Additional detailed comments are provided in an EPRI evaluation[3] which we've attached.

Summary:

In response to a December 13, 2011 request by the Santa Cruz County Board of Supervisors, Health Officer Poki Stewart Namkung of the County of Santa Cruz Health Services Agency (Agency) issued a ten-page memorandum on January 13, 2012 entitled "Health Risks Associated With Smart Meters"[1]. The County Board of Supervisors asked the Agency to report back and identify potential smart meter health effects and possible mitigation measures. While we have to presume the objective of this request was to look at the issues from the point of view of public health, the Agency memorandum does not appear to provide a balanced representation of the research, the risks, or mitigation options. Instead the Agency memorandum is largely focused on scientifically unsupported claims related to "electromagnetic hypersensitivity" (EHS). It is important to note at the outset that while individuals with EHS report real symptoms, health research has been unable to consistently attribute those symptoms to EMF exposure. For example, a World Health Organization examination concluded the following:

> "*The majority of studies indicate that EHS individuals cannot detect EMF exposure any more accurately than non-EHS individuals. Well controlled and conducted double-blind studies have shown that symptoms were not correlated with EMF exposure.*"
>
> *"Physicians: Treatment of affected individuals should focus on the health symptoms and the clinical picture, and not on the person's perceived need for reducing or eliminating EMF in the workplace or home."*

[1] The Smart Grid Technical Advisory Project provides technical assistance and training to state regulatory commissions on topics related to Smart Grid. The Smart Grid Technical Advisory Project does not get involved in litigated or contested regulatory or other proceedings.
[2] http://emfsafetynetwork.org/wp-content/uploads/2009/11/Health-Risks-Associated-With-SmartMeters.pdf
[3] Additional discussion of issues with the Santa Cruz Health Services Agency memo are covered in "EPRI Comments: A Perspective on Two Smart Meter Memoranda," EPRI Report 1024952, February 2012.

"Governments: Governments should provide appropriately targeted and balanced information about potential health hazards of EMF to EHS individuals, health-care professionals and employers. The information should include a clear statement that no scientific basis currently exists for a connection between EHS and exposure to EMF." [4]

Specific Comments

Besides the focus on EHS, the Agency memorandum is characterized by two additional major problems. First, the Agency memorandum appears to be based largely on limited information obtained from a special issue of a single journal[5] (Pathophysiology), with limited acknowledgement to other relevant scientific, health, or other industry sources. Second, the Agency memorandum addresses EMF exposure concerns by reference to a five-page document[6] authored by Daniel Hirsch. The Hirsch document critiques a California Council on Science and Technology (CCST) report[7] prepared in support of a smart meter investigation initiated by the California Public Utilities Commission (CPUC). The Hirsch document is a private submittal to the CPUC, not a formal report. Unfortunately, the Hirsch report is severely flawed on several dimensions. Our specific comments on each of these problems are outlined below.

1. County of Santa Cruz Health Services Agency, January 13, 2012 Memorandum: Health Risks Associated with SmartMeters

Under the paragraph on page 3 (see below) labeled Evidence-based Health Risks of EMFs, the Agency memorandum sets forth (1) its basic assumption regarding EMF impacts from Smart Meters and (2) its criteria for identifying the scientific research relevant to its memorandum. Unfortunately, there are fundamental conflicts between the Agency stated criteria and the substance of its memorandum, specifically: (1) the Agency does not provide a balanced review or perspective on EMF impacts, and; (2) the resource references cited in the memorandum do not adhere to their own "peer review" criteria and instead overemphasize a single reference source.

"There is no scientific literature on the health risks of SmartMeters in particular as they are a new technology. However, there is a large body of research on the health risks of EMFs. Much of the data is concentrated on cell phone usage and as SmartMeters occupy the same energy spectrum as cell phones and depending on conditions, can exceed the whole body radiation exposure of cell phones (see Attachment B1, Figure 4). In terms of health risks, the causal factor under study is RF radiation whether it be from cell phones, Wi-Fi routers, cordless phones, or SmartMeters. Therefore all available, peer reviewed, scientific research data can be extrapolated to apply to SmartMeters, taking into consideration the magnitude and the intensity of the exposure." [8]

[4] World Health Organization, 'Electromagnetic fields and public health', Electromagnetic hypersentivity, Fact Sheet N [0]296, December 2005. http://www.who.int/mediacentre/factsheets/fs296/en/

[5] sciencedirect.com/science/journal/09284680/16/2-3

[6] Comments on the Draft Report by the California Council on Science and Technology, "Health Impacts of Radio Frequency from Smart Meters", Daniel Hirsch, January 31, 2011, http://www.ccst.us/projects/smart2/documents/letter8hirsch.pdf

[7] Health Impacts of Radio Frequency from Smart Meters, Final Report, California Council on Science and Technology, April 2011, http://www.ccst.us/publications/2011/2011smartA.pdf

[8] IBID 1, page 3

- The Agency memorandum includes 51 citations to support its findings. We excluded three - a CPUC opt-out scoping memo, the CCST report, and the Santa Cruz Board of Supervisor moratorium on the installation of smart meters. Of the 48 remaining "technical" citations (classifications listed below) only 24 (or 50%) meet the peer review criteria identified by the Agency as valid sources and 12 of those references (50% of 24) come from a single issue of the Pathophysiology journal (see attachment to this memo).
    - Peer Reviewed Citations (24 citations)
        - 12 references (25% - marked with a yellow highlight) are from two issues of the Pathophysiology journal, 11 which of which are from a single issue,
        - 12 citations (25%) are from non-Pathophysiology peer reviewed sources.
    - Non-Peer Reviewed Citations (24 citations)
        - 19 citations (40% - marked with a red 'x') are from sources that are not peer reviewed but are in fact commentary or opinion articles representative of anti-smart meter positions,
        - 5 citations (10%) reference web sites whose material is difficult to classify as research.

- There is no scientific or other basis to justify the Agency statement in the quoted paragraph above that "...the causal factor under study is RF" and therefore "... all available, peer reviewed, scientific research data can be extrapolated to SmartMeters". This statement is technically and scientifically incorrect and not supported by any research. "RF radiation" is not a single agent. Established science shows that biological effects, when observed, change depending on the state of the biological system, the field intensity, the field frequency, the duration of exposure, and a variety of other variables.
- In the Background section the Santa Cruz memo notes that Smart Meters will use pulsed frequencies in a wide range of "800 MHz – 2400 MHz". This is incorrect. Wireless radio-based Smart Meters use the 900 MHz band (nominally 902 MHz – 928 MHz) for communication with the utility back end systems. Frequencies in the 2405 MHz – 2483 MHz range are typically reserved for optional (and in most cases, not currently operational) Home Area Networks.
- The Agency memorandum concludes by noting that "..there is no scientific data to determine if there is a safe RF exposure level." As a practical matter, the environment in which we live typically includes a number of RF sources, many beyond our control, that have higher emissions (in terms of intensity) than do Smart Meters. These include wireless routers in public and private spaces, radio and TV broadcasts, baby monitors, remote control devices, etc.[9] Science can work to understand the causes of effects, when observed, but it has never been able to categorically declare anything completely safe.

2. Comments on the Draft Report by the California Council on Science and Technology, "Health Impacts of Radio Frequency on Smart Meters", Daniel Hirsch, January 31, 2011

[9] "Smart Meters, Household Equipment, and the General Environment," City of Naperville, Naperville Smart Grid Initiative (NSGI), Pilot 2 RF Emissions Testing – Summary Report – V2.0, November 10, 2011.

Under the paragraph on page 3 labeled Evidence-based Health Risks of EMFs, the Agency memorandum makes reference to the Hirsch document as its "peer-reviewed" source for quantifying that SmartMeter whole-body radiation exceeds that from cell phones. There are several critical deficiencies and problems with the Agency reference to and use of the Hirsch document, specifically:

- The Hirsch document is a privately prepared set of comments, not a peer-reviewed scientific study; consequently it does not meet the Agency's own standard for reference.
- We were unable to identify any educational or professional credentials for Daniel Hirsch or either of the two "research assistants" identified in his document that might qualify them to comment on EMF radiation, health, or SmartMeter operations. [10]
- There are <u>critical errors</u> in the Hirsch document. Specifically Figure 4 claims to correct for two problems with the CCST report: (1) meters operating at 100% duty cycles and (2) whole body exposures.
    - The Hirsch document modifies results from the CCST report based on a number of assumptions that arbitrarily decrease cell phone and microwave oven exposures and thereby appear to enhance smart meter exposures. We provide two examples:

      <u>Example 1.</u>
      "Comparing the peak dose to the ear from a cell phone, when the rest of the body gets vastly less radiation, with a whole body exposure where all organs get roughly the same dose from a SmartMeter, doesn't seem appropriate. If there is a cancer effect, it is likely associated with the total RF energy the body receives."[11]

      We agree with the first part of this statement, specifically, much of the cell phone RF research logically focuses on potential effects to the ear, brain and regions of the body in proximity to cell phone emissions, not the whole body. Likewise, it would also be appropriate to challenge the assumption that smart meters will operate in an "always on" mode when actual field measurements document much lower operating conditions.

      Hirsch's apparent method for extrapolating the exposure to the whole body by simply multiplying original values by a factor of 200[12] is further flawed because it does not take into account the fundamental physics of any radiating source whose strength declines as the square of the distance from the source. Unfortunately, Hirsch can't arbitrarily make assumptions and change results for some but not all sources of exposure just because he thinks it ". . . doesn't seem appropriate."

[10] Mr. Hirsch, who identifies himself as "a lecturer and expert in nuclear policy at UCSC" is in fact a lecturer in social policy at UCSC and, separately, heads an organization called "Committee to Bridge the Gap" whose stated goal is "revealing and correcting government misconduct in the control of nuclear and related hazardous materials that pose significant threats to public health and security if not carefully regulated". The only credentials available for the research assistants listed in the Hirsch document were for Bailey Hall – which identified her as a student at UCSC, an Intern at the Committee to Bridge the Gap, and as a "Level 3" employee at In-N-Out Burger.
[11] IBID 5, page 4
[12] No further explanation is given by Hirsch for this correction factor.

Example 2.

"In other words, the chart (original CCST Figure 1) compares a SmartMeter that is always on with a cell phone or microwave oven when they are being used, even though 99% of the time they are not in use. This overestimates the cumulative exposure by a factor of 100 for the cell phone and microwave oven, and dramatically skews the comparison."[13]

As a result of this comment Hirsch modified and reduced the results in Figure 4 to better reflect what he believes is a more realistic duty cycle for cell phones and microwave ovens. This same adjustment for Smart Meters was not deemed necessary, even though (as stated above) the documented and measured duty cycle for Smart Meters is consistently less than for cell phones and microwave ovens[14].

- The Hirsch Figure 4 fails to note that the CCST report already accounts for the duty cycle issue[15] . The CCST report increased the Smart Meter EMF emissions reported in the original EPRI report by a factor of 20 (to extrapolate the EPRI reported 5% duty cycle to 100%) and used the highest possible (and unlikely) power setting of 1 Watt. This resulted in a "hypothetical maximum use case" that is well in excess of at least two independent measurements of actual Smart Meter operations[16] but still within the FCC safety margins. The CCST report further notes that the actual Smart Meter duty cycle will most likely be in the <1% to 5% range. FCC testing results[17] and additional field measurements[18], show that transmitters may actually not always operate at their rated power but more likely in a range from 0.25 to 0.5 watt. As a result the CCST reported values at 100% duty cycle are already substantially higher than is physically possible with the Smart Meters – thus any further Hirsh correction would be inappropriate because the values are already overstated. The 40 $\mu W/cm^2$ exposure level at 3 feet represented in Figure 4 assumes a 100% duty cycle and full power operation, neither of which is a reasonable operating assumption. More on duty cycle measure is included in Attachment A.
- Second, the issue of whole body exposure vs. localized exposure (e.g. cell phone) in the Hirsch report is inconsistent with extensive scientific research on RF which shows that body tissues respond differentially based on the type of cell involved and the proximity to a source of RF emissions, duration of the exposure, and other specific exposure

[13] IBID 5, page 4

[14] "Smart Meters, Household Equipment, and the General Environment," City of Naperville, Naperville Smart Grid Initiative (NSGI), Pilot 2 RF Emissions Testing – Summary Report – V2.0, November 10, 2011, Tables 9 and 10, and (independently) "Characterization of Radio Frequency Emissions From Two Models of Wireless Smart Meters", EPRI report 1021829, December 2011.

[15] This duty cycle correction is noted in text immediately following the figure both times it appears in the CCST report (as Figure 1, page 5, and Figure 7, page 20) and can be easily seen by comparing the graph in the CCST report with the data from which it was derived in Table 2 that appears on page 21 of the CCST report.

[16] "Smart Meters, Household Equipment, and the General Environment," City of Naperville, Naperville Smart Grid Initiative (NSGI), Pilot 2 RF Emissions Testing – Summary Report – V2.0, November 10, 2011 and "Characterization of Radio Frequency Emissions From Two Models of Wireless Smart Meters", EPRI report 1021829, December 2011.

[17] "An Investigation of Radiofrequency Fields Associated with the Itron Smart Meter", EPRI report 1021126, December 2010.

[18] "Radio-Frequency Exposure Levels from Smart Meters: A Case Study of One Model", EPRI report 1022270, February 2011.

characteristics.[19] In addition, a cell phone placed close to the head provides less distance for the fields to decline before they reach brain (or any other) tissue whereas a smart meter is not likely to be used in such close proximity to a brain. Even if a person is sleeping on the other side of the wall from a smart meter, detailed measurements[20] show that the exposure to whatever portion of the body is coincidentally closest to the meter will experience vastly reduced emissions compared with those from a device with a similar radio used close to the body. RF emissions into the home are shielded in part by the back of the meter, the electrical service panel, exterior and interior walls of the premise, and any furniture or other items in the path between the meter and subject.

[19] See for example Eugene M. Goodman, Ben Greenebaum, Michael T. Marron, Effects of Electromagnetic Fields on Molecules and Cells, In: Kwang W. Jeon and Jonathan Jarvik, Editor(s), International Review of Cytology, Academic Press, 1995, Volume 158, Pages 279-338, ISSN 0074-7696, ISBN 9780123645616, 10.1016/S0074-7696(08)62489-4. (http://www.sciencedirect.com/science/article/pii/S0074769608624894)
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[20] "Smart Meters, Household Equipment, and the General Environment," City of Naperville, Naperville Smart Grid Initiative (NSGI), Pilot 2 RF Emissions Testing – Summary Report – V2.0, November 10, 2011 and "Characterization of Radio Frequency Emissions From Two Models of Wireless Smart Meters", EPRI report 1021829, December 2011.

Attachment A. The Duty Cycle Question.

Much has been made of the question of appropriate duty cycles when reporting exposure. Typically, the higher the duty cycle, the greater the reported emissions. FCC guidelines (OET65) do not require 100% duty cycle for emitters that are not ever likely to run at 100% duty cycle. Here is an excerpt from the FCC document[21] to support this:

> Before beginning a measurement survey it is important to characterize the exposure situation as much as possible. An attempt should be made to determine:
>
> (1) The frequency and maximum power of the RF source(s) in question, as well as any nearby sources.
>
> (2) Duty factor, if applicable, of the source(s).
>
> (3) Areas that are accessible to either workers or the general public.
>
> (4) The location of any nearby reflecting surfaces or conductive objects that could produce regions of field intensification ("hot spots").
>
> (5) For pulsed sources, such as radar, the pulse width and repetition rate and the antenna scanning rate.
>
> (6) If appropriate, antenna gain and vertical and horizontal radiation patterns.
>
> (7) Type of modulation of the source(s).
>
> (8) Polarization of the antenna(s).
>
> (9) Whether measurements are to be made in the near-field, in close proximity to a leakage source, or under plane-wave conditions. The type of measurement needed can influence the type of survey probe, calibration conditions and techniques used.
>
> If possible, one should estimate the maximum expected field levels, in order to facilitate the selection of an appropriate survey instrument. For safety purposes, the electric field (or the far-field equivalent power density derived from the E-field) should be measured first because the body absorbs more energy from the electric field, and it is potentially more hazardous. In many cases it may be best to begin by using a broadband instrument capable of accurately measuring the total field from all sources in all directions. If the total field does not exceed the relevant exposure guideline in accessible areas, and if the measurement technique employed is sufficiently accurate, such a determination would constitute a showing of compliance with that particular guideline, and further measurements would be unnecessary.

[21] Federal Communications Commission, Office of Engineering and Technology, "Evaluating Compliance with FCC Guidelines for Human Exposure to Radiofrequency Electromagnetic Fields", OET Bulletin 65, Edition 97-01, August 1997, page 49.