

## Asher Sheppard Consulting

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Re Correctness and Adequacy of Sheppard's Memo and Related Responses Concerning Soitec Solar Project EMFs:

Dear Josh:

Thank you for the opportunity to respond to the recent statements about my memo and responses to public comments on the two Soitec solar projects. Those statements are, as detailed below, unfounded. For ease in possible future reference, I have numbered the paragraphs of this letter.

1) I have reviewed recent comments by Donna Tisdale and Sam Milham, MD on the memo concerning EMF health concerns dated April 30, 2014 that I prepared for the Draft PEIR on two solar-generation electric power projects proposed by Soitec. The recent comments are in a letter to Ms. Ashley Gungle dated January 2, 2015 by Dr. Milham that was transmitted with a cover note on January 5 with comments by Ms. Tisdale. In his two-page letter, Dr. Milham forwarded a report he wrote that concerned EMFs of a Newberry Springs solar farm. That same report was submitted on Feb. 13, 2014 in comments Dr. Milham made on the subject two Soitec solar projects (Tierra del Sol Solar and Rugged Solar). Those comments were identified as paragraphs I-68 in Dudek's compilation of public comments. Previously, Dudek requested I respond to those February 2014 comments, which I did on May 13, 2014. In that reply I addressed many of the same points about so-called dirty electricity as are now at issue per the January 5 transmission to Ms. Gungle.

2) Therefore, there is little new to say in reply on the matters of science and public health policy regarding EMFs associated with the proposed solar project that was not previously presented in my memo report of April 30, 2014 and similarly, there is little to add to my later responses to Dr. Milham's comment I68, divided into parts I68-1, I68-2, and I68-3. For convenience, I attach my responses to I68-1 to I68-3.

3) The latest comments, however, allow me another opportunity to clarify the situation of established knowledge about EMF health effects and Dr. Milham's statements in which he takes exception to judgments held by a consensus of scientists and public health officials. I also have another opportunity to expand on the significance of measurement data shown in Dr. Milham's Newberry Springs report.

4) In a cover note, Ms. Tisdale quotes Dr. Milham in part to the effect that I had “completely ignored the electrical pollution/ dirty electricity problem” and consequently came to three “wrong/untrue” conclusions. My response to these statements by Ms. Tisdale is incorporated in the following response to Dr. Milham insofar as her comments were essentially a synopsis of Dr. Milham’s letter.

5) My original EMF memo did indeed consider at appropriate depth the matters of harmonics and filtering of non-60 Hz electrical signals due to the nature of the inverters that change DC electricity to 60-Hz AC electricity. See p 2 (Introduction), p 3 (footnote relating to corona effects), p 4 (relating to CPVs). The term “dirty electricity,” which is not used in the technical literature, did not appear in my original memo but was an explicit subject of my replies to I68.

6) The summary of transient generation by inverters in Dr. Milham’s January 2 letter is correct. It appears from that paragraph that “dirty electricity” is synonymous with power system transients. It would take me far afield to discuss power quality in depth. Transients and harmonic content waveform are major elements, but it suffices to say that power system operators are aware of such issues. Power quality is a discipline of its own within power system engineering. My response to I68-1 goes further in addressing the relevance of transients to potential EMF health effects and refers to a literature search on “dirty electricity” I conducted at that time. I repeated that search on PubMed (a U.S. National Library of Medicine database) on January 14, 2015. I found no new scientific papers bearing on health and biological effects of exposure to dirty electricity.

7) Dr. Milham states, “My work shows that dirty electricity is a potent universal carcinogen and is responsible for significant human morbidity and mortality.” There was no citation to the literature to support such a sweeping conclusion. Notably, very few agents qualify as potent universal carcinogens and the strength, duration, repetition, and manner of exposure are always significant factors in morbidity and mortality. For example, the carcinogenicity of ionizing radiation (gamma and x-rays, alpha- and beta-radiation, etc.), varies greatly depending on energy content, strength of exposure, chemical properties for topical, ingested and inhaled agents, manner of exposure, tissue exposed and biological factors. In contrast, at least six decades of research on EMF biological and health effects indicate that the weak EMF transients described as dirty electricity would not have effects on health, or such serious, universal effects. Much is known about EMF exposures that are strong enough to be potentially harmful, and, as for ionizing radiation, there are many factors related to outcomes.

Moreover, a well-established scientific database shows no mechanistic data from biological or biophysical research to support a hypothesis for adverse effects from exposures to the public like those from solar power infrastructure. An important scientific rule of thumb applies here. To support an extraordinary claim, a scientist must provide extraordinary evidence. Assertions about

the adverse effects of dirty electricity do not satisfy that rule because the reports cited are severely limited in depth of investigation, quality, quantity and relevance for human health. To date, the available research has not stimulated research funding that would change the situation.

As a retired epidemiologist, Dr. Milham is well aware of the difficulty of establishing cause and effect relationships by inferential methods based on observations. That is, it takes well-characterized exposures, a strong effect on health, and many studies to demonstrate morbidity and mortality attributable to a specific agent. Exploratory epidemiology can be done with lower standards at lower cost, but strong statements about disease cannot be supported without research that uses strong methods and acquires data from repeated studies by multiple investigators. Dirty electricity has not been studied adequately, if at all, in order to meet, or even approach, those requirements. To my knowledge, there is no current funding to support epidemiological research into health effects of dirty electricity, indicating that it is highly unlikely that evidence on health hazards will change in the foreseeable future.

8) A statement about dirty electricity effects on dairy cow production is similarly unreferenced and cannot be discussed further here. There are, however, well-documented effects of electric shock on dairy cow milk production. Those effects occur under circumstances of improper grounding and failure of electrical equipment. There is no reason to equate electrical shocks caused by voltage differences between a cow's legs and exposure to electrical transients on power systems that may be the source of weak electric and magnetic fields.

9) The claim for a possible hazard at considerable distances from the project site is based on data from electrical noise Dr. Milham detected using uncalibrated devices and by the fact that electrical noise can be carried on power lines along with the dominant 60-Hz currents. I addressed those measurements in response to I68-2. To reiterate in plainer language, the oscillographs and related data do not show the strength of the electric and magnetic fields present. Moreover, the methods used to obtain the data are not described well enough to critically evaluate them. As Dr. Milham is aware from experiences he mentioned, it only takes an AM radio to detect electrical noise, although at a higher frequency than the 20 kHz he is most interested in. This is something many homeowners know from experience with an electronic dimmer switch. An AM radio behaves as a detector of electrical noise because it is purposefully designed to tune and amplify weak radio signals that travel miles, even thousands of miles, from a broadcast antenna to the receiver. The device used to obtain data in Newberry Springs may be more or less sensitive than such radios, but it requires considerable engineering expertise in antenna design and instrument design in order to generate quantitatively useful data. Instruments for this purpose are commercially available.

10) My first conclusion on scientific consensus about potential health risks of "time-varying EMFs comparable to those of the project" clearly includes all project EMFs including the harmonics described in the original memo and transients addressed in replies to I68. The failure to find the words "dirty

electricity” reflects semantics favored by the commenters, that is, the term “dirty electricity,” not an omission of scientific consideration of transient EMFs and harmonics.

11) My second conclusion, “EMFs from the CPV trackers would not be significant outside each project’s boundary,” was interpreted by Ms. Tisdale and Dr. Milham to include transients carried on powerlines to distant locations. As written, my conclusion reflects the rapid decrease in field strength with distance from a source, which is a key feature of all EMF exposures that explains why EMF exposures to the public are very low except in rare circumstances very close to an antenna or powerline. The most common circumstance of close proximity to an antenna occurs with exposure to the low-power radio transmitters of cellular telephones that can be held close to the body. The statement that my second conclusion is in error is based on transients that may originate at a solar generation site and be carried on powerlines beyond the range of transients from onsite equipment. Nonetheless, transients carried away on a powerline will be subject to the same factors that underly my conclusion. Those factors are rapid attenuation with distance and the absence of evidence for biological or health effects from exposure to EMFs of comparable frequency (or frequency distribution) and field strength.

12) Both commenters claim that my third conclusion is in error because it does not consider dirty electricity. However, my third conclusion refers to static fields which have no connection with transients or “dirty electricity.” There is no error of mine.

13) To sum up, I can confidently repeat a concluding statement to my review of comment I68. “The overwhelming majority of the scientific literature on EMF health effects does not concern or support a role for poor power quality as a cause of adverse health.”

Sincerely,



Att: Replies of May 13, 2014 to public comment I68 by Sam Milham in file “Sheppard responses to comment I68 (S. Milham) -Soitec solar.pdf”

**Responses (“A1:”) by Asher Sheppard on 5/13/2014 to Comments I68-1, I68-2, I68-3 with keys (“Q1”) to the full comment.**

**I68-1**

Q1 “[H]omes and businesses...with photo voltaic systems [and] the inverter and switchgear room at a photovoltaic 23 megawatt solar generating plant...are seriously polluted with dirty electricity.”

A1: “Dirty electricity” and “dirty electricity units” are not terms used in electrical engineering or physical science. K-factor is usually used by transformer power engineers to derate transformers because of heating that occurs when there is a high level of non-sinusoidal current. The topic of power quality is of importance to power suppliers and customers. The growing complexity of modern computer, communications, appliances and other powered devices makes power quality a diverse and complicated technical specialty in power engineering. However, power quality is almost never a feature of biological and health research. For example, a literature search of the National Library of Medicine’s PubMed database for “dirty electricity” had 17 hits, all involving a handful of activists including Drs. Milham and Havas whose work is included in the reference list of these responses on the DPEIR. A search on the term “power quality” gave more hits, of which all but two concerned power engineering. Dirty electricity is claimed to be a cause or possible cause of various human diseases. Dirty electricity units appear to be a way to characterize harmonic content and noise on the voltage or current waveform of mains power. Sixty-Hz electricity entirely free of noise and harmonics would consist of only a current and voltage varying at 60 Hz – “pure sinusoidal 60-Hz.” In contrast to “dirty electricity units” level of harmonic distortion, higher DEUs do not necessarily indicate a health hazard. (DEUs) and “Graham-Stetzer” units found in the dirty electricity papers and websites, an academic engineer or physicist would characterize noise content using measures such as total harmonic distortion (THD), which is most commonly used. Laboratory instrumentation to measure THD and other factors is available. As is true for any physical measurement, a given level of harmonic distortion, higher DEUs, do not necessarily indicate a health hazard.

**I68-2**

A1: The top panel of this figure shows a waveform identified as “Soitec Solar Newberry Springs CA Waveform in air a” measured in mV (millivolts) on the y-axis over a time period of 45 ms. There is insufficient description here of the source of the data. However, page 2 of I68-3 gives Milham’s method to measure power quality for epidemiologic studies. Quite likely, as was described for the epidemiologic work, these data were obtained with a “collapsible antenna” directly connected to an oscilloscope. Although the description is vague, it is likely that the high impedance oscilloscope input would detect voltages from possible sources in the home where it is presumed measurements were made. A key factor in establishing identity of the source as inverters at the Newberry Springs solar site is distance from the site, which was not indicated. The lower panel shows that almost all the signal (marked as mV rms) was at 60-Hz, which is evidently the frequency with the greatest signal strength.

These two panels illustrate a noisy waveform, but otherwise are not informative about currents introduced into an exposed person or with regard to potential biological or health effects. Potential biological and health effects are more closely related to currents in the body than to electric potentials or electric fields in the body. The two graphs cannot be directly used for technical concerns such as interference with electronic devices, including communications equipment.

### **I68-3**

Q1: "...finding that high frequency voltage transients and harmonics...was the active etiologic agent..."

A1: Anecdotal observation in epidemiology is very often wrong and analysis of clusters, which often are stimulated by an unexpected anecdotal observation, has a poor record for reliability. One reason that cluster analysis often does not lead to a conclusive result is suggested by the fact that it is inherent in the nature of random distributions to have clusters. This can be demonstrated readily by looking at clustering among grains of salt dropped from a salt shaker. A demonstration that one factor, here "dirty electricity," is the cause of disease among a number of people is a challenging task that would require more than one or a few observations.

Ecologic studies, of which Milham's cluster study is a variant, have a considerable methodological literature directed at obtaining information free of "ecologic bias" and other problems (Morgenstern 1998). A National Cancer Institute fact sheet on cancer clusters (National Cancer Institute 2014) provides a useful definition of a cancer cluster, methods of investigation, and indicates the problems that make it difficult and rare to show a causal relationship between a suspected cause and a cluster of cases. This fact sheet identifies the particular difficulty of investigating a disease or condition with high prevalence such as lung and breast cancer. This difficulty also applies to the hyperactive children investigated by Dr. Milham. Note that the perspective on ecological analysis in epidemiology is held to be useful guidance despite the fact that the seminal event of modern epidemiology was an observation during a severe cholera epidemic that cholera cases (then not known to have a bacterial origin) were more common for homes clustered near a particular well in mid-19th C London. As shown later, the well was contaminated by sewage. The CDC developed specific guidelines (Centers for Disease Control and Prevention 2013) to address the challenges of cancer cluster investigation, thereby emphasizing reasons for a large degree of skepticism about an succeeding with an eventual proof of causation when considering a suspected cancer cluster .

Dr. Milham gives a brief synopsis of the methods he used to obtain evidence for poor power quality (I68-3, p 2). Measurements obtained from a length of wire coupling to the electric field and connected to the high impedance input of an oscillograph can provide a different picture from what would be seen with an instrument-grade antenna that would obtain calibrated data. Second, currents within body tissues have a complex relationship to external electric and magnetic fields that depends on frequency and tissue properties. Use of a simple antenna and oscilloscope can, as here, identify the existence of electrical noise, but the technique used could not determine field strengths in units useful to others. Moreover, the magnitude of currents within a human body cannot be determined from measurements with simple uncalibrated instruments.

In contrast to electric field measurements with an antenna, an instrument-grade current transformer, such as frequently used in the power industry, would be needed to measure power quality of the current waveform. Power quality of the current waveform data is preferable to electric field data with an antenna as they give more readily repeatable measurements that can be attributed to a source. Similarly, determinations of ground current using screwdrivers as probes and long leads that apparently are unshielded could be indicative of non-sinusoidal components of the ground current, but are of little or no usefulness as a measure power quality in absolute or relative terms. As for the other methods, an AM radio can readily detect weak signals in a range around 1 MHz, but doesn't give information interpretable for a potential risk assessment.

The figures for "Solar array 49-810 Rancho Santa Fe La Quinta CA" illustrate demonstrate the presence of electrical noise on the mains power, but as in other data shown here, do not give adequate quantitative information to assess field strengths and exposures to human beings.

Dr. Milham states (I68-3 p 2) that "dirty electricity gets into your body by contact with the earth or from dirty electricity that gets into your house through the ground rod, wires or conductive pipes. Your neighbor's dirty electricity can make you just as sick as your own." The assertion about illness has no basis in established biomedical science and public health. They are at this time idiosyncratic beliefs held by a few. The overwhelming majority of the scientific literature on EMF health effects does not concern or support a role for poor power quality as a cause of adverse health.

#### References

Morgenstern H. 1998. *Ecologic Studies*. In: Modern Epidemiology, ed: Rothman, K. J. and Greenland, S., Philadelphia: Lippincott - Raven, 459-480.

National Cancer Institute. 2014. Cancer clusters. (accessed 09-May-14).