Department of Energy
Washington, DC 20585

November 12, 2009

Allison Hamilton
Oregon Department of Transportation
355 Capitol St. NE Room 115
Salem, OR 97301-3871

Dear Ms. Hamilton:

Thank you for contacting the U.S. Department of Energy regarding the Oregon Solar Highway program and your proposed 3 megawatt photovoltaic installation. In response to citizen concerns about potential health effects of electromagnetic fields (EMF) generated from the proposed installation, I have asked the National Renewable Energy Laboratory to conduct a literature review on the topic.

Their analysis shows that the health risks of the proposed installation due to electromagnetic fields are minimal, and that this issue should not impede the project from moving forward.

In summary, the magnitude of EMF exposure measured at the perimeter of PV installations has been shown to be indistinguishable from background EMF, and is lower than that from many household appliances such as televisions and refrigerators. Further, evidence linking EMF exposure from high-voltage power lines to cancer has been shown to be weak. High voltage power lines produce much stronger EMF than the proposed PV installation.

The Department of Energy believes strongly in the need to deploy solar technologies on a large scale to meet our national priorities for clean energy. The Department's Solar Energy Technologies Program will continue to aggressively analyze issues of concern to ensure safe, sustainable solar installations nationwide.

Please see the attached memo that further outlines the issues and references the published literature.

Sincerely,

John Lushetsky
Program Manager
U.S. Department of Energy
Solar Energy Technologies Program

Attachment

MEMO

To: John Lushetsky and JoAnn Milliken

From: Greg Brinkman and Robert Margolis, National Renewable Energy Laboratory

Subject: Health effects of electromagnetic fields from solar photovoltaic arrays

Date: August 18, 2009

This memo is in response to citizen concerns about electromagnetic field exposure from a proposed 3 MW solar photovoltaic (PV) installation in Oregon.

Electromagnetic fields (EMF) are produced by a variety of natural sources and can also be generated by the production and distribution of electricity. Residential to utility-scale solar PV arrays (i.e., a few kWs to MWs) will produce very low levels of EMF, comparable to low-voltage power lines. While PV produces direct current (DC) power, it is typically converted into alternating current (AC) power which is either used locally, or fed to the grid, typically on low voltage distribution lines.

The strength of an electromagnetic field is measured in units of Gauss (G). Electromagnetic fields at large PV arrays have been measured by Chang and Jennings.[1] PV panels produce weaker electromagnetic fields (<1 mG 3" from the panel) than many household appliances, such as televisions (7 mG at 10.5") and refrigerators (2.6 mG at 10.5").[2] Inverters and power conditioning units inside a solar PV array do produce significant electromagnetic fields, but the strength of all fields declines rapidly with distance. Electromagnetic fields at the perimeter of the PV system were indistinguishable from the background fields.

Studies have shown human exposure to EMF increases when power lines are within close proximity (less than 150 feet) to a residence. Zaffanella and Kalton[3] estimated that mean residential EMF exposure at homes with overhead power lines within 25 feet was 1.74 mG, with a 95th percentile value of 4.48 mG. Mean residential exposure at homes further than 150 feet from the nearest overhead power line was 0.93 mG, with a 95th percentile value of 2.21 mG. EMF strengths up to 10.3 mG have been measured at houses near high-voltage power lines.

The only evidence that links power lines and EMF to adverse health effects exists for high-voltage power lines. Even this evidence, however, is relatively weak (as described below). The level of EMF produced from high-voltage power lines is much stronger than the level of EMF produced by a solar array or the low voltage power lines required to transmit the electricity from a typical solar array.

Two approaches have been used to evaluate the possible health effects from EMF – epidemiology and toxicology.

- Epidemiological studies investigate correlations between exposure to a potential hazard and adverse health effects in a study population. Bias can occur due to confounding

factors if the exposure being studied is correlated with other variables that affect the outcome. For example, living in a residence close to a power line may be correlated with having a lower socioeconomic status, which could affect the incidence of certain health outcomes. This can be controlled using statistical methods if the confounding variables are known.

- Toxicological studies investigate correlations between exposure to a potential hazard and health effects in a population of animals that are usually assigned to a group that receives the exposure and a control group that does not. These studies have an advantage because the two groups can be identical except for exposure levels, and very high exposure levels can be tested. However, laboratory conditions do not always represent environmental exposures and results from animal studies are not always easily extrapolated to humans.

The National Institute of Environmental Health Sciences (NIEHS) at the National Institutes for Health (NIH) performed a review summarizing the health effects of electric and magnetic fields for the Electric and Magnetic Fields Research and Public Information Dissemination Program in the Energy Policy Act of 1992.[4]

The NIEHS study found that the scientific evidence suggesting a link between EMF from high voltage power lines and health effects is weak. The study did find a possible small increased risk of childhood leukemia due to increased exposure to EMF from high voltage power lines using certain methods to measure the exposure.[4] For example, the NIEHS report reviewed five epidemiological studies that examined proximity to different types of power lines as an indicator of EMF exposure. Two of these studies[5,6] showed no evidence of a correlation between power line type and childhood leukemia. Three of the studies did indicate a possible relationship.

Of these three studies, only one study[7] showed a statistically significant correlation between the group with high-voltage power lines near the residence and childhood leukemia. However, this study also measured EMF levels and found no correlation between EMF levels and childhood leukemia. The lack of correlation between EMF levels and childhood leukemia could indicate the presence of a confounding variable that biases the relationship between power line types and childhood leukemia. More recent reviews of scientific studies have found similar results.[8]

Animal exposure studies have not demonstrated a significant link between EMF exposure levels from high voltage power lines and cancers[4], although one study showed a significant reduction in mammary gland tumors in the exposed group.

Conclusion:

Evidence that EMF from power lines can lead to adverse health effects in humans is relatively weak, and is based on exposure to high-voltage power lines in close proximity (within 150 feet) to residences. Large solar photovoltaic arrays would not likely lead to these levels of exposure anywhere outside the perimeter of the system. Based on the available literature, there is little cause for concern of adverse impacts due to the projected electromagnetic fields at homes near the proposed installation.

References:

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4. Health Effects from Exposure to Power-Line Frequency Electric and Magnetic Fields. National Institute of Environmental Health Sciences, National Institutes of Health, 1999. Available at: http://www.niehs.nih.gov/health/topics/agents/emf/
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6. Linet MS, Hatch EE, Kleinerman RA, Robison LL, Kaune WT, Friedman DR, Severson RK, Haines CM, Hartsock CT, Niwa S, Wacholder S, Tarone RE. Residential exposure to magnetic fields and acute lymphoblastic leukemia in children. New England Journal of Medicine 337:1-7(1997).
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8. Schuz J, Ahlbom, A. Exposure to electromagnetic fields and the risk of childhood leukemia: a review. Radiation Protection Dosimetry 132:202-211(2008).