BEFORE THE STATE OF WASHINGTON

ENERGY FACILITY SITE EVAUATION COUNCIL

In the Matter of Application No. 2004-01: WIND RIDGE POWER PARTNERS, LLC; WILD HORSE WIND POWER PROJECT	EXHIBIT 38 (DK-T)

APPLICANT'S PREFILED DIRECT TESTIMONY
WITNESS #19: DANIEL KAMMEN

Q Please state your name and business address.

A My name is Daniel Kammen and my business address is 310 Barrows Hall Berkeley, CA 94720-3050.

Q What is your present occupation, profession; and what are your responsibilities and areas of expertise?

A I am a professor and director of the Renewable and Appropriate Energy Laboratory of the University of California at Berkeley. I hold joint appointments as Professor of Energy and Society with the Energy and Resources Group, Professor of Nuclear Engineering in the

DARREL L. PEEPLES
ATTORNEY AT LW
325 WASHINGTON ST. NE #440
OLYMPIA, WA 98506
TEL. (360) 943-9528 FAX (360) 943-1611
dpeeples@ix.netcom.com

Department of Nuclear Engineering, and Professor of Public Policy at the Goldman School of Public Policy, all at the University of California at Berkeley. I teach courses and conduct research on a variety of topics primarily related to energy and its impacts, with an emphasis on renewable energy sources, as well as risk analysis and communication.

Q Would you please identify what has been marked for identification as Exhibit 38(DK-1)?

A Exhibit 38(DK-1) is a résumé of my educational background, expertise and employment experience.

Q. Would you please briefly describe your expertise and qualifications?

A I received my undergraduate degree in physics from Cornell University (1984), and my masters and doctorate in physics from Harvard (1986 & 1988) for work on theoretical solid state physics and computational biophysics. I was then the Wezmann & Bantrell Postdoctoral Fellow at the California Institute of Technology in the Divisions of Engineering, Biology, and the Humanities (1988 - 1991). First at Caltech and then as a Lecturer in Physics and in the Kennedy School of Government at Harvard University, I developed a number of projects focused on renewable energy technologies and environmental resource management. At Harvard I also worked on risk analysis as applied to global warming and methodological studies of forecasting and hazard assessment. I received the 1993 21st Century Earth Award, recognizing contributions to

DARREL L. PEEPLES
ATTORNEY AT LW
325 WASHINGTON ST. NE #440
OLYMPIA, WA 98506
TEL. (360) 943-9528 FAX (360) 943-1611
dpeeples@ix.netcom.com

rural development and environmental conservation from the Global Industrial and Policy Research Institute and *Nihon Keizai Shimbun* in Japan.

From 1993 – 1998, I was an Assistant Professor of Public and International Affairs in the Woodrow Wilson School of Public and International Affairs at Princeton University. I played a key role in developing the interdisciplinary Science, Technology, and Environmental Policy (STEP) Program at Princeton, that awards undergraduate and masters certificates and a doctoral degree. I was STEP Chair from 1997 - 1999 and co-chair before that. In July of 1998, I joined the interdisciplinary Energy and Resources Group (ERG) at the University of California, Berkeley as an Associate Professor of Energy and Society. I am a Fellow of the American Physical Society and a Permanent Fellow of the African Academy of Sciences.

My research interests include: the science, engineering, management, and dissemination of renewable energy systems; health and environmental impacts of energy generation and use, and energy forecasting and risk analysis. I am the author of over 90 journal publications, a book on environmental, technological, and health risks *(Should We Risk It?* Princeton University Press, 1999) and numerous reports on renewable energy and development. I have been featured on radio, network and public broadcasting television and in print as an analyst of energy, environmental, and risk policy issues and current events. My recent work on energy R&D policy appeared in *Science*, and *Environment*, and has been featured on PBS, KQED, CNN, and in many newspapers via the Reuters news service.

DARREL L. PEEPLES
ATTORNEY AT LW
325 WASHINGTON ST. NE #440
OLYMPIA, WA 98506
TEL. (360) 943-9528 FAX (360) 943-1611
dpeeples@ix.netcom.com

I advise the U. S. and Swedish Agencies for International Development, the World Bank, and the US President's Committee on Science and Technology (PCAST), and am a member of the Intergovernmental Panel on Climate Change (Working Group III and the Special Report on Technology Transfer). I serve on the technical review board for the Global Environmental Facility (the STAP), am a lead author for the Special Report on Technology Transfer of the Intergovernmental Panel on Climate Change, and advise the American Academy of Arts and Sciences and well as the African Academy of Sciences.

Q Are you regarded as an expert with regard to risk analysis?

A Yes. I have published a book, *Should We Risk It* (Princeton University Press, 1999) on the methodologies and practicalities of performing risk assessments as well as peer reviewed journal articles on the subject of risk analysis and have taught the subject at both the undergraduate and graduate levels. I have also testified before U. S. House of Representatives' Science Committee panels on these issues.

Q Would you please explain to the Council the principles, techniques and methods used to conduct risk analyses?

A Risk analysis generally begins with identifying the potential sources of risk posed by the activity or facility to be evaluated. This involves identifying the conditions that could create a hazard and evaluating both the probability of those conditions occurring and the likely consequences if they were to occur. These risks are then quantified using accepted risk calculation methodologies, including an analysis of sensitivities. The resulting

DARREL L. PEEPLES
ATTORNEY AT LW
325 WASHINGTON ST. NE #440
OLYMPIA, WA 98506
TEL. (360) 943-9528 FAX (360) 943-1611
dpeeples@ix.netcom.com

quantified risk calculations are then evaluated and compared to the risks of other common or related activities to determine whether they are significant or not.

Q Are there local, national or international regulatory standards for public safety risks related to wind turbines?

A No. Currently there are no local or national regulatory standards for public safety risks relating to wind turbines in the United States. Guidance documents have been developed for this subject in some European countries, but there are no uniform international regulatory standards. However, third party certification programs for wind turbines (such as RISO, DNV and GL) do incorporate safety features and performance in their review of turbines for certification.

Q Are there local, national or international standards regarding public safety risks for other types of energy facilities?

A Generally speaking, no. There are no uniform standards that, for instance, state that the individual risk posed by any prospective energy facility should be less than or equal to 1 in a million or some other specific risk level. Certain types of facilities that are regulated by the federal government, such as nuclear plants and interstate petroleum pipelines, are subject to national safety-related standards, but these are not based on uniform risk criteria.

DARREL L. PEEPLES
ATTORNEY AT LW
325 WASHINGTON ST. NE #440
OLYMPIA, WA 98506
TEL. (360) 943-9528 FAX (360) 943-1611
dpeeples@ix.netcom.com

Q Would you generally describe the differing risk standards presently used in the U.S. for different types of risks?

A Currently, federal and state government agencies do not utilize a consistent, uniform approach to establishing "acceptable" risk limits for various activities. In many instances, no explicit risk level is stated for regulatory purposes (for example operating a motor vehicle). In other cases, regulatory agencies have adopted specific risk thresholds for various types of activities such as the remediation of contaminated sites and the allowable levels of certain potentially carcinogenic or otherwise hazardous substances in drinking water or food. While there is no uniform risk standard for regulatory purposes in the US, the most common risk standard, where such standards exist, is 1 in a million risk of death.

Q Were you requested to conduct a risk analysis study for Wild Horse Wind Power Project?

A Yes

Q Will you please describe the study you were requested to conduct for the Wild Horse Wind Power Project?

A I was requested to analyze and evaluate the potential public safety risks posed by the proposed wind power project, specifically the risk of a turbine blade becoming detached, the risk of a turbine tower collapsing and the risk of ice being thrown from turbine

DARREL L. PEEPLES
ATTORNEY AT LW
325 WASHINGTON ST. NE #440
OLYMPIA, WA 98506
TEL. (360) 943-9528 FAX (360) 943-1611
dpeeples@ix.netcom.com

blades. I was also asked to compare the risks of these wind turbine related scenarios to other types of risks that have already been quantified in order to put them in perspective.

Q Is this type of study within your area of authority and /or expertise?

A Yes.

Q Please describe the methodology of the study.

A First, we researched available information on the frequency and probability of the wind turbine related risks we were asked to evaluate. We sought information on the documented frequency of occurrence of these potential hazards as well as published sources regarding appropriate mitigations or setbacks to minimize these risks. Then we utilized the information from the ASC and the Applicant regarding the proposed types and sizes of turbines proposed for the Wild Horse Wind Power Project as well as the proposed locations of the turbines relative to roads and other areas with humans present to calculate the potential public safety risk of tower collapse, blade throw or ice throw. We then compared the calculated risk levels for the proposed Project to other, already quantified risks to evaluate their significance.

Q Would you please summarize and briefly describe the study.

A We compiled available research regarding the risks of tower collapse, blade throw and ice throw, based on published studies and guidance documents from the US and Europe. We

DARREL L. PEEPLES
ATTORNEY AT LW
325 WASHINGTON ST. NE #440
OLYMPIA, WA 98506
TEL. (360) 943-9528 FAX (360) 943-1611
dpeeples@ix.netcom.com

then calculated probabilities of the various hazards based on the available research and the specific type and sizes of turbines being proposed for this Project (60 meter rotor diameter to 90 meter rotor diameter) and the specifics of the particular Project site location (such as proximity to homes, roads, etc.) We then compared the calculated risk levels to other, known risk levels for common activities to evaluate their significance.

Q Based on your research, has any member of the ever public been killed by a wind turbine?

A The only reported case of a member of the public being killed by a wind turbine that we were able to find was a parachutist in Germany who jumped into a wind turbine.

Q How does the risk level of someone being killed by a wind turbine at the Wild Horse wind project compare with regulatory standards, or with those or other common activities?

A The risks of many common activities have already been quantified and reported in published sources. These are often used in communicating the results of risk analyses so that decision makers and members of the public can evaluate the significance of the risk level of a given activity or proposal relative to the risks of other activities that are more familiar. Our analysis concludes that the risk of a person being killed or seriously injured from a blade being thrown, a tower collapsing, or ice being thrown from a turbine is less than the following risks (risk source in parentheses):

- Traveling in automobile for 300 miles (accident)

DARREL L. PEEPLES
ATTORNEY AT LW
325 WASHINGTON ST. NE #440
OLYMPIA, WA 98506
TEL. (360) 943-9528 FAX (360) 943-1611
dpeeples@ix.netcom.com

- Riding a bicycle 10 miles (accident)
- Having one chest x-ray at a modern hospital (cancer caused by radiation)
- Living for 2 days in New York or Boston (air pollution)
- Drinking half a liter of wine (cirrhosis of the liver)
- Eating 40 tablespoons of peanut butter (liver cancer caused by aflatoxin B)
- Drinking 30 12 oz. cans of diet soda (cancer caused by saccharin)
- Eating 100 charcoal-broiled steaks (cancer from benzopyrene)

Q In your opinion, does the Wild Horse Wind Power Project, as currently proposed, present a significant risk to public health or safety?

A No, the potential public health and safety risks posed by this Project are insignificant and less than the risks posed by other common energy generating technologies and countless other common activities.

DARREL L. PEEPLES
ATTORNEY AT LW
325 WASHINGTON ST. NE #440
OLYMPIA, WA 98506
TEL. (360) 943-9528 FAX (360) 943-1611
dpeeples@ix.netcom.com