BEFORE THE OHIO POWER SITING BOARD

In the Matter of the Application of Kingwood Solar I LLC for a Certificate of Environmental Compatibility and Public Need.	**)** **)** **)** **)**	**Case No. 21-0117-EL-BGN**

DIRECT TESTIMONY OF BRENT FINLEY

Q.1. Please state your name, title and business address.

A.1. My name is Brent Finley. I am a Managing Principal Health Scientist with Cardno ChemRisk. My business address is 231 Front Street, Suite 212, Brooklyn, NY 11201.

Q.2. What are your duties as a Managing Principal Health Scientist?

A.2. Cardno ChemRisk is a consulting firm that provides state-of-the-art toxicology, industrial hygiene, epidemiology, and risk assessment services to organizations that face public health, occupational health, and environmental challenges. Over the last 30 years, I have authored over 500 health risk assessments related to the presence of chemicals in the environment, consumer products, foods, the workplace, households, and other settings. I have published over 150 peer-reviewed articles describing the health risk assessment of metals, dioxins, polychlorinated biphenyls, chromium, and chlorinated solvents.

Q.3. What is your educational and professional background?

A.3. I have a bachelor's degree in Biological Sciences from Cornell University and a Ph.D. in Pharmacology/Toxicology from Washington State University. Before joining Cardno ChemRisk, I was the Director of Exponent's Human Health Risk Assessment practice for six years.

Q.4. On whose behalf are you offering testimony?

A.4. I am testifying on behalf of the Applicant, Kingwood Solar I LLC (the "Applicant"), in support of its Application filed in Case No. 21-0117-EL-BGN.

Q.5. What is the purpose of your testimony?

A.5. The purpose of my testimony is to comment on the potential for health risks associated with leaching of metals from photovoltaic solar panels.

Q.6. Are photovoltaic solar panels commonly used for power generation?

A.6. Yes. Since the 1970s, photovoltaic solar panels have commonly been used to generate electricity, in applications ranging in size from solar farm facilities to individual rooftop-mounted solar panels.[1] Total solar electricity generation in the United States has increased in recent years, with an estimated 88 billion kilowatt-hours produced in 2020 representing 2.2% of the total United States energy production.[2] In Ohio specifically, there are thousands of solar installations already in use, with panels used in utility, commercial, and residential settings throughout many different communities.[3] One example of a recent community installation is at the Hicksville Public Schools, in Hicksville, Ohio (shown below in Figure 1).

Figure 1*. Ground-mounted Solar Panels at Hicksville Public Schools in Hicksville, Ohio*[4]

[1] https://www.eia.gov/energyexplained/solar/photovoltaics-and-electricity.php
[2] https://www.eia.gov/tools/faqs/faq.php?id=427&t=3
[3] https://puco.ohio.gov/wps/portal/gov/puco/utilities/electricity/service-area-map/ohio-certified-renewable-facilities
[4]https://www.prnewswire.com/news-releases/hicksville-schools-energize-solar-array-301074793.html

Q.7. Do solar panels have a life span?

A.7. Over the course of regular use, solar panels have a 25- to 30-year life span.[5] The exact duration of that period can vary as a factor of climate, panel type, and mounting system, among other factors.[6] With recent progress in solar panel manufacturing, some installations can exceed their normal life span and maintain high levels of performance.[7]

Q.8. Do manufacturers test solar panels for any environmental impacts?

A.8. Solar panel manufacturers do test photovoltaic solar panels for environmental impacts; newly constructed panels must adhere to internationally harmonized reliability and stability standards that ensure safety and durability before the panels are put into use.[8] Typical testing of photovoltaic solar panels involves heat and humidity stress, wind stress, hail impact, water immersion, and radiation exposure to assess reliability in the field.[9]

Q.9. Is there a potential risk of hazardous or toxic substances being released into the environment as a result of the Kingwood Solar Project (the "Project") using solar panel technology?

A.9. There is minimal risk for potential leaching of hazardous substances from solar panels into the environment because any hazardous substances are encapsulated within layers of glass and/or plastic polymer Ethylene Vinyl Acetate ("EVA"), which protect solar cells from air and moisture (see Figure 2, below). While solar panels are in use, this

[5] Chowdhury, M. S., et al. (2020). An overview of solar photovoltaic panels' end-of-life material recycling. *Energy Strategy Reviews*, *27*, 100431.
[6] https://www.nrel.gov/state-local-tribal/blog/posts/stat-faqs-part2-lifetime-of-pv-panels.html
[7] Jordan, D. C., & Kurtz, S. R. (2013). Photovoltaic degradation rates—an analytical review. *Progress in photovoltaics: Research and Applications*, 21(1), 12-29.
[8] Kurtz, S., et al. (2013). Photovoltaic module qualification plus testing (No. NREL/TP-5200-60950). National Renewable Energy Lab (NREL), Golden, CO (United States).
[9] https://vtechworks.lib.vt.edu/handle/10919/90197

encapsulation prevents any leaching of substances into the environment, thus minimizing any potential exposure.[10,11]

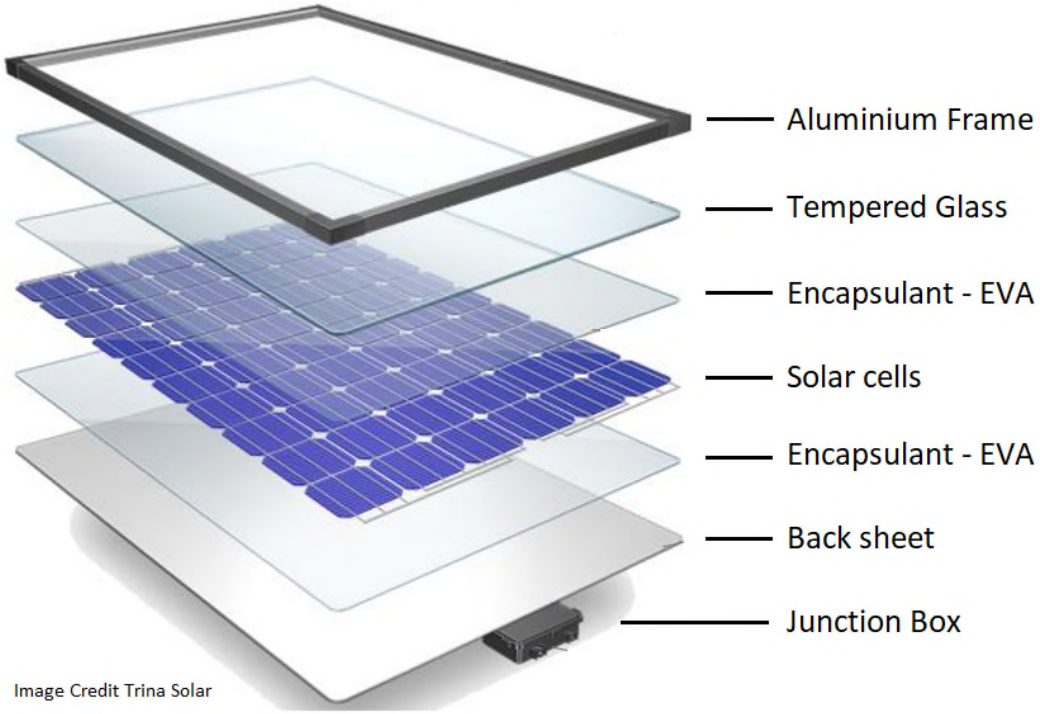

***Figure 2**. Cross Section of Solar Panel*[12]

In addition to their encapsulation, actual amounts of metals in an individual photovoltaic solar panel are very low in the first place. In a silicon-based photovoltaic solar panel, there is roughly 13g of lead per panel, which is ~0.1% of what is found in a car battery, while CdTe panels typically have 7g of cadmium per panel.[13]

In the very unlikely scenario that the solar panels break as a result of a natural disaster (earthquake, tornado, etc.), the metal components may potentially no longer be encased. However, risk of health effects is still remote even in this unlikely scenario. Studies modeling worst-case scenarios for metal leaching from broken or discarded solar panels

[10] Robinson, S. A., & Meindl, G. A. (2019). Potential for leaching of heavy metals and metalloids from crystalline silicon photovoltaic systems. *Journal of Natural Resource and Development*, 9, 19-24.
[11] Mathijssen, D., et al. (2020). Potential impact of floating solar panels on water quality in reservoirs; pathogens and leaching. *Water Practice & Technology*, 15(3), 807-811.
[12] https://www.cleanenergyreviews.info/blog/solar-panel-components-construction
[13] https://content.ces.ncsu.edu/health-and-safety-impacts-of-solar-photovoltaics

indicate either no measurable increases in soil metal concentration, or levels that are well below human health screening levels.[14,15,16] Additionally, because of the addition of the EVA encapsulation layer (see Figure 2), if a natural disaster were to cause a solar panel to break, the panel would likely crack but remain in one piece, similar to what happens in the windshield of a car.[17] Therefore, despite potentially becoming damaged, a cracked solar panel is still unlikely to leach metal substances because of the encapsulation.

Q.10. How will panels be disposed of when the Project is decommissioned?

A.10. As the photovoltaic solar panels reach the end of their lifespan, the Applicant's decommissioning plan (which I have reviewed) will account for dismantling and removal of panels from the Project area. Components from photovoltaic solar panels can be recycled for use in future photovoltaic units.[18] Because solar panels contain potentially toxic metals, at the end of the Project's life, non-recycled components are subject to the United States Environmental Protection Agency's Toxicity Characteristic Leaching Procedure ("TCLP"), as outlined in the Federal Resource Conservation and Recovery Act.[19] Components that pass the procedure can be disposed of as universal waste, while those that do not are regulated as hazardous waste. Materials managed as universal waste are not required to be shipped with a manifest or by a hazardous waste transporter. The universal waste regulations do require that the materials be managed in a way that prevents releases to the environment. In contrast, hazardous wastes have properties that make them dangerous or capable of having a harmful effect on human health or the environment. Prior

[14] Steinberger, H. (1998). Health, safety and environmental risks from the operation of CdTe and CIS thin-film modules. *Progress in Photovoltaics: Research and Applications*, 6(2), 99-103.
[15] Sinha, P., et al. (2012). Fate and transport evaluation of potential leaching risks from cadmium telluride photovoltaics. *Environmental toxicology and chemistry*, 31(7), 1670-1675.
[16] Sinha, P., & Wade, A. (2015). Assessment of leaching tests for evaluating potential environmental impacts of PV module field breakage. *IEEE Journal of Photovoltaics*, 5(6), 1710-1714.
[17] https://content.ces.ncsu.edu/health-and-safety-impacts-of-solar-photovoltaics
[18] https://www.nrel.gov/docs/fy19osti/73689.pdf
[19] https://www.epa.gov/sites/production/files/2015-12/documents/1311.pdf

to use, modern photovoltaic units pass the TCLP test, which is an intensive leachability test.[20]

Q.11. Does this conclude your direct testimony?

A.11. Yes, it does.

[20] https://content.ces.ncsu.edu/health-and-safety-impacts-of-solar-photovoltaics

CERTIFICATE OF SERVICE

I hereby certify that a copy of the foregoing was served upon the following via email on this 23rd day of February 2022.

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Summary: Testimony Direct Testimony of Brent Finley electronically filed by Mr. Michael J. Settineri on behalf of Kingwood Solar I LLC