BEFORE THE OHIO POWER SITING BOARD

In the Matter of the Application of Ross County Solar, LLC for a Certificate of Environmental Compatibility and Public Need.	**)** **)** **)** **)**	**Case No. 20-1380-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, Ross County Solar, LLC ("Applicant"), in support of its application filed in Case No. 20-1380-EL-BGN.

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

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

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

A.6. 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 kWh produced in 2020 representing 2.2% of total US 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 Hopewell-Loudon School in Bascom, Ohio (shown below in Figure 1).

[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://www.seia.org/state-solar-policy/ohio-solar

Figure 1. *Solar Panels on the roof of Hopewell-Loudon School in Bascom, Ohio*[4]

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 photovoltaics 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] Photovoltaic

[4] https://www.wtol.com/article/news/local/good-news/hopewell-loudon-solar-array/512-93a15396-11e4-4b62-a7b0-e9fbf6fa183b

[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).

solar panels typically undergo testing involving 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 to the environment as a result of the Project using solar panel technology?

A.9. There is minimal risk for potential leaching of hazardous substances from solar panels into the environment. Substances of potential concern within the solar cells are encased within layers of glass and 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 encapsulation prevents any leaching of metals into the environment, thus minimizing any potential exposure.[10,11]

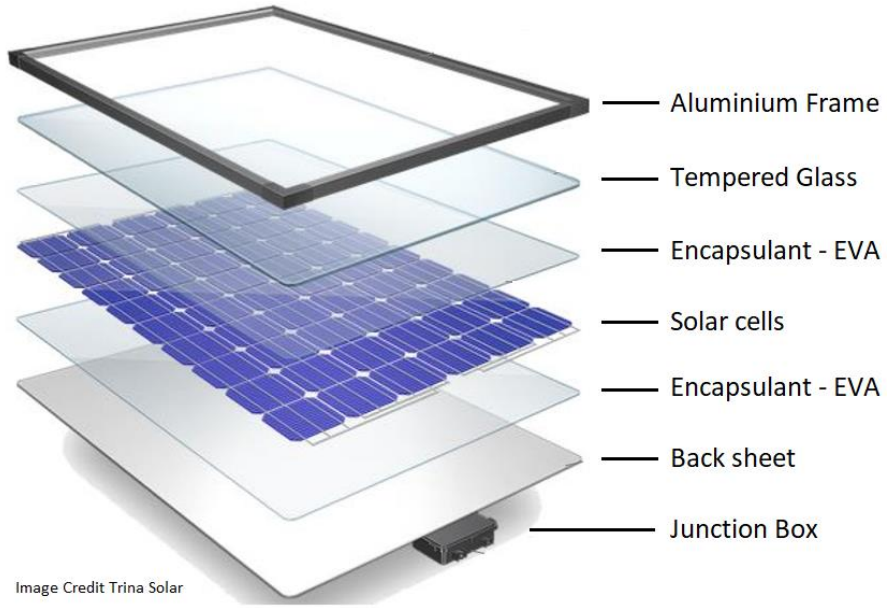

***Figure 2**. Cross Section of Solar Panel*[12]

[9] https://vtechworks.lib.vt.edu/handle/10919/90197
[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

In addition to their encapsulation, actual amounts of metals in an individual photovoltaic panel are very low in the first place. In a silicon-based photovoltaic panel, there is roughly 13g of Pb 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 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

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

toxic metals, at end-of-life non-recycled components are subject to the US EPA Toxicity Characteristic Leaching Procedure ("TCLP") as outlined in the Federal Resource Conservation and Recovery Act ("RCRA").[19] Components that pass the procedure can be disposed of as universal waste, while those that do not are regulated as hazardous waste; modern photovoltaic units typically pass the TCLP test.[20]

Q.11. Does this conclude your direct testimony?

A.11. Yes, it does.

[19] https://www.epa.gov/sites/production/files/2015-12/documents/1311.pdf
[20] https://content.ces.ncsu.edu/health-and-safety-impacts-of-solar-photovoltaics

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Summary: Testimony Direct Testimony of Brent Finley electronically filed by Ms. Anna Sanyal on behalf of Ross County Solar, LLC