

Notes

NEWMOA Hazardous Waste Conference Calls

January 7, 2019

Topic: Characterization and Management of Decommissioned Photovoltaic (“PV”) Solar Panels, Especially from Large Scale Solar Installations

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Participants: CT DEEP (5 people); CT Siting Council (3 people); Mass DEP (3 people); NH DES (9 people); NJ DEP (6 people); NYS DEC (14 people); RI DEM (1 people); VT DEC (6 people); NEWMOA (1 person)

Call leader: Ross Bunnell, CT DEEP

Notes prepared by NYS DEC

Overview of Issues Associated with Photovoltaic (“PV”) Solar Panels

PV solar panels and their associated components can contain any of several RCRA-hazardous constituents, including arsenic, cadmium, chromium, lead, and selenium, and silver. “Associated components” include inverters, transformers, circuit boards, wiring, hardware, etc. Different PV technologies use different chemicals in the PV cells:

- Crystalline silica (c-Si)
- Cadmium telluride (CdTe)
- Copper indium selenide (CIS)
- Copper indium gallium selenide (CIGS)
- Gallium arsenide (GaAs)
- New ones coming all the time

PV panels can also contain other (non-RCRA) environmental pollutants, such as antimony, brominated flame retardants, copper, indium, gallium, molybdenum, nickel, polybrominated biphenyls, polybrominated diphenyl ethers, silicon tetrachloride, tellurium, tin, and zinc. However, would PV panels qualify as “hazardous waste?” Mostly made up of glass, plastic, and non-hazardous metals. One study (based on c-Si panels) found:

- 76% glass
- 10% plastic
- 8% aluminum
- 5% silicon
- 1% copper
- < 0.1% silver, tin, and lead (1,000 ppm)

Concentrations may vary significantly by manufacturer, age, PV technology, etc. Limited TCLP test data appears to show:

- Most new solar panels pass TCLP
- Most older and some newer panels do not pass TCLP (typically for Pb)

PV panels have a life span of 20-30+ years. The oldest photovoltaic (“PV”) solar panels are at or are nearing end of life. The number of PV panels being installed in the USA has been increasing exponentially because of.

- Clean Energy incentives from federal, state, local governments
- Costs continue to come down – competitive with fossil fuels in many areas

One report estimates that by 2034, the amount of spent solar panels in need of recycling will be 70 to 80 times larger than in 2020.

Recycling activity/capacity is very limited in the U.S.:

- [First Solar](#) – claims that it has “state of the art recycling facilities” in the U.S., Germany, and Malaysia capable of recycling up to 90% of the material in solar panels.
- Some companies are shredding panels and sending them overseas.
- [Solar Energy Industries Association \(SEIA\)](#) began forming a [voluntary recycling program](#) in 2016, but it has not been fully launched yet.
- [Product Stewardship Institute](#) (PSI) examining solar panels.
- Washington State: first product stewardship law for solar panels in the U.S.

Europe is way ahead of us:

- [PV Cycle](#) – a non-profit, member-based organization that offers collective and tailor-made waste management services for PV panels and other related wastes. PV Cycle has expanded operations worldwide and appears to have some sort of presence in the U.S. (visit its website).
- Covered by the EU’s [Waste Electrical and Electronic Equipment \(WEEE\) directive](#).
- The majority of the European market are members.
- 17,000 tons collected and recycled since 2010 (does not include refurbishment).

Recycling can include recovering materials from PV solar panels (i.e., glass, metals, etc.), or reusing usable photovoltaic cells or whole panels to make new solar panels. Commercial (e.g., solar farms) vs. residential waste (e.g., rooftop solar):

- Commercial: potentially subject to RCRA regulation.
- Residential: exempt under RCRA’s Household Hazardous Waste Exclusion.

Consider whether solar panels are a candidate for designation as a Universal Waste:

- California has done this.
- NJ – covered under their electronics category?
- Facilitates generation, collection, and handling, but still have to deal with the recycling facilities (could be subject to RCRA permitting as destination facilities).
- Emerging Technologies: solar paint, solar ink?

Consider whether PV panels could be the next “e-waste” problem:

- Management at inappropriate solid waste facilities (auto shredders?).
- Illegal exports to third-world countries.
- Sham reuse/recycling.
- Stockpiling/abandonment (ala CRT glass).

Resources for Further Information

There is some information on the web regarding the characterization and management of PV solar panels at end of life. Some examples include:

- [Life cycle impact analysis of cadmium in CdTe PV production](#), National Photovoltaic Environmental Health and Safety Assistance Center, Environmental Sciences Department, Brookhaven National Laboratory, December 2003.
- [Cleaning Up After Clean Energy: Hazardous Waste in the Solar Industry](#), Stanford Journal of International Relations, Spring 2010.
- [The Not-so-Green Renewable Energy: Preventing Waste Disposal of Solar Photovoltaic \(PV\) Panels](#), Golden State University Environmental Law Journal, July 12, 2011.
- [End-of-Life Management of Solar Photovoltaic Panels](#), International Renewable Energy Agency, June 2016.
- [Health and Safety Concerns of Photovoltaic Solar Panels](#), Good Company, September 2016.
- [Health and Safety Impacts of Solar Photovoltaics](#), North Carolina Energy Technology Center, May 2017.
- [Are We Headed for a Solar Waste Crisis?](#), Environmental Progress, June 21, 2017.
- [Solar Panel Stewardship: The Future is Now](#), Product Stewardship Institute Webinar, 1/4/2018. Note: the above link indicates that there is a fee to obtain copies of the slides and recordings of this webinar. However, these materials can be obtained for free by PSI members. I also have a copy of the webinar slides if anyone would like them.
- [It's time to plan for solar panel recycling in the United States](#), Solar Power World, 10/4/2018.

Each State that Participated in the Call Addressed the Following Questions:

1. Have you received questions on end of life management of PV panels?

CT: Yes, not many, received inquiries from a town and a waste company and a few consultants and attorneys.

Mass: Yes, occasionally received questions about disposal, not much information to share about whether they are hazardous or not.

NH: No.

NJ: Received inquiry from a Class D facility (company known as Thanks for Being Green; aka Magnum) that want to know how NJ regulated PV panel recycling. NJ Class D facilities are those permitted for sorting or recycling of consumer electronics and/or batteries). Major utilities are also interested in the regulation regarding end of life management of PV panels since many telephone poles have a small PV panel attached to it (estimate that utilities have approximately 100,000 panels on poles)

NY: Yes.

RI: No

VT: Not much. Questions may be directed to solid waste recycling and e-waste staff.

2. If so, how did you answer them?

CT: Not sure, don't know if it is hazardous, lately they have provided a nuanced answer based on the information that DEEP has compiled, which is summarized above.

MA: Try to help them find an outlet for recycling.

NH: Not applicable.

NJ: No answers available.

NY: Advised them to make a hazardous waste determination and find a recycler. If the units have brackets, the hazardous scrap metal exemption may apply. Have advised them to handle the panels under the hazardous scrap metal exemption.

RI: Not applicable.

VT: Not applicable.

3. Do you have any TCLP test data on PV panels?

CT: No data.

MA: No data.

NH: No data.

NJ: No data

NY: No data.

RI: No data.

VT: No data.

4. Are there any PV panel refurbishers or recyclers in your state?

CT: Do not know of any, not sure where panels generated in the State are going.

MA: Not aware of any.

NH: Do not have any refurbishers.

NJ: No recyclers in the State. There is one Class D facility in southern region that handles e-waste who wants to recycle PVs.

NY: Don't know. There have been several non-specific inquiries from e-waste recyclers considering expanding their business to include these materials.

RI: No refurbishers or recyclers.

VT: No refurbishers or recyclers.

5. Is your state considering a producer responsibility or product stewardship approach to managing PV panels?

CT: Following PSI's efforts. Nothing active in CT.

MA: Unknown.

NH: Not sure what NH's position is. .

NJ: NJ has two laws – one for consumer electronics and another that is an EPR law, but not sure if end of life management of PV panels could fit under these laws or not.

NY: No.

RI: Open to EPR approach. None proposed.

VT: Don't know. Will investigate. Open to this approach, but DEC is not currently engaged in any efforts that would facilitate this.

6. Is your state considering listing PV panels as a Universal Waste?

CT: No active steps; will keep an eye on this topic; will consider if see more information.

MA: Not at this time.

NH: Not at this time. NH may investigate this option in the future.

NJ: Considering universal waste; have not taken any steps, however.

NY: Not considering adding PVs as universal waste. Waiting to see how this develops. Open to investigating.

RI: Not sure.

VT: Not considered at this time. May investigate this option in the future. VT looked into regulating PV panels as e-waste, but PV panels did not fit under the definition of consumer electronics.

Additional Questions & Discussion

PSI's solar panel webinar presentations are available online for states that are members. Massachusetts and New York are second and third to California and Texas in terms of the amount of installed PV solar panels.

The larger recyclers with large shredders are interested in taking solar panels in the future.

NY-Q: Regarding residential PV panels, has CT considered the regulatory implications of leased panels vs. purchased panels?

CT-A: Aware of the argument that panels leased by companies could be considered to be generated by the company and therefore not exempt as household hazardous waste (HHW). Historically, EPA often leans towards treating these types of waste (like residential gas meters removed by gas companies) as HHW, but that argument is something that needs to be addressed going forward. CT hasn't made a determination about this yet.

VT-Q: Are there any differences between commercial PV panels and residential PV panels?

CT-A: Commercial PV panels tend to have a higher wattage than residential PV panels.

VT-Q: Is there a database or should a database be created that tracks the different PV panels and whether those panels are a hazardous waste?

CT-A: Not aware of any database, but it would be helpful to have that type of data. States don't have the resources to create something like that, but an industry group might be much better suited to develop that kind of database.

CT-Q: What kind of permit would CT require for a PV panel recycler?

CT-A: If they were recycling hazardous waste PV panels and they were storing on-site prior to recycling, they would need a RCRA permit. If they were recycling hazardous waste PV panels without prior storage, they would be exempt from a RCRA permit but would need a solid waste permit for the treatment of waste chemical solids. If they were recycling non-hazardous waste PV panels, they would need a solid waste permit for the treatment of waste chemical solids.

CT – Some electronic recycling facilities, especially the facilities that sort and shred glass with large shredding systems, may be well suited to recycle PV panels since they have infrastructure in place that could recycle the panels.

NEWMOA – Heard that a lot of the current PV panel waste stream is made up of damaged PV panels from commercial solar installations.

Discussion About Enforcement Actions Involving Defective BP Solar PV Panels

NJ – Had an enforcement case involving defective BP Solar PV panels and a subcontractor that was stockpiling PV panels because of a lawsuit requiring BP Solar to replace the solar panels and take back the defective ones. Subcontractor had been stockpiling the PV panels and had sorted them into two piles; one hazardous pile and one non-hazardous pile. The subcontractor used serial numbers on the panels to determine which panels were hazardous waste. NJ instructed the subcontractor to dispose of the non-hazardous PV panels, but the subcontractor sent both the hazardous panels and non-hazardous panels to a solid waste landfill in Pennsylvania. NJ took enforcement action against the subcontractor and BP Solar, but the subcontractor took the brunt of the enforcement. Enforcement action was also taken against the transporter for shipping the hazardous waste panels to the solid waste landfill.

NY – Recently became aware of a similar stockpiling issue of the BP Solar panels in NY. They were PV panels (many of them faulty) that were sold through Home Depot to consumers. Similar to NJ BP solar was stockpiling panels that they were required to take back as part of the class action lawsuit. The manifest for the PV panels indicates that the panels were hazardous for cadmium and lead, but NY is unsure if this was based upon actual testing or generator knowledge. NY was able to determine that these panels came from household systems owned by the resident, and therefore fell out of hazardous waste enforcement jurisdiction.

Solar City manufactures and supplies rooftop solar panels. They have a partnership with Panasonic. Not clear whether they take back the panels.

CT-Q: in considering the older versus newer panels, the large scale solar installations are generally new and most of the older models were used on homes. Are there any large scale solar installations using the older technology? Not much. There may be experimental installations, but not in the northeast U.S. (in other parts of the country).

Information Shared After the Call Regarding the BP Solar Case

Wikipedia Page for BP Solar: https://en.wikipedia.org/wiki/BP_Solar. Says BP Solar was defunct as a corporation as of 12/21/2011. It was a subsidiary of BP (as in British Petroleum).

BP Solar Settlement Page: <http://www.bpsolarsettlement.com/> says that there was a class action settlement under which owners of BP Solar PV panels may be entitled to replacement solar panels and/or inverters. The class action lawsuit was against BP Solar and Home Depot. Resulted in the creation of a >\$65 million fund for the inspection and replacement of defective panels. The Web page provides information on the nature of the defects resulting in the lawsuit. Phone number for persons that may be eligible to receive reimbursement under the settlement: 1-844-360-2767. Email contact address: info@BPSolarSettlement.com. Mail address: BP Solar Panel Settlement, c/o JND Legal Administration, PO Box 6878, Broomfield, CO 80021. Claims began being made for reimbursement from the fund as of 2/6/2017. Claims appear to be ongoing. Lawsuit link: http://www.bpsolarsettlement.com/classaction/bpsolar/documents/bps_ctac.pdf. Filed 9/23/2016 in US District Court, Northern District of California.

Settlement Agreement link: www.bpsolarsettlement.com/classaction/bpsolar/documents/bps-settlement-agreement.pdf:

- Dated 9/1/2016. Defendants included BP Solar International and Home Depot USA, Inc.
- Defective panels were manufactured by BP Solar from 1999 to 2007 and had faulty junction boxes.
- Claimants with defective panels (as determined by a qualified inspector as defined in the settlement) are entitled to have defective panels replaced by a “remediation contractor” as defined in the agreement.
- The disposal of the defective panels removed by the contractors are the responsibility of the “ICA” or “Independent Claims Administrator” identified in the settlement agreement, specifically Jennifer Keogh of JND Legal Administration.
- Roles and responsibilities of the ICA, approved inspectors, remediation contractors, and others regarding the replacement of defective panels are set forth in the “Claims Protocol” attached to the Settlement Agreement as Attachment 1.
- Notice to potential claimants regarding the Class Action Settlement: www.bpsolarsettlement.com/classaction/bpsolar/documents/bps-long-form-notice.pdf. Indicates that “anyone in the United States” who purchased the defective panels is eligible for reimbursement under the settlement. Does not appear to be limited to any particular states.