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Center for a Competitive Waste Industry

**INFORMATION ALERT TO STATE ENVIRONMENTAL AGENCIES
REGARDING LANDFILL SOLAR PANELS**

Synopsis

Closed landfills have been proposed as the site for installing a layer of solar photovoltaic cells with a geomembrane substrate in lieu of prescriptive Subtitle D final covers. Such integrated solar caps would provide renewable electricity as a benefit. Less well understood is the risks and associated costs posed to the states where these landfills are located. Because these new caps omit so many critical features of traditional covers, the prospect cannot be ignored of future site failures that may cost tens of millions of dollars to remediate. Current financial assurances provide no funds for these types of costs. Therefore, rigorous reviews should be given before permitting solar caps as legitimate alternative covers, and if they are permitted, in the face of substantial uncertainties, additional financial assurances should be required as a condition of the permit in order to protect the state's taxpayers.

Subject

Recently, a landfill and a solar collector company have promoted the installation of flexible solar panels on top of closed landfills that are integrated with an underlying geomembrane. The claimed advantage of such a system is the potential to productively utilize otherwise wasted space for the generation of renewable electricity. Examples are the Republic Services' Hickory Ridge Landfill in Georgia and Tesson Road Landfill in Texas.

Issue

State environmental regulators are primarily responsible to insure that closed landfills continue to be isolated so that they will not pose a threat to the environment for the extended periods of time that they remain latently biologically active.

Thus, the salient question for regulators in this regard is, not the ancillary renewable energy benefits, but rather how these integrated solar caps meet their primary responsibility to insure long-term stabilization of the landfill.

After a landfill is closed, the interred wastes remain a threat to the environment for an extended period of time, typically contemplated in terms of centuries. The stabilization of a durable final cover is considered essential to reduce the centuries long threats that are posed by closed landfills.

The matter considered in this note is: Distinct from the solar caps' renewable energy benefits, does the integrated solar cap also provide an equivalence for groundwater protection to prescriptive final covers?

Analysis

The Environmental Protection Agency's landfill rules for final covers are found in 40 CFR §258.40, which collectively are often referred to as the Subtitle D rules.

They provide that, after a landfill is filled to its final grade, a low permeable final cover is to be installed. That cover is to have an overall performance not less than the bottom liner, and in no case permit infiltration greater than 1×10^{-7} cm/sec.

In practice, to achieve these objectives, the final cover usually consists of (from the upper surface to the interface with the underlying wastes):

- Vegetation designed to retard soil erosion and control runoff
- An earthen soil-erosion layer at least 6" thick
- A geonet to allow drainage below the soil erosion layer
- A flexible geomembrane liner, typically a flexible high-density polyethylene (HDPE) plastic sheet, with a thickness of 0.06"
- An infiltration low permeability clay liner of at least 18"
- An intermediate cover of 12" of soil over the landfilled waste

In comparison to traditional designs, the integrated solar cap at the Hickory Ridge and Tessman Landfills consists (from top to bottom):

- A flexible thin layer of photovoltaic cells
- A flexible membrane liner using Carlisle's TPO Geomembrane to serve both as a substrate for the photovoltaic cell layer and as a low permeable barrier
- A grading layer to serve as a level base for the photovoltaic cell layer
- An intermediate cover of 12 inches of soil over the landfilled waste

Thus, on its face, the solar cap does not include the composite clay infiltration liner used in conjunction with the geomembrane in prescriptive Subtitle D covers, which is intended to provide insurance for infiltration in the event of ruptures in the geomembrane, nor the integrated vegetation/soil/drainage layer to support at the surface an enduring protective vegetative cover from the elements.

As a new proposal, there is no actual long-term performance data for the integrated solar cap to evaluate. However, the novel concept runs up against several significant challenges to provide equivalent long-term barrier performance to a Subtitle D cover. Among those new issues immediately apparent are the following:

1. Over centuries long periods of time, will geomembrane-only covers provide the same range of long-term design performance as composite clay/geomembrane covers?

2. Will the waste heat generated in the overlying photovoltaic cells impair the long-term performance of the underlying geomembrane? Normal PV cells release 85%

or more of the energy generated as waste heat, which, if not removed, could exceed 175°F for prolonged periods at the interface between the two layers?

3. Without a thick clay liner, what kind of additional stresses will subsidence in the underlying wastes create on a geomembrane-only cover, especially if the membrane-only cover also experiences more leaks that enhance further decomposition in the wastes? Also, what is the maximum subsidence stresses that the solar cap is designed to withstand?

4. How are the strips of flexible photovoltaic cells and geomembrane bound to each other, and what tests address their durability in a landfill environment?

5. What is the means of adhering the flexible photovoltaic layer to the geomembrane, what tests have been done on their effectiveness, and on the consequences from the two delaminating?

6. What will be used a protective layer over the photovoltaic cells, and what tests have been done on its long-term effectiveness, including on the cells' useful lives, and the consequences from its failure?

In the context of a Subtitle D landfill permit, whether as a standard or as a research, development and demonstration permit, the obligation is on the landfill owner to demonstrate that any alternate cover will provide equivalence to the prescriptive requirements in regard to protection of groundwater. 40 CFR §258.4(a)(3) and § 258.40(a)(1). Statutorily, the renewable energy benefits, while admirable, need to be considered after the core Subtitle D requirements have first been met.

Usually, to meet these tests, an applicant will put forward alternative protective measures to provide equivalence, which leaves as the issue to resolve whether that alternate measure in fact does so. In this case, however, nothing has even been put forward that purports to show anything that provides equivalent protection to those provided by the clay infiltration layer nor the erosion vegetative layer. In addition to that critical omission, there are also the new challenges that the novel solar cap presents, which are listed above, and have yet to be addressed.

Until both are done, and equivalence found, there does not appear to be a proper basis to approve an integrated solar cap as an proper alternative cover allowed in the rules.

Even if something is later shown and found to possibly be adequate, there will remain significant uncertainties as to whether the solar cap will survive and perform to the same degree as the Subtitle D cover for the requisite extended period of time. In that eventuality, the solar cap over the closed landfill will have to be excavated and replaced with a prescriptive cover. This may cost in the order of \$150,000 per acre, or more than \$50 million for a mega-sized landfill.

The likelihood that, in the future, the original owner of the landfill will pay the significance expense for cover replacement does not appear to be realistic. As a closed landfill, the facility will no longer be revenue producing to the original owner. That is a circumstance, which history teaches, will encourage the owner to abandon the site when confronted with major maintenance or corrective action expense. For this reason, Congress included as a further requirement in Subtitle D of the Hazardous and Solid Waste Amendments of 1984, for EPA to adopt financial assurance rules for the post-closure period. 42 USC §6901, at SECTION 4010(c)(6).

Unfortunately, in general those financial assurances do not provide any funds for this purpose for a State to draw on. For one thing, the relevant items requiring assurances only include the cost of installing a final cover once. 40 CFR §258.71. Carlisle Energy Services, which is providing the integrated solar cap to Republic Services, states on its web site that its “installation cost is comparable to a traditional Subtitle D cap.” Therefore, once the solar cap is installed, those assurance funds will have been expended, and not be available for restoring a failed cover in the future if needed.

In addition, neither would there be any funds for corrective actions later found to be necessary to address a release of pollutants into groundwater due to a failed solar cover, because those assurances, anomalously, can only be required after the event has occurred. 40 CFR §258.73. Finally, even if there were coverage, some of the allowable assurance mechanisms under the EPA rules are widely considered inadequate to provide real assurance, including the corporate financial test and the corporate guarantee. 40 CFR §40.258.74(e) and (g).

Recommendations

If presented with an application to amend a landfill permit in order to allow an integrated solar cap in lieu of a prescriptive cover, state regulatory agencies should:

1. Require supporting data to show the type of equivalence required for the permit amendment being sought.
2. Carefully review the data for its adequacy to show equivalence.
3. Because the irreducible uncertainties are significant, even if a showing appears to have been made, require as a condition of the amendment: (a) inclusion of the additional cost for removing a failed cover and installing a prescriptive cover, and (b) exclude from this new coverage reliance on the corporate financial test and corporate guarantee.

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