Solar PV and Closed Ash Ponds - A Match made in Heaven?

Neal P. Kochis, P.E.¹, Steven F. Putrich, P.E.², Lee Saunders, P.E.³

¹Haley & Aldrich, Inc., 6500 Rockside Road, Suite 200, Cleveland, OH, 44131, Cell: (216) 469-5478, nkochis@haleyaldrich.com; ²Haley & Aldrich, Inc., 6500 Rockside Road, Suite 200, Cleveland, OH, 44131, Cell: (330) 310-6800, sputrich@haleyaldrich.com, ³Haley & Aldrich, Inc., 6500 Rockside Road, Suite 200, Cleveland, OH, 44131, Cell: (440) 570-9420, isaunders@haleyaldrich.com

With the continued improvement/increased efficiency and cost effectiveness of solar PV, solar farms are becoming more and more prevalent across the country. Utilities are now more routinely establishing renewable/clean energy goals as part of their company portfolios, while also facing the likely closure of numerous large, open area ash ponds in the near future. This presents a favorable opportunity for the development of solar PV farms on closed ash pond units.

The US solar industry continues to grow at a record pace. PV currently represents over 30% of new electric capacity generated across the country and there are some 2 million solar installations now completed as opposed to one million in 2016. In addition, utilities are leading the way with some 60% of added electricity generating capacity consisting of solar PV. Finally, over half of the states now also have renewable energy standards and goals.

At the same time, by the year 2020, of the estimated 20,000+/- acres of ash ponds across the US, a majority of these are expected to initiate closure within the next 1 to 2 years per federal CCR Rule requirements. It is also estimated that a majority of the closures are proposed to close in place (install a final cover over the ash contained within the unit). Finally, these unit closures will include a 30-year minimum maintenance requirement.

For these reasons alone utilities would be wise to initiate feasibility studies for siting consideration of future PV applications. But the fact is that assuming a given closed ash pond is operating as designed, there are several additional advantages for PV at closed ash ponds over that of traditional greenfield sites. These advantages include cost savings for the purchase/lease of land, avoidance of the development permit requirements associated with zoning, ordinance restrictions, public scrutiny and risks of delay. There are also benefits regarding environmental concerns and significant cost and time savings associated with site preparation since the closed ash ponds have already been cleared, graded at relatively gentle slopes (typically 1% to 5%) and vegetated. Stormwater management and erosion control features and measures would have also already been incorporated into the ash pond closure design that would likely
not require significant modification to accommodate PV infrastructure. Closed ash ponds are also situated near the existing grid infrastructure.

There are some relatively minor limitations to installing solar PV over closed ash ponds associated with the fact that the final covers cannot be breached. This restriction simply means that PV alternatives will likely be limited to ballasted, fixed tilt systems that rest on the ground surface instead of the more traditional driven post system. Construction methods may also need to be modified slightly from that of a traditional greenfield since concentrated or successive loading from construction equipment will generally need to be avoided to ensure the stability and integrity of the ash pond final cover system.

Other special considerations for installing PV on a closed ash pond may include the use of above-ground ballasted cable trays/conduits, subgrade reinforcing via placement of crushed stone and or geogrid reinforcement below inverters and other select structures and construction of temporary or permanent access roads during construction for high traffic areas. Closed ash ponds will also have vegetation management requirements that may result in more frequent mowing and/or require specialized equipment or vegetation management measures.
Solar PV and Closed Ash Ponds – A Match made in Heaven?

Neal P. Kochis, P.E.
Steven F. Putrich, P.E.
Lee Saunders, P.E.
CCR & Industrial Waste Program
Haley & Aldrich, Inc.
INTRODUCTION
Goals for Today

– Show how a Closed Ash Pond would typically be a favorable site for Solar PV application, particularly over that of a traditional greenfield site.
– Identify use limitations & special considerations for this application.
Overview

1. Why Solar PV at Closed Ash Ponds?
2. General Assumptions
3. PV Site Selection Considerations
4. Use Limitations
5. Special Considerations
INTRODUCTION
Why Solar PV at Ash Ponds?

- **U.S. Solar Industry Growing at Record Pace**
  - PV 30+% of New Electric Capacity Generated
  - 1.9+ Million solar installations in the U.S. (Up from 1 million in 2016; 4 million expected in 2023)
  - Utilities lead the way with 60% of added capacity

- **U.S. Renewable Energy Standards & Goals**
  - 29 states have Renewable Energy Standards or goals
  - 18 states specify renewables/solar in portfolio
INTRODUCTION

Why Solar PV at Ash Ponds?

Anticipated Closure Of Ash Ponds

• Closures by 2020 - Estimated 20,000+/- acres of Ash Ponds across US, a majority of which will need to initiate closure by Oct. 2020 per Federal CCR Rule requirements (failure to meet LR & GW requirements)

• Close in Place – A majority of closures are currently proposed as close in place

• Post-Closure Maintenance - Most closed ash ponds must be maintained for a min. 30-years
GENERAL ASSUMPTIONS/REQUIREMENTS

• COVER STABILITY - The final cover system needs to be stable and performing as designed.

• BEARING CAPACITY - The final cover system is expected to have adequate bearing capacity to accommodate the deadloads of a typical ballasted PV system.

• COVER SLOPES – Typically 1% to 5% grades

• MINIMAL SETTLEMENT - Long-term significant differential settlement is not expected; would not be a serious design constraint
PV Site Selection Considerations

Comparison of Greenfield vs. Closed Ash Pond
PV Site Selection Considerations

LAND PURCHASE/LEASE

• **Greenfield** – may need to locate/contract/purchase land

• **Closed Ash Pond** – no land cost; property already in-place and a known commodity

DEVELOPMENT PERMIT REQUIREMENTS

• **Greenfield** – must satisfy zoning, ordinance & site development requirements (setbacks/offsets, public scrutiny, clearing limitations, etc.) as applicable; potential risk of delay;

• **Closed Ash Pond** – simply conform to conditional use permit requirements and CCR Rule (permits not likely required)
PV Site Selection Considerations

ENVIRONMENTAL CONCERNS

• **Greenfield** – may require state or federal site environmental evaluation (i.e.,
  wetland delineation, ecosystem investigations, etc.)

• **Closed Ash Pond** – siting restrictions have already been addressed

SITE PREPARATION

• **Greenfield** – will require site/civil engineering design and construction (site
  access, clearing, grading, erosion control & stormwater management)

• **Closed Ash Pond** – site preparation is essentially complete with functioning
  stormwater management system in place; but must ensure cap integrity
during solar PV installation
PV Site Selection Considerations

GEOTECHNICAL CONCERNS

• **Greenfield** – site specific; wide range of variability, but not typically a significant issue for providing minimal bearing support for anchor loading

• **Closed Ash Pond** – would need to confirm dike stability due to overall additional loading and point loads; avoid liner penetrations

SYSTEM ANCHORING/RACKING OPTIONS

• **Greenfield** – all options available; driven post or ballasted anchoring; fixed tilt, one and two axis tracker systems

• **Closed Ash Pond** – limited to ballasted, fixed tilt systems (no penetrations)
PV Site Selection Considerations

INTERCONNECTION/INFRASTRUCTURE

• **Greenfield** – distance from site to existing grid access can vary adding potential additional challenges/costs

• **Closed Ash Pond** – adjacent to existing utility infrastructure

SITE SERVICEABILITY/LONG-TERM MANAGEMENT

• **Greenfield** – new independent site requiring routine maintenance throughout operating life of solar array

• **Closed Ash Pond** – routine maintenance/operation costs already accounted for as part of long-term care plan (typically a 30-year post-closure regulatory requirement)
# PV Site Selection Considerations

<table>
<thead>
<tr>
<th>CONSIDERATION</th>
<th>GREENFIELD SITE</th>
<th>CLOSED ASH POND</th>
</tr>
</thead>
<tbody>
<tr>
<td>Land Purchase/Lease</td>
<td>$ $</td>
<td></td>
</tr>
<tr>
<td>Development Req'mts.</td>
<td>$ $ $</td>
<td></td>
</tr>
<tr>
<td>Environmental Concerns</td>
<td>$ $ $</td>
<td></td>
</tr>
<tr>
<td>Site Preparation</td>
<td>$ $ $</td>
<td></td>
</tr>
<tr>
<td>Geotechnical Concerns</td>
<td>$</td>
<td></td>
</tr>
<tr>
<td>Anchoring/ Racking</td>
<td>$</td>
<td>Limited Options</td>
</tr>
<tr>
<td>Connect to Infrastructure</td>
<td>$ $ $</td>
<td></td>
</tr>
<tr>
<td>Long-Term Mgmt.</td>
<td>$ $ $</td>
<td></td>
</tr>
</tbody>
</table>

= Cost Factor

= Time Factor
Use Limitations

Associated with Solar PV at a Closed Ash Pond
Use Limitations – Anchoring

• **DRIVEN POSTS** - For Typical Greenfield Sites, Solar PV Anchoring System installation uses driven posts
  – Can accommodate fixed tilt, or single- or dual-axis tracker systems
Use Limitations – Anchoring/Racking

• **BALLASTED** - For Closed Ash Pond Sites, ballasted installations are necessary (no liner penetrations)

• **FIXED TILT** - 1-axis trackers are not practical with ballasted systems due to sensitivity to differential settlement/alignment tolerances
Use Limitations – Potential Geotechnical Concerns

DIKE SLOPE STABILITY

• Will need to confirm that dikes can accommodate additional dead load of ballasted anchors and racking systems

• Distributed load of PV system for ballasted systems typically in the range of 200+/- psf
  – Worst case – include a buffer around perimeter dike

LOADING LIMITATIONS

• During construction

• Confirm support for foundation point loads
Special Considerations
Special Considerations – System Design

• Assume electrical connections in above-ground, ballasted cable trays/conduits

• Incorporate temporary access roads during construction for high traffic areas; permanent access roads as needed

• Subgrade for inverters and others select structures may require additional crushed stone/geogrid reinforcement to span loads
Special Considerations/Logistics – During Installation

• Ensure the integrity of the cap
  – Potential for low-ground pressure (LGP) equipment
  – Limit ground disturbance
  – Ensure available area for staging parts and equipment outside cap area
Special Considerations – Cap Maintenance

• Vegetation Management
  – More stringent requirements than typical greenfield
  – Mowing may be more labor-intensive; require specialized equipment
  – Transition to or replace vegetation with low-growing seed mixture
  – Potential for creative and innovative alternatives
Special Considerations – Stormwater Management

• Existing Stormwater Management System already in-place
  – No significant modifications expected
  – Selective Unit Placement – avoid placing ballasts within main drainage swales

• Erosion Control – address as needed
  – Erosion not anticipated to be a significant issue in sheet flow areas due to very mild slopes across site
  – May need added protection if placing ballasts across channelized drainage areas
Solar PV and Closed Ash Ponds – A Match made in Heaven?

Neal P. Kochis, P.E.
Steven F. Putrich, P.E.
Lee Saunders, P.E.
CCR & Industrial Waste Program
Haley & Aldrich, Inc.