Hickory Solar

Decommissioning Plan

October 28, 2019

Prepared for:

City of Chesapeake, Virginia

Prepared by:

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Suite 640
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1.0 Decommissioning Plan

This Decommissioning Plan is submitted pursuant to City of Chesapeake PLN-USE-2018-042 Hickory Solar Farm Amendment, dated January 16,2019, issued to Caden Energix Hickory LLC, condition #16.

This Decommissioning Plan is pursuant the following parameters.

1. **The anticipated life of the Hickory solar energy facility is 35 years.**
2. **The estimated net cost of the decommissioning in the future expressed in current (2019) dollars is $218,309.**
3. **The cost estimate of the decommissioning plan shall be updated every five (5) years by Caden Energix Hickory LLC and provided to the City of Chesapeake**
4. **The estimate was determined as detailed in this Decommissioning Plan.**
5. **The project will be decommissioned in a manner as detailed in this plan.**
6. **Name and physical address of entity responsible for this Decommissioning Plan and for providing a surety to the City of Chesapeake guaranteeing completion of the decommissioning plan:**

   Caden Energix Hickory LLC
   2311 Wilson Blvd.
   Suite 640
   Arlington, VA 22201

1.1 General

The following provisions are intended to ensure that facilities are properly removed after their useful life or as required pursuant to **PLN-USE-2018-042 Hickory Solar Farm Amendment**. The plan shall include provisions for removal of all structures and foundations, restoration of soil and vegetation and a plan ensuring financial resources will be available to fully decommission the site. The Contractors shall comply with requirements of all permits during the decommissioning process.

1.2 Decommissioning and Reclamation

At the end of commercial operations, the Owner will be responsible for removal of all above ground equipment and roads and the equipment pad foundations found at the inverters and substation to a depth of 36”. The owner will restore and reclaim the site to pre-construction topography and topsoil quality to the extent practical, including the access roads. The Owner reserves the right to extend the Project instead of decommissioning at the end commercial operations with landowner permission and upon obtaining all necessary State and local permits. If the Owner seeks to extend the life of the Project, they will decide whether to continue operation with existing equipment or to retrofit solar panels and power systems with upgrades based on new technologies.

Decommissioning includes removing the solar panels, solar panel racking, steel foundation posts and beams, inverters, transformers, overhead cables and lines, equipment pads and foundations, equipment cabinets, and ancillary equipment. The civil facilities, access road, security fence, and any drainage structures are included in the scope. Standard decommissioning practices would be utilized, including dismantling and repurposing, salvaging/recycling, or disposing of the solar energy improvements.

After all equipment is removed, any holes or voids created by poles, concrete pads and other equipment will be filled in with soil to the surrounding grade and seeded with a previously approved seed mix. All access roads and other areas compacted by equipment will be de-compacted to a depth of 18 inches from finished grade prior to fine grading and seeding. This may include re-vegetation as meadows, returning the site to use consistent with this Decommissioning Plan, or re-development of the land for other beneficial uses, based on consultation with the landowner.

1.3 List of Decommissioning Activities

1.3.1 Timeline

Decommissioning is estimated to take 4 to 6 months to complete and the decommissioning crew will ensure that all equipment and materials are recycled or disposed of properly.

1.3.2 Removal and Disposal of Site Components

The removal and disposal details of the site components are found below.

Modules: Modules will be inspected for physical damage, tested for functionality, and disconnected and removed from racking. Functioning modules will be packed and stored in an offsite facility for reuse or resale. Non-functioning or non-reusable modules will be packed, palletized and shipped to the manufacturer or a third party for recycling or disposal.

Racking: Racking and racking components will be disassembled and removed from the steel foundation posts, processed to appropriate size, and sent to a metal recycling facility.

Steel Foundation Posts: All structural foundation steel posts will be pulled out to full depth, removed, processed to appropriate size, and shipped to a recycling facility. During decommissioning, the area around the foundation posts may be compacted by equipment and, if compacted, the area will be de-compacted in a manner to adequately restore the topsoil and sub-grade material to a density consistent with meadow or woodland uses.

Overhead and Underground Cables and Lines: Underground cables and conduits contain no materials known to be harmful to the environment. As part of the decommissioning of the project, all cable will be excavated and removed from the site. Topsoil will be segregated and stockpiled for later use prior to any excavation and the subsurface soils will be staged next to the excavation. The subgrade will be compacted to a density of approximately 90 percent of Standard Proctor. Topsoil will be redistributed across the disturbed area. Overhead lines will be removed from the project and taken to a recycling facility.

Inverters, Transformers, and Ancillary Equipment: All electrical equipment will be disconnected and disassembled. All parts will be removed from the site and reconditioned and reused, sold as scrap, recycled, or disposed of appropriately, at the Owner’s sole discretion, consistent with applicable regulations and industry standards.

Equipment Pads and Ancillary Foundations: Topsoil will be removed from an area surrounding the foundation and stockpiled for later use/replacement, as applicable. Foundations will be excavated to a depth sufficient to remove all conduits, cables, aggregate, and concrete to a depth of 36 inches below grade. The remaining excavation will be filled with clean subgrade materials of quality comparable to the immediate surrounding area. All unexcavated areas compacted by equipment used in decommissioning will be decompacted in a manner to adequately restore the topsoil and sub-grade material to a density of approximately 90 percent of Standard Proctor. All materials will be removed from the site and reconditioned and reused, sold as scrap, recycled, or disposed of appropriately, at the owner’s sole discretion, consistent with applicable regulations and industry standards.

Fence: All fence parts and foundations will be removed from the site and reconditioned and reused, sold as scrap, recycled, or disposed of appropriately, at the owner's sole discretion, consistent with applicable regulations and industry standards. The surrounding areas will be restored to pre-construction conditions to extent feasible.

Access Roads: Facility access roads will be used for decommissioning purposes, after which removal of roads will be discussed with the Landowner, using the following process:

1) After final clean-up, roads may be left intact through mutual agreement of the landowner and the owner unless otherwise restricted by Federal, State, or Local Regulations.

2) If a road is to be removed, aggregate will be removed and shipped from the site to be reused, sold, or disposed of appropriately, at the Owner's sole discretion, consistent with applicable regulations and industry standards. Geotextile fabric will be removed and disposed of appropriately off site. Ditch crossings connecting access roads to public roads will be removed unless the landowner requests they remain. The subgrade will be de-compacted to a depth of approximately 18 inches using a chisel plow. Topsoil that was stockpiled during the original construction will be distributed across the open area. The access roads and adjacent areas that are compacted by equipment will be de-compacted.

1.3.3 Restoration/Reclamation of Site

The Owner will restore and reclaim the site to the pre-construction condition unless the landowner requests a condition less expensive to attain for future property use. The owner assumes that most site will be returned to meadow, as exists currently on areas planned for the solar modules, after decommissioning and will implement appropriate measures to facilitate such uses. If no specific use is identified, the Owner will vegetate the site with a grassland seed mix. The goal of restoration will be to restore natural hydrology and plant communities to the greatest extent practicable while minimizing new disturbance and removal of native vegetation. The decommissioning best management practices (BMP's) to minimize erosion and to contain sediment that will be employed on the Project to the extent practicable with the intent of meeting this goal include:

1. Minimize new disturbance and removal of native vegetation to the greatest extent practicable.

2. Removal of solar equipment and access roads up to three feet below surrounding grade, backfill with subgrade material and cover with suitable topsoil to allow adequate root penetration for plants, and so that subsurface structures do not substantially disrupt ground water movements.

3. Any topsoil that is removed from the surface for decommissioning will be stockpiled to be reused when restoring plant communities. Once decommissioning activity is complete, topsoil will be re-spread to assist in establishing and maintaining plant communities.

4. Stabilize soils and re-vegetate with regional plants appropriate for the soil conditions and adjacent habitat and use local seed sources where feasible, consistent with landowner objectives. Reseeding with native plants will not be performed for site that will be returned to agricultural use or other more intensive beneficial uses.

5. During and after decommissioning activities, install erosion and sediment control measures in all disturbance areas where potential for erosion and sediment transport exists, consistent with storm water management objectives and requirements.

6. Remediate any petroleum product leaks and chemical releases prior to completion of decommissioning.

Decommissioning and restoration activities at each site will be completed within 12 months after the date the site ceases to operate.

1.4 Post-Restoration Monitoring

Decommissioning of the site will be in compliance with permits for NPDES/SDS CSW Permit, Spill Containment and Countermeasure (SPCC) Plan, and SWPPP, if grading activities are necessary and exceed applicable permit thresholds. Decommissioning should include post-restoration monitoring as required by the NPDES/SDS CSW Permit and SWPPP and other applicable requirements. In addition, the Owner's Field Representative assigned to decommissioning monitoring will stay in contact with landowners, including onsite check-ins until the NPDES/ SDS CSW permit is closed.

Estimated Decommissioning Costs
Including Dismantling/Removal Costs
and Salvage Value

Project Name: Hickory Solar Project, Chesapeake, VA
Date: October 1, 2019

Project Size	40.95	MW-DC	32	MW-AC
	Quantity	Unit	Unit Cost	Total Cost
Mobilization/Demobilization	1	Lump Sum	$146,585.00	**$146,585**
Mobilization was estimated to be approximately 7% of total cost of other items. This number was developed from speaking with contractors.				
Permitting				
State Permits	1	Lump Sum	$10,000.00	**$10,000**
Subtotal Permitting				
Decommissioning will require a SWPPP and SPCC plan, cost is an estimate of the permit preparation cost				
Civil Infrastructure				
Removal Gravel Surfacing from Road	2,112	Cubic Yards (BV)	$3.67	$7,751
Haul Gravel Removed from Road	2,640	Cubic Yards (LV)	$9.52	$25,133
Disposal of Gravel Removal from Road	3,920	Tons	$0.00	$0
Removal Geotextile Fabric from Road Area	19,006	Square Yards	$1.40	$26,608
Haul Geotech Fabric Removed from Beneath Access Roads	19,006	Square Yards	$0.20	$3,801
Disposal of Geotech Fabric Removed from Beneath Access Roads	19,006	Square Yards	$0.10	$1,901
Grade Road Corridor (Re-spread Topsoil)	12,218	Linear Feet	$3.31	$40,442
Erosion and Sediment Control for Road Restoration	6,109	Linear Feet	$1.87	$11,424
Turf Establishment on Removed Road Area	3.93	Acres	$2,350.00	$9,236
Removal of Security Fence	10,100	Linear Feet	$6.00	$60,600
Subtotal Civil Infrastructure				**$186,895**
Civil removal costs are a combination of VDOT unit costs where applicable, RS Means cost for Lynchburg, VA, and industry standards.				
Structural Infrastructure				
Removal Tracker Steel Foundation Posts	17,807	Each	$13.00	$231,491
Haul TrackerSteel Post	1,458	Tons	$3.75	$5,467
Removal Tracker Racking	1,489	Each	$120.00	$178,680
Tracker Racking	2,242	Ton	$5.00	$11,211
Subtotal Structural Infrastructure				**$426,849**
Steel removal costs were calculated by using information from array manufacturers for installation rates and using the same rates to calculate total days to remove equipment. Hauling calculations are based on the locations of metals recyclers.				
Electrical Collection/Transmission System				
Removal of PV Panels	97,494	Each	$12.50	$1,218,675
Removal of Combiner Boxes	104	Each	$60.00	$6,240
Removal of PCU Station (Inverters/Panelboard/Transformer)	7	Each	$4,000.00	$28,000
Removal of Interconnection Switchgear	2	Each	$4,000.00	$8,000
Removal of Scada Equipment	1	Each	$5,000.00	$5,000
Subtotal Electrical Collection/Transmission System				**$1,265,915**
Electrical removal costs of PV Panels and Combiner Boxes were based industry standards on installation rates of a two man work crew. PCU Station, MV Equipment and Scada Equipment removal cost are based on removal of equipment, concrete pads, and conduits using a truck mounted crane and contractor provided information on installation rates.				

Site Restoration				
Stabilized Construction Entrance	1	Each	$2,000.00	$2,000
Perimeter Controls	10,100	Linear Feet	$1.87	$18,887
Permanent Seeding on area within Removed Array	148.7	Acres	$1,000.00	$148,700
Subtotal Site Restoration				**$169,587**
Site restoration costs are based on past solar project experience.				
Subtotal Demolition/Removals				**$2,205,831**
Salvage				
Fencing	75.8578817	Tons	$211.00	$16,006
Steel Posts	1,458	Tons	$211.00	$307,597
Module Racking	2,242	Tons	$211.00	$473,103
PV Modules	97494	Each	$11.59	$1,129,955
Inverters and Transformers	7	Each	$7,482.50	$52,378
Interconnection Switchgear	2	Each	$3,741.25	$7,483
Scada Equipment	1	Each	$1,000.00	$1,000
Subtotal Salvage				**$1,987,521**
Total Demolition Minus Salvage				**$218,309**

Notes:

1. Prices used in analysis are estimated based on research of current average costs and salvage values.
2. Prices provided are estimates and may fluctuate over the life of the project.
3. Contractor means and methods may vary and price will be affected by these

Hickory Solar Project Decommissioning Assumptions

To develop a cost estimate for the decommissioning of the Hickory Solar Project, Caden Energix engineers made the following assumptions and used the following pricing references: Costs were estimated based on current pricing, technology, and regulatory requirements. The assumptions are listed in order from top to bottom of the estimate spreadsheet. When publicly available bid prices or Virginia Department of Transportation (VDOT) bid summaries were not available for particular work items, we developed time and material-based estimates considering composition of work crews and equipment and material required using RS Means data. When materials may have a salvage value at the end of the project life, the construction activity costs and from the hauling/freight cost are separated from the disposal costs or salvage value to make revisions to salvage values more transparent.

1. Decommissioning year is based on the 35-year projected life of the project.
2. This Cost Estimate is based on the First Solar Site Layout/Preliminary Conceptual Design dated 3/15/18.
3. A project of this size and complexity requires a full-time project manager or support staff.
4. Common labor will be used for the majority of the tasks except for heavy equipment operation. Since VDOT unit prices are used, where possible, the labor rates will reflect union labor rates.
5. Mobilization was estimated at approximately 7% of total cost of other items.
6. Permit applications will require the preparation of a Storm Water Pollution Protection Plan (SWPPP) and a Spill Prevention Control and Countermeasure (SPCC) Plan.
7. Road gravel removal was estimated on a time and material basis using a 14-foot width and a 4-inch thickness. Since the material will not remain on site, a hauling cost is added to the removal cost. The recycling costs for road aggregate are volatile varying from approximately $10 per ton for disposal to $10 per ton for recycling.
8. Grade Road Corridor reflects the cost of mobilizing and operating light equipment to spread and smooth the topsoil stockpiled on site to replace the aggregate removed from the road.
9. Erosion and sediment control along road reflects the cost of silt fence on the downhill side of the road.
10. Topsoil is required to be stockpiled on site during construction, therefore this topsoil is available on site to replace the road aggregate, once removed. Subsoiling cost to decompact roadway areas is estimated as $350 per acre (based on state DOT bid prices), and Turf Establishment, which includes seed, fertilizer, mulch, and care until grass is established is $10,000 per acre.
11. Fence removal includes loading, hauling, and recycling or disposal. Fence and posts weigh approximately 10 pounds per foot.
12. Array support posts are generally lightweight “I” beam sections installed with a backhoe-like piece of specialized equipment. (No structural details are available at the time of decommissioning cost estimating.) Crew productivity is approximately 150 posts per day, and

the same crew and equipment should have a similar productivity removing the posts, resulting in a per post cost of approximately $13.00.

13. A metal recycling facility (Sims Metal Management) is located in Chesapeake, VA, 15 miles from the project site. Pricing was acquired from www.scrapmonster.com. There are 17807 Posts driven on the project for a total Weight of approx. 430 tons and we estimate the hauling costs at approximately $0.25 per ton mile. The pricing from Scrapmonster is adjusted to 75 percent of the published price to reflect the processing required for the posts to fit recycling requirements and Atlantic Iron & Metal margin.
14. Based on the review of a manufacturer's details of the array support structures the structures weigh approximately one pound per square foot. Each solar panel has an area of 25 square feet. The facility has 97494 modules, 2.44 million square feet of array, 1,458 tons. The frames are made of light weight steel and/or aluminum extrusions so a crew with hand tools can disassemble and cut the pieces to sizes for recycling at a rate of about 400 pounds per person per hour, or about $200 per ton.
15. Hauling the steel to Chesapeake at $0.25 per ton mile costs about $2 per ton.
16. First Solar Series 6 solar panels rated at 420 watts measure approximately three feet by six feet and weigh 36 kg or approximately 79 pounds so they can easily be disconnected, removed, and packed by a three-person crew at a rate we estimate at 20 panels per hour.
17. 2.75 MW inverters will be used on this project. Pad mounted Inverters are medium sized enclosures (9'-10" wide, 8'-6" tall, and 8'-0" deep that are mounted on a metal skid, which is secured to a concrete slab. They weigh 13,230 pounds and can be disconnected by a crew of electricians. They must be lifted by a truck mounted crane for transport to the recycler. They contain copper or aluminum windings.
18. Transformers for this project will be mounted on the same metal skid as the inverters. The transformers weigh approximately 16,700 pounds and contain either copper, or more commonly, aluminum windings that have significant salvage value. They are typically oil filled, but most transformer recyclers will accept the transformers with oil. The estimated costs include removal of the skid and concrete pads and conduits feeding the equipment.
19. Medium voltage (MV) equipment and SCADA equipment are mounted on the same concrete pad as the transformer and enclosed in weatherproof cabinets. Their size requires light equipment to remove them. The costs shown include the removal of the concrete pads.
20. To reduce tracking of sediment off-site by trucks removing materials, we have included a rock construction entrance priced based on state DOT bid prices.
21. Perimeter control pricing is based on a sediment fence placed on the downgrade side of the work area perimeters, and protecting wetlands and drainage swales within the project area. Pricing is based on VDOT unit prices.

    No topsoil is planned to be removed from the site during decommissioning and most of the site will not have been compacted by heavy truck or equipment traffic so the site turf establishment cost is based on VDOT unit prices for applying lime, fertilizer, seed, and mulch at the Road and

Bridge Specifications of Section 603 of $1,000 per acre plus an allowance for some areas to be decompacted.

24. Metal salvage prices (steel, aluminum, copper) are based on quotes from www.scrapmonster .com for the U.S. East Coast in May 2018. These prices are based on delivery to the recycling facility with the material prepared to meet size, thickness, cleanliness and other specifications. A reduction of 25% has been taken from this price to reflect the processing by the Contractor to meet the requirements. The prices are three months old at the time they are displayed on the website.
25. The steel posts and array racking are priced based on #1 HMS (high melt steel). ($300)
26. Solar module degradation is approximately 0.50% per year, or 84% capacity remaining after 35 years. There is currently a robust market for used solar panels and pricing can be found on eBay and other sites. We have assumed that as long as the modules are producing power they will have economic value. To avoid unconservative pricing for the used modules we used the minimum pricing of $0.04 per watt found in the published paper, “Salvage Value of Photovoltaic Systems”. Pricing for recycling of damaged modules was obtained from ECS Regenesys (ECS) and is $0.48 per pound, plus shipping to their Texas facility. An ECS representative noted that in 35 years the recycling process will have changed significantly. For interim decommissioning, resale of used modules will be most cost effective.
27. There is an active market for reselling and recycling electrical transformers and inverters with several national companies specializing in recycling. We have assumed that the electrical equipment will be obsolete at the time of decommissioning so we have based the pricing on a percentage of the weight that reflects the aluminum windings that can be salvaged. Pricing was obtained from scrapmonster.com. We have assumed a 25% recovery of the weight of the transformers and inverters for aluminum windings.
28. Care to prevent damage and breakage of equipment, PV modules, inverters, capacitors, and SCADA must be exercised, but removal assumes unskilled common labor under supervision.
29. All salvage will be for bulk material or equipment.