Cassadaga Wind Farm

Decommissioning Cost Estimate

Towns of Charlotte, Cherry Creek, and Arkwright
Chautauqua County, New York

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1. Cassadaga Wind Farm

1.1 Purpose

This report summarizes the specific project components that will be removed, the costs associated with their removal and, where applicable, their associated salvage value. This report also provides overall unit costs (per turbine) for decommissioning the Cassadaga Wind Farm (CWF).

1.2 System Description

The Cassadaga Wind Farm (CWF) is a proposed wind energy facility located in the townships of Cherry Creek, Charlotte and a small portion of Arkwright (Towns). In general, the Cassadaga Wind Farm facilities will be comprised of 48 wind turbines, an underground electrical collection system, interconnection and substation facilities, access roads, operation and maintenance building, meteorological and communication towers and associated facilities.

1.3 Decommissioning Sequence

Should the CWF be decommissioned, the following facilities would require removal and the associated disposal of materials and equipment:

- Wind turbines
- Foundations
- Access roads
- Interconnections and substations
- O&M building and facilities

2. Wind Turbines

2.1 Wind Turbine Decommissioning

Properly maintained wind turbines typically have a life expectancy of 20 to 25 years. At the end of the Project life, depending on market conditions and project viability, the wind turbines may be “re-powered” or upgraded with more efficient turbines and equipment. However, if not upgraded, or if the turbines are non-operational for an extended period of time (such that there is no expectation of their returning to operation), they will need to be decommissioned.

For the basis of this estimate, a Gamesa 126 – 2.625 MW turbine with a height of 102 meters (335 feet) was used for the calculation of unit weights for the salvage values of the equipment and materials. The turbine along with the tower and associated components will have resulting salvage values after decommissioning and removal of the units.

At this time, only scrap value has been included in the salvage value estimate due to the final turbine model not being known. Upon notification of the final turbine model selected by Cassadaga

Wind, the net salvage value would be reviewed and updated as determined appropriate by the Engineer to include both scrap value and re-sale value. This revised estimate would be provided to the Towns, as well as the Department of Public Service, no later than 90 days prior to the start of construction of the Facility.

The major components of the wind turbines (tower, nacelle, hub and blades) are modular items that allow for ease of construction and disassembly during decommissioning or replacement. The tower is comprised of approximately 256 tons (232 metric tons) of painted steel structure. The hub is comprised of approximately 35 tons (31.7 metric tons) of fabricated steel. Both the tower and the hub have the potential to be salvaged for scrap value. The nacelle has an overall unit weight of approximately 120 tons (108.5 metric tons) and is constructed of a combination of steel, copper, and various other materials. Portions of the components within the nacelle and generators have the potential to be salvaged for scrap value.

Scrap metal prices historically fluctuate with existing market conditions. The current salvage value for scrap #1 heavy melt steel (HMS) is approximately $235.00 per US ton. Salvage values for No. 3 copper materials (CU 88 percent to 90 percent) currently average $4,180 per US ton ($2.09/lb). The salvage unit values for scrap steel and copper are estimated based on current commodity prices. The commodity market prices used in the above estimate were obtained from the Scrap Register, in June 2017 (May 2017 prices).

For the purpose of this estimate, it is assumed that the tower and nacelle will yield approximately 80 percent salvageable materials. Since the hub assembly is a steel manufactured unit, it is anticipated that the hub assembly will yield 100 percent salvageable metallic materials. Copper salvage estimates were derived by assuming 5 percent of the total nacelle weight consists of copper bearing materials. Since the construction of the rotor/blades are predominantly non-metallic materials (fiberglass reinforced epoxy and carbon fibers), no salvageable value for the rotor/blades were used in the decommissioning cost estimate. This is considered a conservative salvage estimate.

Based on the design of the wind farm using 48 turbines, the total estimated steel salvage value for the tower, nacelle and hub assembly is estimated to be approximately $3,779,000. The total estimated copper salvage value is estimated to be approximately $3,772,000.

Petroleum, oils and/or lubricants (POL) contained in the wind turbine nacelle would require the removal and off-Site disposal during wind turbine decommissioning. Using currently estimated disposal costs, the costs anticipated for removal of POL from the nacelle and associated hauling fees to an approved off-Site disposal location, will be approximately $1,000.00 for each wind turbine.

Based upon the anticipated total labor and equipment cost, including mobilization and demobilization, the estimated cost for dismantling of the turbines is outlined below. The cost estimate is based upon a two-day dismantling effort per turbine and included costs for a lift crane, secondary crane, mobilization, demobilization, and associated labor costs. The estimate includes the costs associated with the transport of the turbine components from the Site to a recycling facility.

Table 2.1 Wind Turbine Decommissioning

Turbine Decommissioning	Unit Cost	Unit
Mobilization to Site	$13,300	Per Turbine
Turbine Removal/Dismantling – Assume 1 Turbine Removal every 2 days	$38,700	Per Turbine
Load/Transport Turbine Parts for Recycling	$45,200	Per Turbine
Removal/Disposal of POL	$1,000	Per Turbine
Subtotal	$98,200	Per Turbine
Total Estimated Cost for 48 Turbine Removals	**$4,713,600**	**Total**

3. Wind Turbine Foundations

3.1 Wind Turbine Foundation Decommissioning

The target removal depth of the foundation is required to be a minimum of 3 feet below grade for foundations located in non-agricultural lands and a minimum of 4 feet below grade for foundations located in active agricultural lands. For the purpose of this estimate, all foundations were calculated for removal to a depth of 4 feet to prevent interference with future farming activities. The estimated cost of removing each foundation includes the costs associated with mobilization, demolition, backfill and disposal of material, and final site restoration.

Table 3.1 Wind Turbine Foundation Decommissioning

Turbine Foundation Decommissioning	Unit Cost	Unit
Mobilization and Excavation – Assume 1 day per Foundation	$5,500	Per Foundation
Concrete Demolition – Assume 3 days per Foundation	$12,500	Per Foundation
Disposal of Materials and Backfilling – Assume 1 day per Foundation	$10,700	Per Foundation
Subtotal	$28,700	Per Foundation
Total Estimated Cost for 48 Foundation Removals	**$1,377,600**	**Total**

3.2 Wind Turbine Grounding System

The grounding system for each wind turbine consists of a grounding ring of copper cable that runs in a circle around the edge of the foundation near the foundation bottom. This ring connects several copper grounding rods driven into the ground around the perimeter of the foundation. A typical foundation is constructed so that the bottom of the spread footer is approximately 10 to 12 feet below grade (a typical depth used for example purposes only). The copper grounding ring would be approximately 12 feet below grade and the grounding rods would be installed so that their highest point is also12 feet below grade. Because all of these components are more than 4 feet below grade, removal will not be required. Additionally, there is no recognizable benefit to removing these components. For these reasons, removal of the wind turbine grounding system is not part of this decommissioning plan for the CWF.

4. Substation and Interconnection Station Decommissioning and Removal

The Project includes an interconnection station to the existing electrical grid and a substation for the collection of power generated from the turbines. The CWF substation will be disconnected from the electrical grid prior to initiating decommissioning activities at the substation. The work will include the removal and disposal of the structural steel support system, foundations, electrical components, switches, breakers, wiring, transformer, transformer oil and fluids, and all other appurtenant structures and equipment.

The interconnection station will not be decommissioned under this Project and will remain in service after the Project has been decommissioned. The interconnection station would be removed at a later date by the existing power utility company.

Final site restoration, removal of site fencing, and site grading is included in the following costs:

Table 4.1 Substation and Interconnection Station Decommissioning and Removal

Substation and Interconnection Station	Cost for Work Item	Material Salvage Value	Final Cost for Work Item
Mobilization Substation	$2,000	-	$2,000
Demolition and Removal Substation	$91,200	$63,900	$27,300
Total			$29,300
Use			$29,200

5. Operation and Maintenance Building

The Operation and Maintenance Building (O&M Building) is planned to be a functional commercial building built in accordance with local building codes. This building will likely have remaining uses even after the Project is decommissioned. For this reason, removal of the O&M Building is not to be part of decommissioning of the CWF.

6. Access Roads

6.1 Typical Access Road Construction Details

Based on preliminary data, a total of 84,700 linear feet (16 miles) of access roads are included under this Project. Final access roadway width will be approximately 20 feet. The total area of access roads included under this Project will be approximately 188,300 square yards.

Typical access roads are constructed of a layer of geotechnical fabric and a final compacted course of gravel 9 inches in thickness. The actual details of construction have not been finalized at the time of this report and may be modified during final design of the Project.

6.2 Access Road Decommissioning

The decommissioning of the access roads will involve the removal and transportation of the aggregate materials off site for separating the salvageable aggregate material. It is possible the local townships may accept this material without processing for their use; however, for the purpose of this report, it is assumed that all materials will be removed and hauled to a reprocessing site within a 20-mile round-trip distance of the wind farm. The decommissioning procedure will also include the removal and proper disposal of the geotextile fabric. It is assumed that a large amount of the geotextile will be removed along with the aggregate and sorted at the off-site processing area to be disposed of in a nearby landfill. The estimate of access road decommissioning costs takes into account the current cost of hauling and excavation. The following unit price costs were used in the preparation of this estimate:

- Geotextile Fabric Removal ($0.25 per square yard)
- Geotextile Fabric Disposal ($150.00 per cubic yard)
- Gravel Aggregate Removal and Hauling ($24.00 per cubic yard)

The salvage value of the access road materials are based upon the following assumptions:

- 75 percent of the aggregate will be salvaged for reuse as aggregate base course gravel.
- Remaining material (25 percent) is suitable for general fill in non-structural fill areas.

Assuming the materials would be stockpiled at the process site and sold by the processor at a later date, the salvage values are as follows:

- Reprocessed aggregate to be used as base course ($6.25 per cubic yard)
- Remaining aggregate and sand to be used as general fill ($2.50 per cubic yard)

The only scenario that could offer a lesser cost to remove and salvage the aggregate would be disposal at a nearby site that needed inert fill. For the purposes of this estimate, no consideration has been given to this option since no suitable site has been identified for disposal of the material. The estimated costs for access road removal and disposal is presented in the following table:

Table 6.1 Access Road Decommissioning

Access Road Removal	Quantity	Unit Cost	Total Cost
Gravel Course Access Road Removed (CY)	47,100 CY	$24.00 /CY	$1,130,400
Geotextile Fabric Removal	188,300 SY	$0.25/SY	$47,075
Geotextile Fabric Disposal	50 CY ±	$150.00/CY	$7,500
Total			$1,184,975
Use			$1,185,000

The estimated salvage values obtained from the removal (reclaimed) aggregate materials is presented in the following table:

Table 6.2 Aggregate Salvage Values Removed

Removed Aggregate Salvage Values	Quantity	Unit Salvage Value	Total Salvage Value
Gravel Aggregate Course (reused) (CY)	35,300 CY	$6.25/CY	$220,625
Aggregate (reprocessed as general fill) (CY)	11,800 CY	$2.50/CY	$29,500
Total			$250,125
Use			$251,000

7. Crane Pads

Each crane pad will be constructed of compacted soil. It is not anticipated that granular base fill will be used for the construction of the crane pads. At the conclusion of the decommissioning activities, the crane pad areas will be scarified (decompaction), as necessary, and in consultation with the landowner, and restored to near original condition.

8. Cables

8.1 Cable Wire and Trench Typical Installation

All cable trenches will be a minimum of 3 feet below grade for foundations located in non-agricultural lands and a minimum of 4 feet below grade for foundations located in active agricultural lands. In all cable locations outside of the access roads, the trenches are backfilled with on-site earthen materials. Underneath roadways, the cable will be direct bury a minimum of 4 feet below the final surface.

8.2 Cable Wire and Trench Decommissioning

Due to the degree of depth the cables will be buried, it is not necessary to excavate and remove them in the event of decommissioning. Removal of the cables would not be cost-effective for the decommissioning of the Project. The presence of cable wires do not create a problem to farming activities and will not require any restoration.

9. Earthwork and Topsoil Restoration

Once all of the aboveground improvements are removed, the remaining work to complete the decommissioning of the CWF will consist of backfilling and grading of the disturbed areas. It is estimated that approximately 47,100 cubic yards of backfill material and topsoil will be necessary for restoration of the Project. The following estimate of decommissioning cost for earthwork and topsoil restoration is presented in the following table:

Table 9.1 Earthwork and Topsoil Restoration

Description	Quantity (CY)	Cost (per CY)	Total Cost
Earth Fill	31,400	$12	$376,800
Topsoil	15,700	$20	$314,000
Total			$690,800
Use			$691,000

10. Summary of Decommissioning Costs

This estimate was developed using the various cost resources listed below:

- R.S. Means
- GHD Historical Data
- Vendor quotes (where applicable)
- Current/Historic Commodity Prices
- Estimator Judgment

The following is a summary of the total cost of decommissioning the CWF:

Decommissioning Costs – 48 Each Gamesa 126-2.625 MW Wind Turbines	
Turbine Removal (included removal/disposal of POL in nacelle	$4,713,600
Turbine Foundation Removal	$1,377,600
Access Road Removal	$1,185,000
Earthwork and Topsoil	$691,000
Total Decommissioning Costs – All Wind Turbines	**$7,967,200**
Decommissioning Cost – Substation and Interconnection Station	
Total Decommissioning Costs – Substation	**$29,300**
Salvage Value – Wind Turbine	
Steel Salvage Value	$3,779,000
Copper Salvage Value	$3,772,000
Aggregate Salvage Value	$251,000
Total Salvage Value – All Wind Turbines	**($7,802,000)**
Salvage Value Net Decommissioning Costs	
Total Value	$194,500
Value per Turbine	**$4,052**
Use	**$4,060**

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