Wind Project Decommissioning Plan

Rugby Wind Project

Prepared for
Rugby Wind, LLC
a subsidiary of
Avangrid Renewables, LLC

September 2019

BARR

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Certifications

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September 26, 2019

Date

1.0 Introduction

Rugby Wind, LLC (Rugby Wind), a wholly owned subsidiary of Avangrid Renewables, LLC, operates the Rugby Wind Farm (Facility) in Pierce County, North Dakota (Figure 1). The Facility generates up to 149.1 megawatts (MW) of electricity at rated capacity and will includes 71 Suzlon S88 2.1MW wind turbine generators (WTG or turbine) Figure 2 shows the site layout.

This Decommissioning Plan provides a description of the decommissioning and restoration phase of the Facility, including a list of the primary wind farm components, dismantling and removal activities, and disposed or recycled materials. A summary of estimated costs and revenues associated with the decommissioning phase is also included.

1.1 Wind Farm Components

The main components of the Facility include:

- Turbines (tower, nacelle, hub, rotor, and three rotor blades per WTG)
- Turbine foundations
- Step-up transformers
- Access roads
- Crane pads
- Electrical collection system
- Meteorological (MET) tower
- Substation equipment and foundations
- Operation and maintenance (O&M) buildings and foundations

1.2 Expected Lifetime and Triggering Events

The anticipated Facility life is 40 years from the start of commercial operation on October 3, 2005. Depending on market conditions and Facility viability, the turbines may be refitted with updated components, such as nacelles, towers, and/or blades to extend the life of the Facility. In the event that the turbines are not retrofitted, or at the end of the Facility's useful life, the turbines and associated components will be decommissioned and removed from the site. Decommissioning of the facility is not expected to have any effects on present and future natural resource development.

Turbine components that have resale value may be sold in the wholesale market. Components with no wholesale value will be salvaged and sold as scrap for recycling or disposed at an offsite licensed solid waste disposal facility (e.g., landfill). Decommissioning activities will include removal of the turbines and associated components as listed in Section 1.1 and described in Section 2.

1.3 Decommissioning Sequence

Decommissioning activities are anticipated to be completed in an 18-month timeframe. Monitoring and site restoration may extend beyond this period to ensure successful revegetation and rehabilitation. The anticipated sequence of decommissioning and removal is described as follows; however, overlap of activities is expected:

- Conduct site investigation
- Contact land owners
- Conduct access assessment
- Conduct public road condition assessment
- Conduct site access road assessment
- Complete decommissioning permits application and notification
- Prepare site by site decommissioning sequence and schedule
- Negotiate decommissioning contractor terms and conditions
- Obtain necessary permits and approvals
- Provide Notice to Proceed for Decommissioning Contractor
  - Mobilize and prepare field staff yard and offices
  - Mobilize construction equipment (cranes, lowboys, graders, utility trucks, etc.)
  - Begin site access road maintenance and, where necessary, apply crushed rock to facilitate equipment access
  - Identify and secure laydown area at each site to process decommissioned equipment and material
  - Disconnect and secure electrical equipment from public power grid
  - Secure rotating machinery in preparation of disassembly
  - Begin fluid removal and processing
  - Mobilize crane(s)
  - Remove blades and place in laydown area for site processing
  - Remove nacelle and place in laydown area for processing. or alternately, load directly to shipping and move to remote site for processing

- Disassemble tower and place in laydown area for site processing
- Mobilize crane to next site (this may be overland if possible to negotiate with land owners to speed disassembly and avoid multiple over road transport and erection operations)
- Process blades and load for disposal/recycle
- Process tower and load for transport to scrap yard
- Remove underground cable where surfaced
- Remove tower foundation to a depth of 36 inches below final grade using approved means and methods
- Haul tower foundation material to disposal site for reprocessing (concrete to be crushed, rebar for recycle)
- Remove substation equipment and foundations to a depth of 36 inches below final grade
- Remove buildings and foundations to a depth of 36 inches below final grade
- Remove access road and surfacing (gravel) where required
- Haul surfacing material to approved stockpile for reclaim or sale
- Regrade site to appropriate contours
- Prepare soil for seeding
- Seed site
- Complete final clean up

2.0 Decommissioning Components and Activities

The wind farm components and decommissioning activities necessary to restore the Facility area, as near as practicable, to pre-construction conditions are described within this section. Rugby Wind will dismantle and remove all towers, turbine generators, transformers, overhead cables, foundations, buildings, and ancillary equipment to a depth of 36 inches unless landowner agreements specify a greater depth. Underground cables will be removed to a depth of 24 inches. To the extent possible the permittees shall restore and reclaim the site to its pre-Facility topography and topsoil quality.

Estimated quantities of materials to be removed and salvaged or disposed are included in this section. Public roads damaged or modified during the decommissioning and reclamation process shall be repaired upon completion of the Facility.

2.1 Wind Farm System Overview

The Facility consists of 71 Suzlon S88 2.1 MW turbines with a total nameplate generating capacity of up to 149.1 MW. Table 1 presents a summary of the primary components included in this decommissioning plan.

Table 1 Primary Components of Wind Farm to be Decommissioned

Component	Quantity	Unit of Measure
Wind turbines (including one tower, one nacelle, one hub and one rotor with three rotor blades per turbine)	71	Each
Step-up transformers	71	Each
Wind turbine foundations	71	Each
Crane pads or mats	71	Each
Access roads	90,758	Lineal Feet (estimated)

2.2 Wind Turbine Generators

The S88 2.1 MW model wind turbine generators are primarily comprised of a modular steel tower, nacelle, and rotor with three rotor blades attached to a hub. The hub height of the turbines is approximately 79.2 meters (m) with an 88 m rotor diameter. The components are modular in design, allowing for ease of construction, replacement, and disassembly during decommissioning. Turbine components in working condition may be refurbished and sold in a secondary market yielding greater revenue than selling as salvage material. For the purposes of this report, estimates will be based on the salvage value, as this will be the most conservative estimate of revenue.

Turbine Tower - The turbine towers are painted modular monopole steel structures approximately 78 m long. Each tower weighs approximately 204 tons of which 95% is salvageable steel. It is estimated that the tower sections will be cut down to transportable size and sent to a scrap metal facility for processing.

Nacelle - The nacelle sits at the top of the turbine tower and has an overall weight of approximately 79 tons including the bedplate. The nacelle is comprised of approximately 85% steel along with the balance being copper/aluminum alloys and other non-salvageable materials. Non-salvageable material within the nacelle will be disposed in a landfill.

Hub, Rotor, and Rotor Blades - The rotor and hub weight, not including the blades, is approximately 19.5 tons. It is mainly comprised of steel that will be salvaged along with the tower and nacelle. The rotor blades are constructed of non-metallic materials such as fiberglass, carbon fibers, and epoxies. These materials will likely have no salvage value and will be recycled for a cost.

Other Turbine Components - In addition to the main components previously described, each WTG contains other items such as ladders and platforms, anchor bolts, and internal electrical wiring that will have additional salvage value.

Decommissioning Activity - The wind turbines will be deactivated from the surrounding electrical system and made safe for disassembly. Improvements to access roads and crane pads will be completed to allow crane access to turbines for removal of components. Liquid wastes, including gear box oil and hydraulic fluids will be removed and properly disposed or recycled according to regulations current at the time of decommissioning. Control cabinets, electronic components, and internal electrical wiring will be removed and salvaged. The hub and rotors will be lowered to the ground as a unit for disassembly. The nacelle and turbine sections will be disassembled and removed in the reverse order of assembly.

2.3 Step-Up Transformers

After deactivation, oil will be drained and recycled or disposed at an approved solid waste management facility. The transformer will then be disassembled and removed. Depending on condition, the transformers may be sold for refurbishment and re-use. If not re-used, the transformer will be salvaged for raw materials.

2.4 Wind Turbine Foundations

Typical spread footing foundations utilized for the Facility turbines are predominantly located underground. Below the pedestal is the foundation base, a typically octagonal-shaped concrete structure. The entire foundation sits on supporting sub-grade typically around 10 feet below the ground surface.

Concrete demolition will be completed on the upper 36 inches of the pedestal. This will include the anchor bolts, rebar, conduits, cables, and concrete to the required depth. The site will be back-filled with clean fill and graded and the land contours restored as near as practicable to preconstruction conditions. Topsoil will be placed on the disturbed area and revegetated. The cost estimate for the excavation and removal of turbine foundations is conservatively based on the previous foundation design sizes. Material would be demolished and hauled to a landfill.

2.5 Collection System

The Facility collection system towers and overhead cable will be dismantled and scraped. Buried cables 24 inches or more below ground surface will be completely deactivated and abandoned in place. Minimal decommissioning costs are associated with the collection system and are included in the turbine decommissioning estimate. If, at the time of decommissioning, the salvage value of the underground cable exceeds the cost of extraction and restoration, the cables may be removed and salvaged.

2.6 Crane Pads

Crane pads are located at the base of each turbine to support the large cranes necessary for assembly and disassembly of the turbines. Pads are generally 60 feet by 80 feet and consist of compacted native soils and approximately one-half foot of base fill. After decommissioning activities are completed, the crane pad aggregate will be removed and the areas filled with native soil, as necessary. Land will be graded, and pre-construction contours restored to the extent practicable. Restoration will likely be performed in conjunction with the turbine foundation and/or access road restoration. Soils compacted during de-construction activities will be de-compacted (ripped to 18 inches), as necessary, to restore the land to preconstruction land use. Labor for trucking and equipment is the primary expense for the crane pad removal.

2.7 Access Roads

The Facility includes roads to provide access from public roads to the turbine sites. The final width of the roads is approximately 16 feet, widening near the turbine base. The total length of Facility access roads is approximately 17 miles. The estimated quantity of these materials is provided in Table 2.

Table 2 Typical Access Road Construction Materials

Item	Number	Unit
Geotextile	180,000	Square Yards
Aggregate Course	90,758	Linear Feet

Rugby Wind will remove all access roads unless an affected landowner request otherwise. Rugby Wind will record any agreement for removal to a lesser depth or for no removal with the County and show the locations of all such foundations. Rugby Wind will submit all such agreements with affected landowners to the County prior to completion of restoration activities. Rugby Wind will restore the Facility within 24 months after expiration of the issued permit, or upon earlier termination of operation of the Facility. The estimate assumes all roads are to be removed and returned to preconstruction state. Decommissioning activities include the removal and stockpiling of aggregate materials onsite for salvage preparation. Local townships or farmers may accept the material prior to processing for use on local roads or field access roads; however, for the purpose of this estimate it is conservatively assumed that all materials will be removed from the Facility area.

Following removal of aggregate, the access road areas will be graded, de-compacted (ripped to 18 inches), back-filled with native soils, as needed, and land contours restored as near as practicable to preconstruction conditions.

Aggregate road material is assumed to have salvage value in the secondary market. The largest factors in pricing this value is the quality of aggregate reclaimed and a potential buyer near the Facility site. The estimate assumes costs for removal and hauling as well as a salvage value received from a buyer in the area.

2.8 Facility Substation

All equipment, conductors, transformers, steel, wiring, and fencing is to be removed. Footings, underground cabling, and aggregate will be removed from the substation site to a depth of 36 inches. Electrical equipment may have value on the secondary market for refurbishment or scrap. Steel and foundations are to be removed and brought to the landfill. Cost of demolishing the substation was based on crews and a scheduled timeframe. Other than metals in the transformer and switchgear no salvage cost was given to the substation.

2.9 Topsoil Restoration and Revegetation

Facility sites that have been excavated and back-filled will be graded as previously described to restore land contours as near as practicable to preconstruction conditions. Topsoil will be placed on disturbed areas and seeded with appropriate vegetation to reintegrate it with the surrounding environment. Soils compacted during de-construction activities will be de-compacted, as necessary, to restore the land to preconstruction land use.

3.0 Decommissioning Cost Estimate Summary

Expenses and revenues associated with decommissioning the Facility will be dependent on labor costs and market value of salvageable materials at the time of decommissioning. For the purposes of this report, approximate mid-2018 to mid-2019 average market values were used to estimate labor, expenses and salvage values. Fluctuation and inflation of the salvage values or labor costs were not factored into the estimates.

3.1 Decommissioning Expenses and Revenues

Facility decommissioning will incur costs associated with the disassembly, removal, excavation, and restoration of the proposed wind turbine sites and support infrastructure as described in Section 2. Table 3 summarizes the estimates for activities associated with the major components of the Facility.

Revenue from decommissioning the Facility will be realized through the sale of wind farm components and construction materials. Turbine components may be sold within a secondary market or as salvage. For purposes of this report, estimated recovery values were based on the salvage value, as this is the more conservative estimate of revenue.

The market value of both steel, aluminum and copper fluctuate daily. Salvage value estimates were based on a current average price of steel, aluminum and copper derived from sources including material processing facilities, American Metals Market index and scrapmonster.com. The price used to value the steel used in this report is $170 per ton. This factors in a 10-year steel average, scrap yard handling, processing to mill size (two feet by five feet) and milling. The value of copper, $1.90 per pound ($3,800 per ton) and the value of aluminum at $.56 per pound ($1,120 per ton) were used in this report. The nacelle was assumed to have approximately 80% salvageable steel content; the hub and gearbox 90% and the tower 95%. Salvage pricing for reclaimed aggregate was estimated to be $7/CY or roughly 25% of value of new aggregate material. Table 3 summarizes the potential salvage value for the wind turbine components, transformer, and construction materials.

Table 3 Estimated Decommissioning Expenses and Revenues

Activity	Decommission or Salvage	Unit	Number	Cost or Salvage Price per Unit	Total
Overhead and Profit (6%)	Decommission	Lump Sum	1	$500,000	$500,000
Mobilization and demobilization (3%)	Decommission	Lump Sum	1	$250,000	$250,000
Access Road Prep	Decommission	Lump Sum	1	$153,000	$153,000
Crane Mob and Operations	Decommission	Each	71	$31,549	$2,240,000
Tower Disassembly	Decommission	Each	71	$21,099	$1,498,000
Blade Demo & Recycling	Decommission	Each	71	$9,718	$690,000
Turbine Foundation Removal	Decommission	Each	71	$9,254	$657,000
Collector Line Removal	Decommission	Lump Sum	1	$247,000	$247,000
Site Restoration (Roads, Turbine & Aux Sites)	Decommission	Lump Sum	1	$1,492,000	$1,492,000
O & M Removal	Decommission	Lump Sum	1	$53,000	$53,000
Substation Demo	Decommission	Lump Sum	1	$71,000	$71,000
MET Tower Demo	Decommission	Lump Sum	1	$15,000	$15,000
Hauling	Decommission	Lump Sum	1	$1,225,000	$1,225,000
Contingency	Decommission	Percent	15%	$1,363,000	$1,363,000
Total Estimated Decommissioning Cost					**$10,454,000**
Turbine tower (steel) (total per 71 turbines)	Salvage	Tons/turbine	194	$(170)	$(2,339,000)
Nacelle (steel) (total per 71 turbines)	Salvage	Tons/turbine	38	$(170)	$(454,000)
Rotor hub (total per 71 turbines)	Salvage	Tons/turbine	18	$(170)	$(212,000)
Generator/gearbox (total per 71 turbines)	Salvage	Tons/turbine	29	$(170)	$(348,000)
Transformers (total per 71 turbines)	Salvage	Tons/turbine	1	$(2,100)	$(149,000)
Copper (total per 71 turbines)	Salvage	Tons/turbine	2.6	$(3,800)	$(698,000)
Aluminum (total per 71 turbines)	Salvage	Tons/turbine	5.1	$(1,120)	$(404,000)
Oil disposal	Salvage	Per turbine	1	$1,000	$71,000
Collector line (aluminum)	Salvage	Lump Sum			$(138,000)
Gravel Road and Laydown Reclaim	Salvage	Lump Sum			$(422,100)
Total Potential Salvage Value					**$(5,093,100)**

3.2 Net Decommissioning Cost Summary

The following is a summary of the net estimated cost to decommission the Facility, using the information detailed in Sections 3.2 and 3.3. Estimates are based on 2019 prices, with no market fluctuations or inflation considered.

Table 4 Net Decommissioning Summary

Item	Cost
Decommissioning expenses	$10,454,000
Potential revenue - salvage value of turbine components and recoverable materials	$(5,093,100)
Net Decommissioning Cost	**$5,360,900**
Per Turbine Decommissioning Cost (based on 71 turbines)	**$75,506**

This engineer's estimate produces an estimate of the cost of decommissioning the Facility based on the following considerations:

1. Limited decommissioning design work has been completed.
2. Quantities based on design work completed.
3. A concept-level Class IV, per AACEI cost estimate classification system 17R-97, cost estimate.

3.3 Financial Assurance

Rugby Wind will commit to a surety bond or letter of credit for financial assurance. Decommissioning costs will be re-evaluated ten years after the initial decommission report approval, then every five years following.

3.4 Salvage Value

Salvage values are the most variable component of the decommissioning study. Depending on the material, equipment, and salvage opportunities, the means and methods used by the contractor would vary from scrapping materials completely to selling equipment in the secondary market and processing materials and equipment, onsite or at a facility, for future use or scrap value.

Assumptions in the salvage values were based on current conditions and processing applications. Many materials that are non-recyclable will likely be sent to a landfill, such as concrete debris, wood, or turbine blades.

3.4.1 Pricing assumptions

Material salvage pricing is derived from the American Metals Market Index and scrapmonster.com. Prices below are quoted from scrap yards based on current market prices. The steel price is a 10-year market average. In order to capitalize on these prices, material would need to be shipped to a mill and be cut to size prior to shipment. In this case, most components were assumed to be disassembled in a process similar to erection and cut to shippable size onsite. Ability to reclaim all scrap at this pricing is not likely. Some factor is taken in the pricing to account for an assumed grade of scrap.

The following pricing assumptions were used to calculate scrap and waste value. Weights are in gross tons:

- Steel $170/ton
- Copper $3,800/ton
- Aluminum $1,120/ton
- Gravel $7/CY

Salvage weight has been estimated from life cycle studies or has been taken from manufacturer's technical data sheets. Some resale value of components is likely. In this case, certain transformers and electrical components would be considered to have immediate value on the market because of their longer design life. It is likely that newer components may be installed during the lifetime of the wind farm due to maintenance or failure of older components. This estimate does not make attempts to quantify resale of equipment to a secondary market, rather it assumes that all salvage costs will come from scrapping of raw materials.

3.5 General Conditions

The following typical contractor markups were applied to the Demolition Cost Estimate only:

- Mobilization/Bond/Insurance/Tax/Permitting 3%
- Contractor Project Management/Overhead/Profit 6%

3.6 Contingency

A contingency of 15% was applied to the estimate and was derived by taking account of the level of design and by expert judgment. The following items were considered when developing contingency costs.

- Weather days
- Crane Breakdown per crane path design
- Toxic material handling
- Permitting requirements
- Disassembly of WTG components in scrap process
- Surveying

- Environmental Services
- Regulatory guidelines
- Fencing, Structure, Culvert removal
- Engineering
- Tax
- Signage

3.7 Escalation Rate

Barr Engineering Co. (Barr) has not changed, scaled, or accounted for escalation of costs in the future. Considering the volatility of several markets, construction, energy, and labor, an update to this cost estimate prior to actual decommissioning is recommended. This study quantifies the Facility in today's current market and estimates cost in 2019 dollars.

3.8 Estimate Classification

This concept-level (Class IV, per AACEI cost estimate classification system 17R-97) cost estimate is based on engineering of 1-15% design and is meant for feasibility uses. Class IV estimates are typically used for screening, determination of feasibility, concept evaluation, and preliminary budget approval. The estimated accuracy range for the Total Cost as the project is defined is -20% to +30%. The accuracy range is based on professional judgment considering the level of decommissioning design completed, the complexity of the project and the uncertainties in the project as scoped.

3.9 Cost Resources

The following is a list of the various cost resources used in the development of the cost estimate:

- 2019 R.S. Means
- American Metals Market Index
- Scrapmonster.com
- Barr historical project data
- Vendor quotes on scrap and shipping associated costs
- Estimator judgment

3.10 Estimate Methodology

Costs were built up from crews and equipment over an estimated schedule as well as contacting industry professionals for quotes and pricing. Some items, such as the MET tower costs, were lump sum allowances based on similar decommissioning studies.

3.11 Labor Costs

The estimate is based upon national labor rates.

3.12 Sales Tax

This demolition contract estimate has been assumed to not incur any sales tax.

3.13 Soft Costs

The cost estimate does not include any soft costs. Soft costs that would likely be associated with the decommissioning would be engineering, design, permitting, land, legal, and other fees.

3.14 Major Assumptions

The estimate assumes the work will be done on a competitive bid basis and the contractor will have a reasonable amount of time to complete the work. All contractors are equal, with a reasonable project schedule, no overtime, work performed as under a single contract, and no liquidated damages.

This estimate was prepared in August 2019. As with all estimates, it represents a snapshot in time of what is known about the Facility and expected to occur. The commodities and energy markets are ever changing. Changes in either could have dramatic effects on this estimate. Therefore, this estimate should be viewed in that light and if more than 180 days have passed or there have been significant changes in the commodity markets, this estimate should be updated and reevaluated.

- Commodity prices for steel, copper, and aluminum were sourced from the AMM cost index and adjusted based on discussions with scrap vendors. (Different types and grades of metals will vary pricing.)
- The site is readily accessible.
- Only minor repairs to access roads will be necessary to accommodate crane access.
- Turbine blades will be disposed or recycled. Materials will be brought to an approved disposal site within 60 miles.
- Only turbine foundation pedestal sections and a portion of the footing is to be removed to 36 inches below grade.
- 95% of tower steel was estimated to be recoverable.
- 40% of the generator weight is salvageable copper.
- Aluminum ladders, internals, and platforms are estimated to be 2 ton per turbine.
- Contractor will be allowed to stage construction to obtain the most efficient workflow possible.

- Contractor will not be required to perform work using the same means or methods used to produce this estimate.
- Contractor will be allowed to use the most appropriate, safest, and efficient methods available to them at the time of performing the work.
- Contractor will secure and provide any required demolition permits or certificates.
- Demolition contractor will load salvage materials in appropriate sizes and weights at each site to recycling buyer's vehicle.
- Assumed 89,760 linear feet (17 miles) of access road, 16 feet in nominal width.
- Turbine and tower dismantling production is 2 work days per turbine.
- Crane movement and setup is separate from dismantling operation.
- Site restoration includes roadway removal and regrading of site, including deep tilling to remove compaction of soils at the road and tower site. All roads, crane pads, laydown yards and substation gravel will be removed.
- Salvaged roadway material is stockpiled or delivered within a 20-mile radius of the project site. Reclaimed gravel is assumed to have resale value.
- Half day of decommissioning preparation per site, including oil removal, is allocated prior to crane dismantling.
- All recycled material is processed to manageable sizes for transport from site.
- Hauling fees are included in the estimate for all materials to be removed to local landfills, aggregate pits or recycling facilities.
- Sales tax is not included; the Facility is assumed not to be purchasing major quantities of new materials.

4.0 Referenced Documents

This study is based upon the following documents:

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