APPENDIX U – DECOMMISSIONING COST ANALYSIS

Decommissioning Cost Analysis

Deuel Harvest Wind Energy LLC

Deuel Harvest North Wind Farm
11/29/2018

Decommissioning Cost Analysis

prepared for

Deuel Harvest Wind Energy LLC
Deuel Harvest North Wind Farm
Deuel County, South Dakota

11/29/2018

prepared by

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LIST OF ABBREVIATIONS

Abbreviation	Term/Phrase/Name
BMPs	Best management practices
Burns & McDonnell	Burns & McDonnell Engineering Company, Inc.
Deuel Harvest	Deuel Harvest Wind Energy LLC
GE	General Electric
Invenergy	Invenergy LLC
kcmil	Circular mil
kV	Kilovolt
MW	Megawatt
O&M	Operations and Maintenance
Project	Deuel Harvest North Wind Farm
Project Facilities	Wind turbines, a Project Substation, an Interconnection Substation, an approximately 150-foot 345-kV Interconnection Transmission Line, up to four (4) meteorological towers, an operations and maintenance (O&M) building, gravel access roads, and other appurtenant facilities
Project Site	Location of the Project in Deuel County, South Dakota
SDPUC	South Dakota Public Utilities Commission
Study	Decommissioning cost analysis

1.0 EXECUTIVE SUMMARY

1.1 Introduction

Burns & McDonnell Engineering Company, Inc. (Burns & McDonnell) was retained by Deuel Harvest Wind Energy LLC (Deuel Harvest), an affiliate of Invenergy LLC (Invenergy), to conduct a decommissioning cost analysis (Study) as part of an application for Energy Facility Permits from the South Dakota Public Utilities Commission (SDPUC) for the Deuel Harvest North Wind Farm (Project). The purpose of this Study was to review the Project and provide a recommendation regarding the decommissioning cost and plan for retiring the facilities at the end of its useful life.

The Project is proposed to be located in Deuel County, South Dakota, in the townships of Portland, Lowe, Altamont, Glenwood, and Herrick (Project Site). The Project will consist of up to 112 wind turbines, with a nameplate capacity of up to 310.1 Megawatts (MW), and generation capacity of up to 300 MW of electricity. The two wind turbine model types the Project will utilize are the General Electric (GE) 2.82-127 and GE 2.3-116 wind turbine generators. The Project also includes a Project Substation, an Interconnection Substation, an approximately 150-foot long 345-kilovolt (kV) Interconnection Transmission Line, up to four (4) meteorological towers, an operations and maintenance (O&M) building, 26.8 miles of gravel access roads, and other appurtenant facilities (collectively, the Project Facilities).

1.2 Methodology

At the time of retirement, the above-grade steel structures and turbine nacelles are assumed to have significant scrap value to a salvage contractor, offsetting a portion of the cost to remove these items. However, the Project will also incur costs for removal and disposal of the wind turbine generator blades, foundations, and other Project Facilities, along with the costs for the restoration of the site following the removal of salvageable equipment.

The decommissioning cost estimate provided herein include the costs to return the site to a condition compatible with the surrounding land, similar to the conditions that existed before development of the Project. Included in the estimate are the costs to retire the power generating equipment associated with the Project, as well as the costs to retire the Project Facilities, with all equipment and structures removed to a depth of 3.5 feet below grade. These costs are offset by the estimated revenue that will be received for scrap value of steel, aluminum, and copper equipment; no resale of the Project Facilities for reuse is considered. Accordingly, it is a “no resale” estimate.

1.3 Results

The total net cost to decommission the Project at the end of its useful life based on the assumptions noted herein is estimated to be approximately $3,256,300, or approximately $29,074 per turbine. It is expressly noted that while costs are presented both in total and per turbine, a change in the quantity of turbines may not cause the total decommissioning cost to increase or decrease linearly by the per turbine cost, due to non-scalable differences in balance-of-plant costs and other similar factors.

2.0 INTRODUCTION

2.1 Study Overview

Burns & McDonnell was retained by Deuel Harvest, to conduct the Study as part of an application for Energy Facility Permits from the SDPUC for the Project. The purpose of this Study was to review the Project and provide a recommendation regarding the decommissioning cost and plan for retiring the Project facilities at the end of its useful life.

2.2 Decommissioning Elements

The following Project Facilities will be included in decommissioning and demolition:

- Wind turbine generators
    - Nacelle
    - Tower
    - Foundation
    - Electrical equipment
- Substations
    - Above-ground equipment
    - Cabling
    - Foundation
    - Fencing
    - Crushed rock
- O&M facility
    - Building
    - Foundation
    - Fencing
    - Crushed rock
- Meteorological equipment
    - Tower
    - Foundation
- Collection system
    - Cabling
    - Junction boxes
- Site access roads
- Interconnection Transmission Line

3.0 PROJECT OVERVIEW

3.1 Project Summary

The Project Site is proposed to be located in Deuel County, South Dakota, in the townships of Portland, Lowe, Altamont, Glenwood, and Herrick. The Project is planned to consist of up to 112 wind turbines, with a nameplate capacity of up to 310.1 MW, and generation capacity of up to 300 MW of electricity.

The Project also includes a Project Substation, an Interconnection Substation, an approximately 150-foot 345-kV Interconnection Transmission Line, up to four (4) meteorological towers, an O&M facility, and 26.8 miles of gravel access roads.

Because the Project has not yet been constructed, Burns & McDonnell did not visit the Project location as part of this Study. The contents of this evaluation, including conclusions provided herein, are based exclusively upon desktop analysis.

3.2 Project Facilities

The following sections provide an overview of the proposed Project Facilities.

3.2.1 Wind Turbines

The Project is proposed to consist of up to 112 turbine generators, including up to 101 GE 2.82-127 turbines and up to 11 GE 2.3-116 turbines. The 2.82-MW turbines include 88.6-meter, conical, tubular, steel towers which support the turbine nacelles mounted on top. The nacelle of each turbine includes three (3) blades mounted to the nacelle rotor, with a total rotor diameter of 127 meters. The 2.3-MW turbines include 80-meter, conical, tubular, steel towers which support the turbine nacelles mounted on top. The nacelle of each turbine includes three (3) blades mounted to the nacelle rotor, with a total rotor diameter of 116 meters. All turbines are assumed to be fully removed as part of this Study.

3.2.2 Wind Turbine Foundations

Each wind turbine tower will be supported by a cylindrical concrete pedestal on top of a sloped, octagonal concrete spread footing, as is commonly used throughout the wind industry. The cylindrical concrete pedestal is proposed to be approximately 13 feet in diameter and three (3) feet tall. Less than one (1) foot of the pedestal is to exist above-grade. The sloped, octagonal concrete base beneath the pedestal will extend downward an additional five (5) feet. The base of the foundation is proposed to have a bottom diameter of approximately 55 feet. The total foundation depth is proposed to be approximately eight (8) feet below grade.

All underground facilities for the Project will be removed to a depth of at least 3.5 feet below grade. Thus, the concrete pedestal, as well as approximately one (1) foot of the base, will be removed and backfilled as part of the decommissioning, and the remaining foundation will be left in place.

3.2.3 Access Roads

Each wind turbine will have an access road to allow for vehicle access to facilitate inspections and maintenance of the turbines and associated equipment during operation. The proposed access roads are 16 feet wide and consist of crushed gravel that rests on compacted subgrade. The Study accounts for removal of approximately 26.8 miles of access roads. All public and county roads are assumed to remain in place after decommissioning; therefore, their removal is not included in this Study.

3.2.4 Collection System

Each wind turbine generates three-phase electrical power that is transformed to 34.5-kV with an oil-filled, medium-voltage transformer located adjacent to the base of the turbine. All such transformers are assumed to be removed as part of this Study.

The Project will include an underground 34.5-kV electrical power collection system that will collect the electrical power from the wind turbines and route it to the Interconnection Substation. As noted in the proposed plans, a total of 67.5 miles of underground cable lines (ranging in size between #1/0 to 1500 kcmil) will be buried at a minimum below-grade depth of at least 48 inches. All cables (including both power and communication cabling) buried at a below-grade depth of 3.5 feet or less will be removed when the Project is decommissioned. All cables buried deeper than 3.5 feet below grade will be left in place when the Project is decommissioned as they will be buried deeper than the required underground cable removal depth of 3.5 feet, as specified by the Deuel County Zoning Ordinance B2004-01.

3.2.5 Project Substation

Power from each wind turbine will be delivered via underground power collection circuits to an on-site Project Substation, where it is to be transformed from 34.5-kV to 345-kV via two (2) main power transformers. The proposed plans are also assumed to include two (2) high-voltage circuit breakers, one (1) dead-end structure, substation steel structures, medium-voltage circuit breakers, switching devices, perimeter fencing, auxiliary equipment, and a control enclosure. All above-grade equipment within the perimeter fence of the substation, equipment to a below-grade depth of 3.5 feet, as well as underground cables to a depth of 3.5 feet are assumed to be removed as part of the Study, in accordance with the Deuel County Zoning Ordinance B2004-01 requirements.

3.2.6 Interconnection Substation

The Interconnection Substation will serve as the electrical interconnection between the Project and the regional transmission system. For the Interconnection Substation, this Study includes the removal of three (3) 345-kV circuit breakers, three (3) dead-end structures, substation steel structures, disconnect breakers, disconnect switches, bus conductors, auxiliary equipment, perimeter fencing, and a control enclosure.

3.2.7 Interconnection Transmission Line

Output from the Project is delivered to the Interconnection Substation through a 345-kV Interconnection Transmission Line that is proposed to span approximately 150 feet from the Project Substation to the Interconnection Substation. All above-grade equipment for the Interconnection Transmission Line, including structures and cabling, and all below-grade equipment to a depth of 3.5 feet are assumed to be removed as part of the Study. The Project is expected to use 795 kcmil "Tern" reinforced conductors supported by steel dead-end structures at either end. Given that the Project Substation and Interconnection Substation are proposed to be approximately 150 feet apart, no below-grade Interconnection Transmission Line infrastructure will be located outside of the Project Substation or Interconnection Substation boundaries.

3.2.8 Operations and Maintenance Building

The Project includes an on-site O&M building consisting of spare parts storage and an area for minor maintenance. The proposed 7,000 to 10,000 square-foot building, as well as the surrounding gravel and perimeter fencing, is assumed to be decommissioned and removed as part of this Study.

3.2.9 Meteorological Equipment

Up to four (4) meteorological towers are proposed to be installed as part of this Project. The towers are proposed to be permanent, lattice-type towers that range in height from 80 to 88.6 meters and are supported by guying wires. The towers are assumed to be fully removed as part of this Study, including their supporting foundations.

4.0 DECOMMISSIONING

4.1 Decommissioning Plan

When it is determined that the Project should be retired, the Project equipment will be removed as noted herein. It is assumed that the Project will incur costs for removal and disposal of the wind turbines, wind turbine foundations, and other Project facilities, as well as costs for the restoration of the Project Site. Above-grade steel, aluminum, and copper equipment, however, is expected to have significant scrap value to a salvage contractor. All recyclable materials will be recycled to the extent possible, while all other non-recyclable waste materials will be disposed of in accordance with state and federal law.

The wind turbine blades will be removed from the wind turbine rotors using a crane, cut into manageably-sized sections, loaded onto a trailer, and hauled to a local landfill for disposal; the wind turbine blades are constructed from a composite material that is assumed to have no salvage value at the time of decommissioning. The turbine nacelles will be removed from the towers with a crane. The towers and nacelle will then be dismantled, cut onsite, and hauled off to a scrap yard.

All concrete wind turbine foundations will be removed to a depth of 3.5 feet below grade; the portions of the foundation that are greater than 3.5 feet below grade will be abandoned in place. The recovered concrete will be demolished, loaded into a dump truck, and hauled to a local landfill for disposal. Voids left from the removal of the concrete footings will be backfilled with surrounding subsoil and topsoil and fine graded to provide suitable drainage.

All underground power collection circuits will be removed to a depth of 3.5 feet below-grade, in accordance with the Deuel County Zoning Ordinance B2004-01 requirements. Each circuit includes three (3) cables, a fiber-optic cable, and a grounding wire, and will be removed from the trench in which it is to be buried to a below-grade depth of 3.5 feet.

The Project Substation will be removed from the site, including all above-grade equipment (e.g., transformers, breakers, busbars), buildings, crushed rock surfacing, and fencing. All below-grade equipment (e.g., foundations) will be removed to a depth of 3.5 feet below grade.

All crushed rock surfacing will be removed from the Project's access roads. The removed crushed rock will be loaded into dump trucks and hauled offsite for disposal. The cost to remove the crushed rock, load it into dump trucks, and haul it to the final destination (assumed to be within 30 miles of the Project site) will be at the expense of the Project, at which point the ownership of the crushed rock will be transferred to a third party.

Following the removal of crushed rock surfacing, a layer of topsoil will be added to replace the removed rock. The areas where crushed rock has been removed will be fine graded to provide suitable drainage. In right-of-way and non-agricultural areas, the ground will be seeded to prevent erosion.

Prior to commencing activities associated with foundation removal, crushed rock surfacing removal, or any other earthwork, an approved erosion control plan will need to be developed by the demolition contractor. Best management practices (BMPs) applicable at the time that decommissioning activities occur will need to be implemented by the contractor for control of storm water runoff; since decommissioning activities are not anticipated to occur for 20 years or more, BMPs may differ from current standards. However, if decommissioning takes place in the near future, Burns & McDonnell would anticipate BMPs such as silt fencing and proper compaction, seeding, and mulching practices to be implemented. To the extent necessary, permits relating to decommissioning activities will need to be obtained, including permits from the Environmental Protection Agency and the United States Army Corps of Engineers. The costs included in this Study are expected to be sufficient for a demolition contractor to develop suitable plans for the control of surface water drainage and water accumulation. The costs included in this Study are also expected to be sufficient for a plan, where appropriate, for backfilling, soil stabilization, compacting, and grading prior to commencing demolition activities.

All impacted areas at the site will be returned to predevelopment conditions to the extent practicable. Restoration efforts will follow those specified in the Project application for Energy Facility Permits; all disturbed areas will be graded back to natural contours, de-compacted, and seeded as needed. This will allow all land disturbed by the construction of the Project to be returned to agricultural use at the end of the useful life of the Project. The cost estimates provided in the following section include activities and costs to return the land to a condition suitable for agricultural use subsequent to decommissioning of the Project.

The activities associated with the decommissioning plan described above are anticipated to be completed within a six (6) month timeframe, according to the following estimated schedule:

- Decommissioning Planning & Permitting: 2 months
- Demolition: 3 months
- Site Restoration: 1 month

Additional time may be required for post-decommissioning activities, including monitoring of new vegetation. However, this timetable and the cost estimates below should provide sufficient time and budget to comply with any applicable health and safety regulations.

4.2 Decommissioning Costs

The total cost to decommission the Project at the end of its useful life, based on the assumptions noted herein, is estimated to be approximately $3,256,300, or approximately $29,074 per turbine; a detailed breakdown of these costs is included in Appendix A. It is expressly noted that while costs are presented both in total and per turbine, a change in the quantity of turbines may not cause the total decommissioning cost to increase or decrease linearly by the per turbine cost, due to non-scalable differences in balance-of-plant costs and other similar factors. These costs are offset by the estimated revenue that will be received for scrap value of steel, aluminum, and copper equipment; no resale of the Project Facilities for reuse is assumed. Accordingly, it is a "no resale" estimate.

4.3 Decommissioning Assumptions

In addition to other assumptions noted herein, the following key assumptions are utilized for the Study:

1. All costs are presented in current (2018) dollars using the nearest site cost index from Watertown, South Dakota.
2. The decommissioning estimate is based on details and equipment defined through conversations with and documentation provided by Deuel Harvest.
3. An offsite landfill is assumed to be used for disposal of demolition waste. The Brooking Landfill, which is approximately 50 miles from the proposed Project Substation location, provided a debris disposal rate of $44.00 per ton and a concrete disposal fee of $21.00 per ton, which are a typical disposal rates for projects of this scale.
4. Where applicable, scrap values are based upon an average of monthly American Metal Market prices for October 2017 through September 2018 (i.e., one calendar year). The values utilized to calculate scrap value include the cost to haul the scrap via truck and/or rail to the major market which provides the best price. Based on hauling and rail prices, the best market at the time of this Study was Chicago, Illinois. Prices used include:
    a. Steel scrap value is $268.85 per short ton ($211.11 per short ton, net transportation)
    b. Copper scrap value is $2.20 per pound ($2.17 per pound, net transportation)
    c. Aluminum scrap value is $0.44 per pound ($0.41 per pound, net transportation)
5. Fluids located within the turbine nacelle, which may include oils and process chemicals, and are assumed to be drained and disposed of offsite as part of the demolition; these costs are included in the estimate.
6. It is assumed that all chemicals and consumables in storage and owned by the Project will be drained and the material disposed of prior to demolition; these costs are excluded from the estimate.

7. In accordance with Deuel County Zoning Ordinance B2004-01, all underground equipment, including cables, will be removed to a depth of 3.5 feet below grade. All structures or foundations greater than 3.5 feet below grade will remain in place and are excluded from the decommissioning estimate.
8. Access roads, parking areas, storage yards, crane pads, and all other areas constructed from asphalt, concrete, gravel, or compactable fill will be removed, recycled, and reclaimed.
9. Crushed rock from roads, balance-of-plant areas, and turbine foundation areas is assumed to have value as a commodity for reuse by a third party (e.g., demolition contractor, local landowner, municipality). The cost to remove the crushed rock, load it into dump trucks, and haul it an average of 30 miles will be at the expense of the Project; however, it is assumed the third party will accept the crushed rock at no charge. Therefore, cost of disposal is excluded from the estimate.
10. Costs for grading and re-seeding have been included in the decommissioning cost estimate.
11. Waste material and crushed concrete will be properly disposed of offsite.
12. It is assumed that all Project-specific access roads, fences, gates, and buildings will be removed as part of the decommissioning. Additionally, disturbed areas will be restored to original grade, reclaimed with native soils, seeded, and replanted with native vegetation consistent with surrounding land use.
13. Transformers will be removed and processed on-site. The cost to drain and dispose of transformer oil off-site is included in the decommissioning cost estimate.
14. Cost estimates include five (5) percent indirect costs and ten (10) percent contingency.
15. Market conditions may result in cost variations at the time of contract execution.

4.4 Statement of Limitations

In preparation of this report, Burns & McDonnell has relied upon information provided by Deuel Harvest and other third-party sources. While Burns & McDonnell has no reason to believe that the information provided to Burns & McDonnell, and upon which Burns & McDonnell has relied, is inaccurate or incomplete in any material respect, Burns & McDonnell has not independently verified such information and cannot guarantee or warrant its accuracy or completeness.

Burns & McDonnell's estimates, analyses, and recommendations contained in this report are based on professional experience, qualifications, and judgment. Burns & McDonnell has no control over weather; cost and availability of labor, material, and equipment; labor productivity; energy or commodity pricing; demand or usage; population demographics; market conditions; changes in technology; and other economic or political factors affecting such estimates, analyses, and recommendations. Therefore, Burns & McDonnell makes no guarantee or warranty (actual, expressed, or implied) that actual results will not vary, from the estimates, analyses, and recommendations contained herein.

Estimates provided herein were prepared based on current knowledge of site conditions, current regulations, and current material classifications. Burns and McDonnell has no evidence or reason to believe that the cost estimate will be inaccurate at the end of the Project's useful life; however, Burns and McDonnell's estimates do not include allowances for unforeseen environmental liabilities associated with unforeseen events not considered part of normal operations. Estimates also do not include allowances for environmental remediation associated with changes in classification of materials.

This report is for the sole use, possession, and benefit of Invenergy for the limited purpose as provided in the agreement between Invenergy and Burns & McDonnell. Any use or reliance on the contents, information, conclusions, or opinions expressed herein by any other party or for any other use is strictly prohibited and is at that party's sole risk. Burns & McDonnell assumes no responsibility or liability for any unauthorized use.

APPENDIX A - DECOMMISSIONING COST BREAKDOWN

Table A-1: Estimated Cost for Wind Turbine Decommissioning (2018$)

Deuel Harvest North Wind Farm Wind Project

Decommissioning Cost Evaluation

Wind Turbine Removal Cost		
Removal	$	4,147,000
Hauling & Disposal	$	734,000
Total	**$**	**4,881,000**
Scrap Value	**$**	**(7,584,000)**
Wind Turbine Foundation Removal Cost		
Removal	$	346,000
Hauling & Disposal	$	321,000
Total	**$**	**667,000**
Collection System Removal Cost		
Removal	$	28,000
Total	**$**	**28,000**
Substation Removal Cost		
Removal	$	480,000
Hauling & Disposal	$	25,000
Total	**$**	**505,000**
Scrap Value	**$**	**(268,000)**
Interconnection Transmission Line Removal Cost		
Removal	$	4,000
Hauling & Disposal	$	1,000
Total	**$**	**5,000**
Scrap Value	**$**	**(2,000)**
Civil Works Removal Cost		
Removal	$	678,000
Hauling & Disposal	$	2,476,000
Grading & Seeding Costs	$	210,000
Total	**$**	**3,364,000**
O&M Facility Removal		
Removal	$	75,000
Hauling & Disposal	$	24,000
Total	**$**	**99,000**
Scrap Value	**$**	**(36,000)**
Met Tower Removal		
Removal	$	27,000
Total	**$**	**27,000**
Scrap Value	**$**	**(3,000)**
Other Costs		
Oils & Chemicals Removal & Disposal	$	119,000
Total	**$**	**119,000**
Total Estimated Cost	**$**	**9,695,000**
Owner Indirect Costs (5%)	**$**	**484,800**
Contingency Costs (10%)	**$**	**969,500**
Total Gross Cost	**$**	**11,149,300**
Total Scrap Value	**$**	**(7,893,000)**
Total Net Cost	**$**	**3,256,300**

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