Decommissioning estimate

Vestas V3.0-112 Turbines on the proposed Monticello Hills Project

Introduction

Decommissioning of wind turbines which are at the end of their useful life is a potentially significant expense that might be borne by the landowner or the community at large. To mitigate this risk, communities typically require a decommissioning plan and security facility to cover the cost of removal of the turbine and recovery of the site. The motivation for requiring such a security facility is to have sufficient resources to be able to contract for the removal of the wind farm in the event of the financial default of the wind company. Thus, it is necessary that such a decommissioning reserve cover the likely and reasonably foreseeable costs for removal of the turbines and reclamation of the site to its prior use (for example, agriculture). It is useful to consider what could happen when such security is not posted and there are no responsible parties with the resources or inclination necessary to undertake decommissioning. In the first "wind rush" of the late 1970's and early 1980's, thousands of turbines were erected and over time, many were abandoned. The second "wind rush" of the past decade has not yet resulted in any meaningful numbers of decommissioned turbines and thus the older data provides useful guidance as a first assessment of the potential scope of the problem. Paul Gipe, the author of many books on wind power estimated that the 1997 cost to decommission and remediate the 14,000 abandoned turbines in California was $100 million[1]. Gipe noted that actual decommissioning costs for several examples ranged from $20 to $650 per kW of installed capacity depending on the standards used for remediation[2]. The typical cost reported by Gipe was in the range of $80/kW, net of the scrap value. Thus, based on this historical data, to a first approximation the cost to mitigate 18MW (18000kW) of turbines would be in excess of $1 million. This order-of-magnitude estimate only suggests that a detailed analysis is appropriate, it is not to be taken as a valid number in its own right.

A Word about Contractor's Estimates

In a few cases, decommissioning plans have included quotations from contractors to support the application of the "work for scrap" model to industrial turbines, but such quotations are to be taken with a grain of salt for several reasons. There are several pricing models in common usage in the construction industry: firm-fixed-price (FFP), unit price and time & material (T&M); the FFP model being most prevalent. In the FFP model, the contractor assumes risk that his quoted price is adequate to cover his costs, support overhead and provide for a profit. FFP quotations are nearly always competitive and awarded to the lowest responsible bidder. High bids don't generate business while low bids might result in the contractor's bankruptcy. For

[1] See http://www.wind-works.org/articles/Removal.html or for a more recent discussion: http://www.americanthinker.com/2010/02/wind_energys_ghosts_1.html

[2] For example, partial removal of the foundation led to lesser costs and full removal of all buried foundations and utilities resulted in dramatically higher costs.

this reason, a contractor's estimate should only be taken as valid if there is risk that he will be required to actually perform the work.

Understanding the Value of Scrap

Decommissioning plans and accompanying financial security vehicles are intended to avoid the problems experienced following dereliction of the turbines of the first wind rush, thus it is imperative that the cost estimate accommodate normal variation in costs so that the decommissioning fund is adequate to protect the landowners and the public at large. Any remaining scrap value (figured according to its value at the point of sale and in a form acceptable to the recycler or component buyer), can serve as a hedge against unforeseen cost overruns and returned as a rebate to the turbine owners following decommissioning[3].

In all of the estimates for decommissioning of large industrial turbines that I have read, the costs were added up, the scrap value was estimated and a difference was taken as the net costs. But is this methodology valid? As we have seen, there are few actual examples of decommissioning of large industrial turbines and the examples of turbines in current need of removal are in fact still standing; there does not seem to be lines of scrap dealers or contractors willing to do such complex, dangerous work for the residual scrap value; despite a current soft market for construction and a robust market for steel and copper scrap. While there is certainly scrap value to the steel structures of these turbines, copper in their windings, etc., I have not found any example of a contractor who has actually demolished and restored a major industrial turbine site for the value of this scrap alone. This is not to say that "working for scrap value" is not something that happens from time to time – it is actually quite common in the shipping industry but ships are typically towed to locations where labor is inexpensive, for example to India or the far east.

Scrap value varies greatly on daily, weekly and yearly timescales, depending on economic conditions at the time; it cannot be estimated a year in advance let alone 20 or more years in advance. In fact, it is so volatile that there are no lack of fee-based information services that will provide recent data trends. The USGS provides historical scrap values with a two year look-back. For example, here is a graph of steel scrap value from 1934 to 2009 in constant 1998 dollars[4], which I have converted to 2011 dollars using a conversion factor of 1.39196 based on the Consumer Price Index[5]. Note that a metric ton is 2205 lbs (1000kg rather than 2000lbs).

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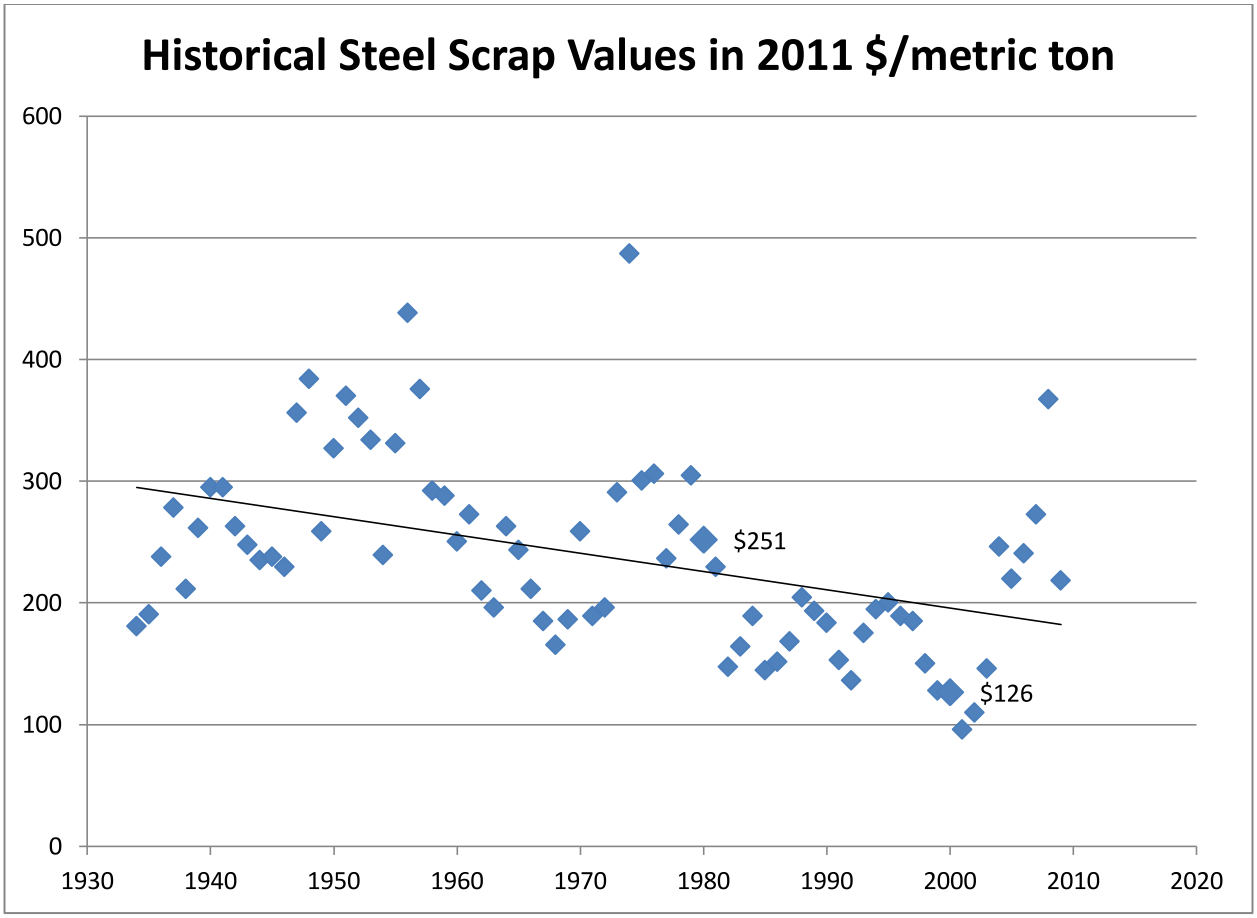
[3] It is also not inconceivable that after twenty years of operation that there could be an unsatisfied mechanics liens, unpaid PILOT funds, etc. and the scrap value might represent a suitable form of security to satisfy such unmet legal obligations following due process of law.

[4] Source: USGS

[5] http://data.bls.gov/cgi-bin/cpicalc.pl



Note the difference between 1980 (the first "wind rush") and 20 years later; scrap value dropped by 50% from $251/ton to $126/ton. Currently, scrap is at or near an historical high, it would be unwise to project this price 20 years into the future as a security vehicle to cover the cost of decommissioning. It is interesting that the long term trend line for scrap value is down whereas the experience of the past several years is upward.

So what is the value of steel scrap? Steel from the turbine would be classed as No. 2 Scrap steel according to the following description[6]:

> No.2 Steel shall consist of clean iron & steel scrap with a minimum thickness of 1/8", and a maximum size of 60"x18", material handling compatible to feed a furnace charge box.

Ridgeline's estimate of $350/ton is in line with that for No. 2 scrap steel; however the steel must be cut to 60" x 18" size and delivered to the mill to obtain this price. Ridgeline has not apparently included the cost of cutting the tubes to size in its estimate and this is a critical flaw in their analysis of scrap value. According to Ogershok & Prey[7], costs for torch cutting steel plate of 3/8 inch thickness is $3.38 per lineal foot, the thickest section for which a unit price is

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[6] http://www.scrapindex.com/metal/usa/steel/index.html
[7] 2009 National Construction Estimator, Craftsman Book Company © 2008 ISBN 978-1-57218-208-0

given. The Department of Energy Deactivation and Decommissioning Focus Area[8] estimated cutting costs per inch for various steel thicknesses in a 1998 report comparing cutting methods, the estimate for 1" thickness was $1.05 per lineal inch or $12.60 per LF. Since there will be economies of scale for the cutting, I have opted to use the lower number of $3.38 in my calculations. The tower is nominally 300' tall and ranges from 13.7' diameter to an estimated 8' diameter at the top (a detailed drawing was not available to this Engineer as of this writing) for an average of perhaps 10'. Based on these assumptions (which can readily be updated when detailed information becomes available) combined with the maximum piece size to meet the requirements for recycling No. 2 Steel, each 60" section would have to be cut up in 21 sections (105' of longitudinal cutting per 5' average tower section plus 55 circumferential cuts of 31.4' each for a total cut length of 8,027 LF.

For other turbine components, this Engineer cannot find a market for used industrial turbine blades or other parts. Ridgeline did not include any such scrap allowance in their estimate, but if any is claimed it should be accompanied by historical pricing data and a history of past sales that might support any such claims.

Foundation Demolition

The Ridgeline estimate for demolition was for demolition to a depth of 36". It is assumed that this is the height of the "top hat" portion of the foundation which has a diameter of perhaps 15'. The lower "ballast" portion of the foundation would presumably be left in place, and if permitted by law is a reasonable approach. The volume of the demolished portion is around 20 cubic yards of heavily reinforced concrete. Ogershok & Prey's 2009 National Construction Estimator recommends a cost of $144/CY ($5000 as a minimum) for the concrete demolition but the cutting of the re-bar and anchor bolts is a significant expense, assume 2" diameter bolts every foot around the circumference or around 40 total; rebar concentration is probably 9 per square foot for a total of around 1600 rods. There are no standards for cutting either rebar or anchor bolts but extrapolating the cost for cutting 1 lineal inch of 1" thick plate is analogous to cutting a larger diameter rebar while cutting a 2" bolt is perhaps four times this value. In addition, the cut sections must be disposed of.

Blade Demolition

Ridgeline did not itemize the costs for blade disposal and there are no standards for this work. The blades might each be analogous to perhaps a 3000 sq. ft. light wood structure for which Ogershok & Prey suggest a charge of $2.45 for the first floor, generating 1 CY of debris for every 8 square feet which would be loaded into 40-yard roll-off containers. These estimates can be updated as specific design information becomes available.

[8] http://www.em.doe.gov/EM20Pages/pdfs/pubs/itsrs/itsr1847.pdf see table 5 in section 5.

Project Management and Contractor Costs & Fees

Ridgeline did not include any costs for usual and customary construction costs such as for project management, site engineering, survey crews to locate underground utilities, etc. Additionally, direct and indirect overheads and profit must be considered because a general contractor must be hired to do the work. Ogershok & Prey suggest 24.8% as a general contractor markup; local conditions suggest that 15% is a more common value and will be used.

Additional costs not included

The purpose of this analysis is not to create an exhaustive estimate of all costs likely to be incurred in decommissioning, rather it is to illustrate the inadequacy of the applicant's own estimate. Thus, I did not include costs for widening roads, creating pads from which to operate cranes, obtaining any necessary permits, creating and implementing a storm water management plan (disturbance is greater than 1 acre) and so forth. Such costs can be estimated but are beyond the scope of this analysis.

Summary

The effort necessary to decommission a nearly 500′ tall turbine and partially restore the site is significant and costly. Scrap prices fluctuate greatly and often do not cover the cost of cutting, loading and delivering the material to the mill. Relying on future scrap value as a financial security instrument is tantamount to playing the futures market. This method has not worked in other areas and as we have shown, Paul Gipe noted in 1997 that the cost to decommission net of scrap value ranged from $20/kW to $625/kW. The following estimate for Monticello Hills is approximately $58/kW, in line but on the low end of 1997 values as reported by Gipe. Further, we do not know what the regulatory climate might be in 20 years. Health, safety and environmental laws and regulations could be more or less strict than today, we simply don't know. For example, it could be necessary to remove the full foundation and all underground utilities – a very costly undertaking. I would argue that any anticipated scrap value be used as a hedge against such unknowns and returned to the owner as a rebate following completion. This is not an unusual approach, for example most owners and construction managers of large construction projects retain a percentage of the contract cost from the contractor until the end of the project; 5-10% is typical. Such "retention" is intended to incentivize the contactor to complete "punch-list" items and is returned upon project completion. The scrap value can serve the same purpose.

Respectfully submitted,

Jonathan P. Knauth, P.E.

Knauth's Analysis of cost to decommission turbines
Public commentary on the Ridgeline Energy LLC Monticello Hills Application

Description	Qty	Unit	Unit Price	Extended
Project Manager	0.5	Mo	$ 6,150.00	$ 3,075
Job Site Engineer	0.5	Mo	$ 3,680.00	$ 1,840
Removal of Tower	270	MH	$ 59.05	$ 15,944
Cranes, conventional cable	80	hr	$ 379.00	$ 30,320
Crane boom extensions, 1 wk	12	each	$ 600.00	$ 7,200
Hydraulic Truck Crane, crane erection	16	hr	$ 189.00	$ 3,024
Cut tube to recyclable length	8027	LF	$ 3.38	$ 27,131
Load Trucks	10.5	Loads	$ 120.00	$ 1,260
Haul Steel to recycling center	10.5	Loads	$ 230.00	$ 2,415
Demolish Reinforced Concrete	20	CY	$ 144.00	*$ 5,000*
Cut anchor bolts	40	each	$ 10.00	$ 400
Cut rebar	1600	each	$ 1.50	$ 2,400
Load Concrete Debris	33	CY	$ 22.36	$ 738
Haul Concrete 6 miles	5	loads	$ 230.00	$ 1,150
Concrete recycling charge	5	loads	$ 100.00	$ 500
Fill, delivered to site	20	CY	$ 33.00	$ 660
Grade area	2.5	Acres	$ 293.00	$ 733
Truck with driver	32	Hr	$ 75.00	$ 2,400
Mechanical seeding, including seed	2.5	Acres	$ 1,514.00	$ 3,785
Blade demolition (based on light structure)	3	lot	$ 7,350.00	$ 22,050
Blade disposal, hauling charge	27	loads	$ 230.00	$ 6,210
Blade disposal, tipping fee	45	tons	$ 55.00	$ 2,475
Survey Party, mark underground utilities	0.5	Day	$ 1,180.00	$ 590
Removal of collection system	100	MH	$ 51.09	$ 5,109
Truck with driver, collection system	16	hr	$ 75.00	$ 1,200
Disposal of collection system	1	load	$ 100.00	$ 100
Nominal Direct Costs				$ 147,708
Mobilization		0.50%		$ 739
Total Direct Costs				$ 148,447
General Contractor's Markup		15.00%		$ 22,267
Total estimate to decommission one turbine				**$ 170,714**
Cost to decommission 6, plus substation				*$ 1,044,282*
Scrap value of steel, 10 year average	190	metric tons	$ 198.00	$ 37,620
Scrap value of steel, 10 year low	190	metric tons	$ 96.00	$ 18,240
Scrap value of steel, 10 year high	190	metric tons	$ 367.00	$ 69,730