GL Garrad Hassan

DECOMMISSIONING STUDY FOR THE PINNACLE WIND POWER PROJECT

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REVISION HISTORY

Issue	Issue date	Summary
A	14 December 2010	Initial issue for review
B	03 January 2011	Updated draft issue following Client's comments
C	05 January 2011	Updated with minor revisions
D	07 January 2011	Minor updates, including appendix of assumptions conversion from metric to US customary units of measure

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LIST OF TABLES

LIST OF ABBREVIATIONS

The following table lists some of the abbreviations used in this report.

Abbreviation	Meaning
BoP	Balance of Plant
GH	Garrad Hassan America
HH	Hub Height
O&M	Operations and Maintenance
WTG	Wind Turbine Generator

EXECUTIVE SUMMARY

At the request of Pinnacle Wind Force, LLC (the "Client"), Garrad Hassan America ("GH") has performed an analysis of the decommissioning cost (net of salvage) of the generating equipment and associated infrastructure at the Pinnacle Wind Farm (the "Project"). The study includes costs associated with the dismantling, removal, and salvage or disposal of the equipment, and it is assumed that this will take place 20 years after the start of commercial operations, although the costs in this study are given in 2010 dollars. The Project is located in Mineral County, West Virginia and when built, will consist of 23 MWT 95/2.4 turbines with a 262ft hub height.

GH assumes that there are strong parallels between wind farm construction and decommissioning programs and consequently bases the estimates for decommissioning costs on its broad experience of wind farm construction programs and the associated costs of labor, plant and materials. The decommissioning cost is calculated as the sum of the cost of disassembly plus the cost of transport (removal). It is noted that crane hire is the most dominant cost item.

Assessments of salvage opportunities are based on the bill of quantities identified in this report, the average material weights and ratios for turbine components derived from previous GH studies and the latest commodity prices and disposal service rates. The net salvage cost is calculated as the difference between the sum of parts resale and scrap revenue, less the landfill cost of the remaining material. It is assumed that 90% of turbine components are sold for scrap and 10% as parts. It is noted that the value of tower steel is the most dominant revenue item.

The net salvage value of the Project components and materials is estimated to be approximately $35,546 (or $1,545 / WTG) higher than the cost of decommissioning. A break-down summary is shown below (costs are considered as a negative convention (-) and revenues as a positive convention (+)):

Cost Item	Decommissioning Cost ($)	Net Salvage Value ($)
Preliminaries	-206,000	0
Grid Interface	-183,200	51,834
Turbines	-1,649,500	2,729,998
Met Mast	-2,500	26,830
Foundations	-150,851	-34,949
Site Electrics	-142,800	21,760
Site Roads & crane pads	-438,946	13,870
Total	**-2,773,797**	**2,809,343**
Net Cost/Value		**35,546**

Summary of decommissioning and salvage costs

Based on the above conclusions, GH considers that a provision for an escrow bond to cover decommissioning will not be necessary.

This summary does not consider the time value of money; the results should therefore be adjusted to represent the inflated costs at the time of decommissioning (e.g. annual escalation). It should also be noted that commodity values are volatile and difficult to predict over a 20-year horizon.

The following factors could influence the magnitude of the escrow bond but have not been considered under the conservative approach of this report. In general, these scenarios would only increase the residual value of the Project and diminish further the need for an escrow bond.

i) It is expected that the total cost could be reduced significantly if the Client were to carry out destructive decommissioning, thus avoiding the need for crane hire, and to leave the site MV collection system buried. There would in this case however be additional considerations such as environmental hazards and reduction in salvage costs. Therefore, a cost-benefit analysis would need to be performed if this option were considered further.

ii) It may be possible to sell whole turbines rather than parts at the end of the Project's 20-year life. Based on 2010 turbine prices this could equate to a secondhand resale value of $8,832,000 for the Project.

iii) Alternatively, the Project could be left in place and continue to operate as a going-concern. While maintenance costs would rise and productivity may fall after Year 20, the Project could still generate enough profit to cover the cost of future decommissioning.

It is stressed that this report is based on broad assumptions regarding the Project, the approach to the decommissioning, the market conditions for contracting costs, scrap value and resale options. It is recommended that the net costs of decommissioning be reviewed closer to the end of the operating period (i.e. at 15 years of operation). The costs of decommissioning after 20 years of operation could be reviewed at this time as well as the costs of decommissioning at 25 years of operation, taking into consideration potential extended operational revenue. It would also be prudent to take into consideration a 're-powering' scenario, in which case the existing turbines would be removed in the interest of constructing a more valuable project with larger, more efficient turbines.

1 INTRODUCTION

1.1 Background

At the request of the Client, GH has performed an analysis of the cost (net of salvage/reuse value) of the dismantling of the generating equipment and associated infrastructure at the Project. The Project is located in Mineral County, West Virginia and when built, will consist of 23 MWT 95/2.4 turbines with a 262ft hub height.

This analysis (the "Decommissioning Study") is to support a requirement imposed by the West Virginia Public Service Commission pursuant to an Order granting the Client a Siting Certificate for the construction and operation of the Project (the "Order"). Among other things, the Order requires the following:

> *Prior to commencing construction, Pinnacle will have obtained a report from a qualified independent third party regarding a decommissioning fund to cover the dismantling of the turbines and towers and land reclamation. The report of the qualified independent party will provide the analysis to set the fund amount. The report shall be updated thereafter as mutually agreed between Pinnacle and the Mineral County Commission, but no less frequently than every five years thereafter. The fund amount will vary over time depending on changes in the estimated market or salvage value of the Project, the estimated cost of dismantling and removing the turbines, and the expected ongoing life of the Project, Pinnacle will obtain the approval of the Mineral County Commission of the evaluative expert and each of the periodic reports. The decommissioning fund shall not be part of Pinnacle's assets. Within ninety (90) days of any report that requires a contribution to the decommissioning fund, Pinnacle will make that contribution into an escrow account held by an agent pursuant to an escrow agreement between Pinnacle and the Mineral County Commission. The methods for deposits to and disbursements from the fund shall be established within and governed by the escrow agreement. Furthermore, the escrow agreement must clearly reflect the role of the Mineral County Commission and state that the obligations set forth in the escrow agreement apply to Pinnacle, its successors, and assigns. The escrow agreement and each report of the qualified independent third party will also be filed with the Commission as a closed entry in this matter. The Commission retains the right to hire its own evaluative expert to review any of the periodic reports and to take such further action within its jurisdiction as the Commission determines is necessary to protect the public interest.*

1.2 Scope

The Client has advised GH that the scope of the required decommissioning includes the removal of all towers, wind turbine generators, transformers, overhead and underground cable, foundations, buildings, ancillary equipment and other physical material owned by and pertaining exclusively to the Project to a depth of three feet (3 ft) below grade and restoration of the property, including roads to the south of Green Mountain Road, to substantially the same grade as it existed immediately prior to construction.

It is understood that the decommissioning cost estimate should exclude the interconnection switchyard and the removal of roads to the north of Green Mountain Road, because these roads will also be used by other parties. For example, the Client advises that Allegheny Power will have a perpetual easement to access its Cross School switchyard located northwest of the project and Mineral County 911/Emergency Management will need access to its communication tower located north of the project.

It is understood that the Client only requires analysis of a removal scenario at the end of the Project's functional life. GH has not, therefore, considered scenarios involving repowering or other life-extending options for the Project. This Decommissioning Study does not consider the assessed scenarios from legal, regulatory or commercial perspectives; this will need to be assessed by the Client.

2 DECOMISSIONNING COSTS

Strong parallels between wind farm construction and decommissioning programs are assumed; consequently, the following estimates are based on GH's broad experience with wind farm construction programs and the associated costs of labor, plant and materials.

All costs quoted are based on 2010 dollars and it should be noted that no specific quotes were obtained in relation to this study. Assumptions used in the analysis are indicated where appropriate. A table of general assumptions is included in this report as Appendix A.

2.1 Preliminaries

Before executing any decommissioning works, it is necessary to plan the work carefully, secure the appropriate permits and insurances and manage the program of work and associated health and safety risk control methods in order to ensure a successful project.

It is assumed that the decommissioning program would be 10 weeks. This time line is essentially based on the assumption that the deconstruction of the wind turbines takes approximately seven (7) weeks. This is assumed to be the critical path activity with a rate of one (1) turbine every two (2) days over a six (6)-day week. In addition, one week is allowed for site mobilization at the beginning of the project, an extra week is allowed for after the last turbine has been dismantled to account for any required reinstatement of remaining roads and crane pads, and a final week is added to demobilize the site. GH has assumed that standard vehicle weight limits would be abided by, thereby minimizing the cost (if any) of reinstatement of existing roads. It should be noted that a delay budget of a half day per turbine is factored into this calculation.

2.1.1 Permits and Studies

The Project will likely be required to procure some form of environmental and jurisdictional administrative studies to support the responsible decommissioning of the Project. The cost of any required road permits is included in this amount. Also included is an estimate for the cost associated with establishing the appropriate environmental protection plans and contracts to be incorporated for the duration of the work. It is assumed that the cost of the actual environmental protection is included in each phase of the work to be performed.

Cost Item	Quantity	Unit	Unit Price ($)	Total ($)
Environmental Study	1	each	10,000	-10,000
Jurisdiction Study	1	each	10,000	-10,000
Environmental Protection Plan	1	each	75,000	-75,000
Total				**-95,000**

Table 2-1: Estimated cost of permits and studies

2.1.2 Staff

It is assumed that the Project will require a site team to be formed to manage the delivery of the Project program on time, on budget and in a safe manner. Over the 10-week program the site team is likely to consist of a full-time site manager as well as a part-time assistant, project manager, health and safety officer, procurement officer and welfare contractors. All other construction staff is accounted for in subsequent sections.

Cost Item	Quantity	Unit	Unit Price ($)	Total ($)
Site Manager	60	days	500	-30,000
Assistant	30	days	300	-9,000
Project Manager	20	days	600	-12,000
Procurement officer	10	days	400	-4,000
Safety officer	10	days	400	-4,000
Welfare contractors	10	days	100	-1,000
Total				**-60,000**

Table 2-2: Estimated cost of site staff

2.1.3 Site Facilities

It is assumed that a typical construction site compound will be installed prior to commencement of work. This will consist of secure, transportable office trailers, which will be powered and heated by a diesel generator or service from Allegheny Power.

Cost Item	Quantity	Unit	Unit Price ($)	Total ($)
Office trailers (3)	10	wks	1,500	-15,000
Power	10	wks	100	-1,000
Site communications	10	wks	100	-1,000
Site (de)mobilisation	2	wks	2,000	-4,000
Insurance	10	wks	3,000	-30,000
Total				**-51,000**

Table 2-3: Estimated cost of site facilities

2.1.4 Conclusion

GH concludes that the total preliminary costs incurred prior to and during the execution of the works would be in the order of $206,000.

2.2 Grid Interface

One of the first tranches of work is likely to be the decommissioning of the grid interface. This typically entails the removal of all overhead HV transmission cabling from the grid connection switchyard to the wind farm collection substation and associated structures, removal of the HV switchgear and associated equipment, and dismantling of the wind farm control building and substation compound.

2.2.1 Disassembly

In the case of the Project it is assumed that a control building is to be removed and a substation and its equipment are to be deconstructed and reclaimed, including the main transformer, breakers, switchgear and related transmission structures.

It is assumed that the scope of the disassembly works includes the cost of labor and machinery required to perform the tasks and the loading of the dismantled material onto transport vehicles for removal from site.

Sponsor has confirmed the length of the transmission line to be 0.75 miles in length (at 138 kV). The figures for removal in this report are based on general estimates to include line removal, pole removal and foundation removal.

Cost Item	Quantity	Unit	Unit Price ($)	Total ($)
Preparation	2	Days	400	-800
Remove equipment	3	Days	800	-2,400
Remove control building	5	Days	1,500	-7,500
Deconstruct substation and remove equipment	10	Days	4,000	-40,000
Remove transmission line	0.75	mi	n/a	-82,000
Reclaim areas	2	acres	2,000	-4,000
Total				**-136,700**

Table 2-4: Estimated cost of grid interface disassembly

2.2.2 Removal

It is assumed that the scope of the removal works includes the cost of labor and vehicles required to transport the dismantled material to an appropriate disposal, salvage or rework facility or to another site for direct reuse. It is also assumed that unloading of the material will be at the cost of the recipient and as such is not accounted for in this section.

It is assumed the transport distances for building rubble, poles and general waste would be within a radius of 50 miles, whereas the more complex and valuable material is assumed to be transported within a radius of 500 miles. A transport cost of either $1.5/mile or $3/mile is assumed for the varying load sizes.

Cost Item	Quantity	Unit	Unit Price ($)	Total ($)
Transport control building	4	trips	1,500	-6,000
Transport general waste (33 yd^3/trip)	4	trips	750	-3,000
Transport transformer	1	trips	1,500	-1,500
Transport switchgear and substation equipment	4	trips	1,500	-6,000
Transport grid materials (poles and cable)	20	trips	1,500	-30,000
Total				**-46,500**

Table 2-5: Estimated cost of grid interface removal

2.2.3 Conclusion

GH concludes that the total costs incurred during the decommissioning of the grid interface would be in the order of $183,200.

2.3 Turbines

Once the site is mobilized it is assumed that the decommissioning of turbines would start immediately and sequentially. This typically entails the individual removal of all 3 blades, followed by the hub, drive train and nacelle enclosure. The tower internals are then stripped of lifts, ladders, cables, cabinets, lighting and other sundries and are then dismantled, section by section, down to the foundation surface.

Since it is possible that the turbines may have a future resale market it is assumed that the disassembly should be done with care, without damaging or cutting any of the components. This presents the most costly and hence conservative scenario in the context of quantifying a decommissioning bond for the Project.

It is noted that quicker and consequently less costly demolishment could be achieved by means of explosives or towing vehicles, thus removing the need for a crane. The turbines can then be broken up on the ground using disc cutters, blow torches and hydraulic shears to separate valuable scrap material from other waste. This approach may also avoid the cost associated with the potential obligation to refurbish the crane pads for safe use before decommissioning by crane could start. For information, disassembly line item costs that could be avoided in this manner have been marked with an asterisk.

2.3.1 Disassembly

In the case of the Project, 23 turbines are to be removed, consisting of 2.4 MW nacelles, with 262ft steel towers in 4 sections, and 311ft blades. Features of note include nacelle-mounted transformers and a substantial cast bedplate designed to absorb axial loading.

It is assumed that the scope of the disassembly works includes the cost of labor, machinery and tools required to perform the tasks and the loading of the dismantled material onto transport vehicles for removal from site. The cranes would only be required on site for approximately 7 weeks during the turbine dismantlement activities. The small crane may be required for slightly longer in order to assist with the met mast recovery and other transport loading activities.

It is also assumed that aside from the possible removal of the drive train to aid lifting, the nacelle and its contents will remain fully intact for purposes of resale. All cooling, heating and lubrication fluids will be drained, stored and appropriately disposed of before the nacelle is removed.

Cost Item	**Quantity**	**Unit**	**Unit Price ($)**	**Total ($)**
Dismantle blades, 3/WTG	69	each	1,200	-82,800
Dismantle hub, 1/WTG	23	each	1,200	-27,600
Dismantle drive train, 1/WTG	23	each	1,200	-27,600
Dismantle nacelle, 1/WTG	23	each	1,200	-27,600
Dismantle tower internals	23	each	4,500	-103 ,00
Dismantle tower, 4/WTG	92	each	1,200	-110,400
Large crane hire, x 1	49	days	12,500	-612,500
Small crane hire, x 1	52	days	5,000	-260,000
Crane pad testing & repair (25% need attention)	6	each	1,000	-6,000
Crane De/Mobilisation	2	each	10,000	-20,000
Special tool hire	10	wks	1,000	-10,000
Total				**-1,288,000**

Table 2-6: Estimated cost of turbine disassembly

2.3.2 Removal

It is assumed that the scope of the removal works includes the cost of labor and vehicles required to transport the dismantled material to an appropriate disposal, salvage or rework facility or to another site for direct reuse. It is assumed that unloading of the material will be at the cost of the recipient and as such is not accounted for in this section.

It is assumed that the transport distances for general waste would be within a radius of 50 miles whereas the more complex and valuable material is assumed to be transported within a radius of 500 miles. A transport cost of either $1.5/mile, $3/mile or $4.50/mile is assumed for the varying load sizes.

Cost Item	Quantity	Unit	Unit Price ($)	Total ($)
Transport blades (2/trip)	35	trips	2,250	-78,750
Transport hubs (2/trip)	12	trips	1,500	-18,000
Transport drive trains (2/trip)	12	trips	1,500	-18,000
Transport nacelle (1/trip)	23	trips	1,500	-34,500
Transport tower internals	6	trips	750	-4,500
Transport tower sections (1/trip)	92	trips	2,250	-207,000
Transport general waste	10	trips	75	-750
Total				**-361,500**

Table 2-7: Estimate of cost of turbine removal

2.3.3 Conclusion

GH concludes that the total costs incurred during the decommissioning of the turbines would be in the order of $1,649,500.

2.4 Met Mast

It is assumed that the met mast will be disassembled at an appropriate time during the 10-week program so as not to interfere with other ongoing work. This typically involves the use of a small crane to dismantle the mast, section by section, down to the foundation surface. The instrumentation and booms would be removed before the associated sections are laid down.

2.4.1 Disassembly

In the case of the Project a 262ft free standing lattice tower type met mast is used.

It is assumed that the scope of the disassembly works includes the cost of labor, machinery and tools required to perform the tasks and the loading of the dismantled material onto transport vehicles for removal from site. It is also assumed that a crane mobilized for turbine removal would be used (therefore no additional crane cost is included).

Cost Item	Quantity	Unit	Unit Price ($)	Total ($)
Dismantle tower	1	days	500	-500
Dismantle equipment	1	days	500	-500
Total				**-1,000**

Table 2-8: Estimated cost of met mast disassembly

2.4.2 Removal

It is assumed that the scope of the removal works includes the cost of labor and vehicle(s) required to transport the dismantled material to an appropriate disposal, salvage or rework facility or to another site for direct reuse. It is assumed that unloading of the material will be at the cost of the recipient and as such is not accounted for in this section.

It is assumed that the transport distances for general waste would be within a radius of 50 miles, whereas the more complex and valuable material is assumed to be transported within a radius of 500 miles. A transport cost of ($3/mile) is assumed.

Cost Item	Quantity	Unit	Unit Price ($)	Total ($)
Transport tower	1	trips	1500	-1,500
Total				**-1,500**

Table 2-9: Estimated cost of met mast removal

2.4.3 Conclusion

GH concludes that the total cost incurred during the decommissioning of the met mast would be in the order of $2,500.

2.5 Foundations

It is assumed that all foundations including those for the turbines, the control building and met mast will be cut back to a depth of 3 feet (approximately 1 meter) and the original ground level reinstated.

It is also assumed that due to the robust nature of reinforced concrete, decommissioning could not be achieved without the destruction of the material, and as such it is unlikely that any of the reclaimed material would have any residual market value as scrap or otherwise.

2.5.1 Disassembly

The concrete and steel would be removed through the use of hydraulic jackhammers and shears. The use of a crusher is not deemed appropriate due to the mixed nature of the reclaimed material. In the case of the Project there are no externally located transformers or switchgear and hence no supplementary foundations to consider.

It is assumed that 50% of the removed volume would be backfilled with aggregates reclaimed from the roads and crane pads on site and 50% would be backfilled with imported topsoil.

Cost Item	Quantity	Unit	Unit Price ($)	Total ($)
Uncover turbine plinths and break out to 3ft deep ($34.40 / yd^3, 130.8yd^3/WTG)	23	each	4,500	-103,500
Break-out control building slab and foundation to 3ft deep ($34.40/ yd^3, 26.2yd^3 slab)	1	each	900	-900
Break-out met mast foundations to 3ft deep ($34.40 / yd^3, 13.1yd^3 slab)	1	each	450	-450
Reinstate top soil (50% of concrete volume)	1,150	yd^3	7.65	-11,501
Total				**-116,351**

Table 2-10: Estimated cost of foundation disassembly

2.5.2 Removal

It is assumed that the scope of the removal works includes the cost of labor and vehicle(s) required to transport the dismantled material to an appropriate disposal or salvage facility. It is assumed that unloading of the material will be at the cost of the Project and as such is accounted for in this section. A transport cost of ($3/mile) is assumed using trucks having a capacity of 20 yd^3.

It is assumed that the transport distances for general waste would be within a radius of 50 miles.

Cost Item	Quantity	Unit	Unit Price ($)	Total ($)
Transport concrete and steel rubble from site	153	trips	150	-23,000
Transport replacement material to site	77	trips	150	-11,500
Total				**-34,500**

Table 2-11: Estimated cost of foundation removal

2.5.3 Conclusion

GH concludes that the costs incurred during the decommissioning of the foundations would be in the order of $150,851.

2.6 Site Electrics

Decommissioning of the site electrics would involve the disconnection, excavation and re-reeling of all high-voltage collection cabling linking the turbines to the site substation and if appropriate, dismantlement of external transformers and switchgear. SCADA fiber optic cabling would only be recovered if running adjacent to the cable excavations, due to its low reclaim value. It should be noted that the speed of execution of these works is heavily dependent on the soil types and conditions at the time of excavation; the costs of extraction could therefore be variable. Decommission costs could be reduced by opting to leave buried cabling underground; however, this would also mean renouncing the scrap value for the materials, so a cost analysis would need to be performed.

2.6.1 Disassembly

In the case of the Project it is assumed that the collection cables run adjacent to the site tracks, covering a distance in the region of 3.42 miles (6014 yards) and buried at a depth of 3.3 feet. The turbines are fitted with internally mounted transformers and switchgear and as such form part of the turbine dismantlement costs.

It is assumed that the scope of the disassembly works includes the cost of labor and the loading of the dismantled material onto transport vehicles for removal from site. It is assumed that the disconnection work at the terminals would be performed as part of turbine removal or substation removal.

<table>
<tr><th>Cost Item</th><th>Quantity</th><th>Unit</th><th>Unit Price ($)</th><th>Total ($)</th></tr>
<tr><td>Disconnect turbines</td><td>23</td><td>each</td><td>100</td><td>-2,300</td></tr>
<tr><td>Excavate trench</td><td rowspan="3">3.418</td><td rowspan="3">miles</td><td rowspan="3">40233.6</td><td rowspan="3">-137,500</td></tr>
<tr><td>Extract and re-reel MV cabling</td></tr>
<tr><td>Backfill the trench and reinstate the ground</td></tr>
<tr><td>Total</td><td></td><td></td><td></td><td>-139,800</td></tr>
</table>

Table 2-12: Estimated cost of site electrics disassembly

2.6.2 Removal

It is assumed that the scope of the removal works includes the cost of labor and vehicle(s) required to transport the dismantled material to an appropriate salvage facility. Unloading of the material will be at the cost of the recipient and as such is not accounted for in this section. It is assumed the material is to be transported within a radius of 500 miles. A transport cost of ($1.50/mile) is assumed with 3x1640ft reel capacity trucks.

Cost Item	Quantity	Unit	Unit Price ($)	Total ($)
Transport cable reels	4	trips	750	-3,000
Total				**-3,000**

Table 2-13: Estimated cost of site electrics removal

2.6.3 Conclusion

GH concludes that the costs incurred during the decommissioning of the site electrics would be in the region of $142,800.

2.7 Site Roads and Crane Pads

Decommissioning of the site access ways will typically include stripping back the surfaces of the site entrance, project roads connecting the turbines, the crane pads, and the site compound area to a depth of 1 to 1.5 feet and replacing them with topsoil in keeping with the surrounding environment.

The project roads south of Green Mountain Road are assumed to be 5.5 yards wide and 1826 yards long, the crane pads are approximately 21.2 yards wide by 43.7 yards long and the lay down areas are approximately 43.7 yards wide by 43.7 yards long.

2.7.1 Decommissioning

In the case of the Project it is suggested that only roads south of Green Mountain Road be reinstated; those to the north would be retained for continued use. This section of road would account for about 30% of the total for the site, i.e. 1826 yards of 6014 yards.

Cost Item	**Quantity**	**Unit**	**Unit Price ($)**	**Total ($)**
Reinstate 23 crane pads (22 m x 44 m x 0.6 m / WTG)	14,440	yd^3	7.646	-110,401
Reinstate site roads (1826 yd x 5.5 yd x 0.44 yd)	4,368	yd^3	7.646	-33,396
Reinstate lay-down area and storage areas (44 yd x 44 yd x 0.44 yd)	837	yd^3	7.646	-6,399
Total				**-150,196**

Table 2-14: Estimated cost of site roads disassembly

2.7.2 Removal

It is assumed that the scope of the removal works includes the cost of labor and vehicle(s) required to transport the dismantled material to an appropriate disposal or rework facility and unload it.

It is likely that any excavated aggregate will be of mixed grades and combined with soil contamination and will have some residual value. It is assumed that the transport distances for landfill and topsoil import would be within a radius of 50 miles. It is assumed that some of the aggregate will be used to backfill 50% of the volume of the foundation excavations, the remainder will be resold for reuse and some may be land filled. All topsoil will have to be imported to site. A transport cost of ($3/mile) is assumed with 20 yd^3 capacity trucks.

Cost Item	Quantity	Unit	Unit Price ($)	Total ($)
Transport excavated aggregate	925	trips	150	-138,750
Transport topsoil to site	1,000	trips	150	-150,000
Total				**-288,750**

Table 2-15: Estimated cost of site roads removal

2.7.3 Conclusion

GH concludes that the costs incurred during the decommissioning of the site roads and crane pads would be in the order of $438,946.

2.8 Decommissioning Cost Summary

The total cost of non-destructive decommissioning (dismantlement and removal of material) is estimated to be in the order of $2,644,800, as outlined in Table 2-16 below.

Decommissioning Item	Decommissioning Cost ($)
Preliminaries	-206,000
Grid Interface	-183,200
Turbines	-1,649,500
Met Mast	-2,500
Foundations	-150,851
Site Electrics	-142,800
Site Roads & Hard standings	-438,946
	-2,773,797

Table 2-16: Summary of non-destructive decommissioning costs

It is expected that the total cost could be reduced significantly if the Client were to carry out destructive decommissioning, thus avoiding the need for crane hire, and to leave the site MV collection system buried. There would in this case however be additional considerations such as any environmental concerns and reduction in salvage costs. Therefore a cost-benefit analysis would need to be performed if this option were considered further.

3 SALVAGE AND DISPOSAL COSTS

Following the disassembly and removal of all materials from the Project site, five potential destinations for the reclaimed material are envisaged. These scenarios may add extra cost to the decommissioning budget or could offer an opportunity to reclaim some value from the wind farm components to offset against the cost of decommissioning.

(i) Low-grade material such as contaminated aggregate, concrete rubble, wood, non-recyclable materials and other mixed general waste will in all likelihood be sent to landfill or incineration at cost to the Project.

(ii) Medium-grade materials such as small- and medium-gauge cabling, small motors, cabinets of mixed electronics, and lighting may be sent to salvage centers to be stripped for parts and sold for re-use or re-processing. This may be done at a nominal or neutral cost to the Project. However, this material will often also be sent to landfill if an appropriate third-party cannot be found. GH notes that it is difficult to predict future costs of salvage due to the unpredictability of commodity prices.

(iii) High grade materials such as large steel components (tower sections, bedplates, hub castings, gearboxes, steel cable), large-gauge copper and aluminum cabling, aluminum flooring and ladders will be sent to reprocessing centers at a neutral cost or slight return to the Project. GH notes that it is difficult to predict future costs of reprocessing due to the unpredictability of commodity prices.

(iv) Reusable components that are deemed to be undamaged, functional and have not fulfilled their design life could be sold back to the manufacturer or its supply chain for a modest second-hand price for refurbishment.

(v) Whole turbines could be sold to a new owner for a second-hand price and transported directly from the Project, via storage, to a new site. GH notes that it is difficult to forecast future value of whole second-hand machines due to the unpredictability of the WTG market and the complexity of the modeling variables.

The most likely salvage opportunities for the Project would correspond to Scenarios i), iii) and iv).

3.1 Salvage Opportunities

The following assessment is based on the estimated bill of quantities outlined in the previous section, typical material weights and ratios for turbine components from GH experience and current commodity prices and disposal service rates.

The following scrap commodity prices are assumed (Ref. Dec. 2010, www.metalprices.com):

- Steel & cast Iron: $272/t;
- Aluminum: $1,542/t; and
- Copper: $3,629/t.

It should be noted that the commodity price of metals is volatile and 20-year values are impossible to predict with any degree of certainty.

The following landfill costs are assumed:

- Class 2 Industrial waste: $34.40/yd^3$; and
- Class 3 General waste: $11.50/yd^3$.

It should be noted that landfill costs are likely to increase over 20 years as space becomes more of a premium; this report should therefore be updated over the Project operating period.

For consistency all material quantities and rates are considered in units of volume, yd^3.

3.2 Grid Interface Materials

There should be opportunity to reclaim scrap value from electrical equipment (cabinets, yard equipment and transformer) and rubble from the civil works reinstatement. All other materials would be sent to landfill at cost. It is assumed that the overhead collector will be made of 3 single core stranded aluminium conductors of approximate size 500 kcmil and length 0.75 miles. The value of the poles is not known; therefore a conservative allocation of $1,000 per pole has been assigned.

			Resale	Scrap								
			Total	Copper ($27,309/yd³)		Steel ($1,643/yd³)		Aluminum ($3,327/yd³)		Class 2&3 Landfill ($34.40 &11.50/yd³)		
Salvage Item	**Qty**	**Unit**	**Value ($)**	**Qty (yd³)**	**Value ($)**	**Qty (yd³)**	**Value ($)**	**Qty (yd³)**	**Value ($)**	**Qty (yd³)**	**Value ($)**	**Net Scrap Value ($)**
General waste	26	yd³	0	0	0	0	0	0	0	26.2	-300	-300
Transformer	10	yd³	0	0.7	17,857	4.6	7,525	0	0	5.2	-180	25,203
Switchgear	8	yd³	0	0.3	8,929	2.6	4,300	0	0	4.9	-168	13,061
Other equipment	4	yd³	0	0	0	0	0	0	0	3.9	-135	-135
Control building	1	unit	2,500	0	0	0	0	0	0	0	0	0
Transmission cable	3	yd³	0	0	0	0	0	2.0	6,528	0.7	-22	6,505
Transmission poles	5	units	5,000	0	0	0	0	0	0	0	0	0
Total			**7,500**		**26,788**		**11,825**		**6,528**		**-806**	**44,334**

Table 3-1: Estimated value/cost of disposal of grid interface material

GL Garrad Hassan

GH estimates that the net value reclaimable from the grid materials would be on the order of $7,500 in resale plus $44,334 in scrap value for a total of $51,834.

3.3 Turbine Materials

There should be considerable opportunity to reclaim scrap value from the turbines as copper in the LV cabling, transformer and generator; steel from the tower, hub, gearbox and bedplate; and aluminum from the tower internals. The blades and nacelle housing are made from glass reinforced plastic and would have to go to landfill if not resold as spares.

It is also assumed that turbine parts sold for reuse after a 20-year period may be valued at 25% of their original purchase price. GH also assumes that 10% of blades, generators, gearboxes and transformers would be viable for resale on the basis that these components are likely to have been refurbished or replaced over the Project life, thus maintaining some valuable residual operating life. The remaining 90% of blades, generators, gearboxes and transformers plus 100% of towers, bedplates, bearings, shafts and hubs would be scrapped.

		Resale Total	Scrap Totals (90% items)								
			Copper ($27,309/yd³)		Steel ($1,643/yd³)		Aluminum ($3,327/yd³)		Class 2 Landfill ($34.40/yd³)		
Salvage Item	**Qty**	**Value ($)**	**Qty (yd³)**	**Value ($)**	**Qty (yd³)**	**Value ($)**	**Qty (yd³)**	**Value ($)**	**Qty (yd³)**	**Value ($)**	**Net Scrap Value ($)**
Blades (6.6t GRP)	69	309,120	0	0	0	0	0	0	280.2	-9,639	-9,639
Hubs (9.9t st, 1.1t GRP)	23	0	0	0	39.2	64,500	0	0	17	-585	63,915
Nacelle (5.5t GRP)	23	0	0	0	0	0	0	0	86.3	-2,970	-2,970
Bedplate (44t steel)	23	0	0	0	150.4	247,250	0	0	0	0	247,250
Shaft (12.1t steel)	23	0	0	0	41.9	68,800	0	0	0	0	68,800
G/box (22t steel)	23	264,391	0	0	75.3	123,840	0	0	0	0	123,840
G/tor (2.2t cop, 3.3t st)	23	86,424	6	164,311	10.3	16,985	0	0	0	0	181,297
Trafo (1.32t cop, 5.3t st)	23	55,200	3.5	96,444	16.5	27,090	0	0	0	0	123,534
Tower internals	23	0	0.7	17,859	0	0	30	100,096	60.2	-2,070	115,886
Tower sections (47.3t)	92	0	0	0	671	1,102,950	0	0	0	0	1,102,950
Total		**715,135**		**278,616**		**1,651,415**		**100,096**		**-15,264**	**2,014,863**

Table 3-2: Estimated value/cost of disposal of turbine material

GH estimates that the net value reclaimable from the turbine materials would be on the order of \$715,135 in component resale plus \$2,014,863 in scrap value for a total of \$2,729,998.

3.4 Met Mast Materials

There is some opportunity to reclaim scrap value from the steel in the mast. The instrumentation and other electronics would probably go to landfill rather than be refurbished. It is assumed that all the met mast components will have come to the limit of their fatigue life after 20 years.

			Resale Total	Scrap								
				Copper ($27,309/yd^3$)		Steel ($1,643/yd^3$)		Aluminum ($3,327/yd^3$)		Class 2 Landfill ($34.40/yd^3$)		
Salvage Item	**Qty**	**Unit**	**Value (\$)**	**Qty (yd^3)**	**Value (\$)**	**Qty (yd^3)**	**Value (\$)**	**Qty (yd^3)**	**Value (\$)**	**Qty (yd^3)**	**Value (\$)**	**Net Scrap Value (\$)**
Tower (1.2 yd^2 x 87.8 yd, at 15% density)	15.7	yd^3	0	0	0	15.7	25,800	0	0	0	0	25,800
Instruments	1.31	yd^3	0	0	0	0	0	0	0	1.3	-45	-45
Booms	0.65	yd^3	0	0	0	0.7	1,075	0	0	0	0	1,075
Total			**0**		**0**		**26,875**		**0**		**-45**	**26,830**

Table 3-3: Estimated value/cost of disposal of met mast material

GH estimates that the net value reclaimable from the met mast materials would be in the order of \$26,830.

3.5 Foundation Materials

It is considered that there is no opportunity to reclaim scrap value from the foundation rubble; as such, it would be sent to landfill at cost to the Project.

			Resale Total	Scrap								
				Copper ($27,309/yd^3)		Steel ($1,643/yd^3)		Aluminum ($3,327/yd^3)		Class 3 Landfill ($11.50/yd^3)		
Salvage Item	**Qty**	**Unit**	**Value ($)**	**Qty (yd^3)**	**Value ($)**	**Qty (yd^3)**	**Value ($)**	**Qty (yd^3)**	**Value ($)**	**Qty (yd^3)**	**Value ($)**	**Net Scrap Value ($)**
Reinforced / concrete rubble	3047	yd^3	0	0	0	0	0	0	0	3047	-34,949	**-34,949**
Total			**0**		**0**		**0**		**0**		**-34,949**	**-34,949**

Table 3-4: Estimated value/cost of disposal of foundation material

GH estimates that the net cost of disposing of the foundation materials would be in the order of $34,949.

3.6 Site Electrics Materials

It is considered that there is some opportunity to reclaim scrap value from the metals in the collection system cabling; the insulation would go to landfill. The electrical cabling is not deemed to be fit for sale for re-use. It is assumed that the underground collector will be made of 3 single core stranded aluminium conductors of approximate size 200 kcmil and length 6014 yards. It is not known what type of earthing system will be installed, so zero value is assumed as a conservative assumption.

			Resale Total	Scrap								
				Copper ($27,309/yd^3)		Steel ($1,643/yd^3)		Aluminum ($3,327/yd^3)		Class 2 Landfill ($34.40/yd^3)		
Salvage Item	**Qty**	**Unit**	**Value ($)**	**Qty (yd^3)**	**Value ($)**	**Qty (yd^3)**	**Value ($)**	**Qty (yd^3)**	**Value ($)**	**Qty (yd^3)**	**Value ($)**	**Net Scrap Value ($)**
MV cable	6.54	yd^3	None	0	0	0	0	6.54	21,760	0	0	**21,760**
Total			**0**		**0**		**0**		**21,760**		**0**	**21,760**

Table 3-5: Estimated value/cost of disposal of electrical material

GH estimates that the net value reclaimable from the site electric materials would be in the order of $21,760.

3.7 Site Roads and Crane Pads

It is assumed that 1504 yd^3 of aggregate will be used to back-fill 50% of the volume of the excavated turbine foundations. It is also assumed that the remaining material will be resold as second-grade engineering backfill at $0.765/$m^3$.

			Resale ($1/$m^3$)	Scrap								
				Copper ($27,309/$yd^3$)		**Steel ($1,643/$yd^3$)**		**Aluminum ($3,327/$yd^3$)**		**Class 3 Landfill ($11.50/$yd^3$)**		
Salvage Item	**Qty**	**Unit**	**Value ($)**	**Qty (yd^3)**	**Value ($)**	**Qty (yd^3)**	**Value ($)**	**Qty (yd^3)**	**Value ($)**	**Qty (yd^3)**	**Value ($)**	**Net Scrap Value ($)**
Aggregate	18141	yd^3	13,870	0	0	0	0	0	0	0	0	**0**
Total			**13,870**		**0**		**0**		**0**		**0**	**0**

Table 3-6: Estimated value/cost of disposal of road material

GH estimates that the net value reclaimable from the site road materials would be in the order of $13,870.

3.8 Salvage Cost Summary

The total net cost of salvage of the decommissioned material is estimated to be in the order of $2,809,343 assuming a combination of scrap sale value (net of landfill costs) and spare part sale value. A break-down is presented in Table 3-7 below.

Salvage Cost Item	Total Resale Value ($)	Total Net Scrap Value ($)	Net Salvage Value ($)
Grid interface material recovery	7,500	44,334	51,834
Turbine material recovery	715,136	2,014,863	2,729,998
Met mast material recovery	0	26,830	26,830
Foundation material recovery	0	-34,949	-34,949
Site electrics material recovery	0	21,760	21,760
Site roads & crane pad material recovery	13,870	0	13,870
Total	**736,506**	**2,072,337**	**2,809,343**

Table 3-7: Salvage/disposal summary

It is noted that it maybe possible to sell whole turbines rather than parts at the end of the Project's 20 year life. Although it is difficult to accurately assess turbine value and demand on this horizon, it is estimated that turbines might be worth up to 10% of their original value in Year 20. Based on 2010 turbine prices this could equate to a resale rate of approximately $160/kW, $384,000 per turbine, or $8,832,000 for the Project. This scenario would substantially reduce the magnitude of any decommissioning bond required.

4 ESCROW PROPOSAL

The total net salvage value of the Project components and materials is estimated to be on the order of $35,546 (or $1,545 / WTG) higher than the cost of decommissioning. A break-down summary is shown below (costs are considered as a negative convention (-) and revenues as a positive convention (+)):

Cost Item	Decommissioning Cost ($)	Net Salvage Value ($)
Preliminaries	-206,000	0
Grid Interface	-183,200	51,834
Turbines	-1,649,500	2,729,998
Met Mast	-2,500	26,830
Foundations	-150,851	-34,949
Site Electrics	-142,800	21,760
Site Roads & crane pads	-438,946	13,870
Total	**-2,773,797**	**2,809,343**
Net Cost/Value		**35,546**

Table 4-1: Summary of decommissioning and salvage costs

Based on the 2010 figures it can be concluded that the residual material value of the Project is expected to be slightly higher than the cost of decommissioning.

This summary does not consider the time value of money; the results should therefore be adjusted to represent the inflated costs at the time of decommissioning (e.g. annual escalation). It should also be noted that commodity values are volatile and difficult to predict over a 20-year horizon.

The following factors could influence the magnitude of the escrow bond but have not been considered under the conservative approach of this report. In general, these scenarios would only increase the residual value of the Project and diminish further the need for an escrow bond.

iv) It is expected that the total cost could be reduced significantly if the Client were to carry out destructive decommissioning, thus avoiding the need for crane hire, and to leave the site MV collection system buried. There would in this case however be additional considerations such as environmental hazards and reduction in salvage costs. Therefore, a cost-benefit analysis would need to be performed if this option were considered further.

v) It may be possible to sell whole turbines rather than parts at the end of the Project's 20-year life. Based on 2010 turbine prices this could equate to a secondhand resale value of $8,832,000 for the Project.

Alternatively, the Project could be left in place and continue to operate as a going-concern. While maintenance costs would rise and productivity may fall after Year 20, the Project could still generate enough profit to cover the cost of future decommissioning.

It is stressed that this report is based on broad assumptions regarding the Project, the approach to the decommissioning, the market conditions for contracting costs, scrap value and resale options. It is recommended that the net costs of decommissioning be reviewed closer to the end of the operating period (i.e. at 15 years of operation). The costs of decommissioning after 20 years of operation could be reviewed at this time as well as the costs of decommissioning at 25 years of operation, taking into consideration potential extended operational revenue. It would be prudent also to take into consideration a 're-powering' scenario, in which case the existing turbines would be removed in the interest of constructing a more valuable project with larger, more efficient turbines.

APPENDIX A – GENERAL ASSUMPTIONS

Unskilled Labor	$35/hr
Skilled Labor	$75/hr
Project Staff:	
Site Manager	$500/day
Assistant	$300/day
Project Manager	$600/day
Procurement	$400/day
Safety Officer	$400/day
Welfare Contractors	$100/day
Debris Removal Truck Size	20 cubic yards
Major Turbine Component Travel Distance	500 miles
General Waste Dump Distance	50 miles
Met Mast Scrap Travel Distance	500 miles
Road Permits accounted for in Jurisdiction Study	