Annexures
Annexure - I

(1) Ease of Doing Business in USA

1.1 How do you perceive legal and Economic risk in USA from business standpoint?
   Very Low - 1  Low - 2  Medium - 3  High - 4  Very high - 5

1.2 How easy it is to start a business in USA for a new entrant company from India?
   Very Easy - 1  Easy - 2  Difficult - 3  Very Difficult - 4  Don’t Know - 5

1.3 How critical is political relationship between two counties i.e. India & USA to do business?
   V. critical - 1  Critical - 2  Not critical - 3  Indifferent - 4  don’t Know - 5

1.4 Availability of capital and ease to raise capital / credits in USA for a new from developed economy like India
   Very Easy - 1  Easy - 2  Difficult - 3  Very Difficult - 4  Don’t Know - 5

1.5 Considering limited number of expatriate visas issued by US Govt. every year, how easy it is for a new entrant to mobilize global talent for deputation in the US market?
   Very Easy - 1  Easy - 2  Difficult - 3  Very Difficult - 4  don’t know - 5

(2) Wind Industry in USA

2.1 Do you think federal & state level policies such as PTC, ITC, and RPS are adequate & conducive to growing wind industry in USA?
   Yes - 1  could be better - 2  No - 3

2.2 Top driver for the Wind industry in US is:
   Better IRR - 1  Climate Change & global warming - 2
   Environment & Green branding - 3  Policy compliance - 4
   Energy Security & high demand - 5
2.3 Top ranked wind energy investor profile in wind industry is
Utilities- 1   Oil & Gas cos. - 2   FIs/Banks /Pension funds- 3
Corporate & Industries- 4

2.4 Best wind resource in the US can be found in which region?
Mid-Western States- 1   North-west Pacific States- 2
Southern States- 3   Western States- 4   North Eastern States- 5

2.5 Top limiting factor in the growth of wind industry in US is
Availability of Finance- 1   Transmission bottlenecks- 2
Competitive energy market- 3   Infrastructure & equipment- 4
Human resources- 5

2.6 Is availability of specialty equipment for logistics, projects and OMS (e.g. Trucks, cranes etc.) a limitation for growth in US?
Yes- 1   Somewhat- 2   NO- 3   Don't Know- 4

2.7 US wind industry's response to cheaper turbines from Chinese OEM is:
Cold- 1   Lukewarm- 2   Cautious- 3   Warm- 4   Enthusiastic- 5

2.8 Level of barriers for global wind turbine manufacturers to enter & grow in US wind industry is:
Non Existent- 1   Low- 2   Considerable- 3   Significant- 4

2.9 What is the most important decision making criteria for wind energy investors in US?
Cost of Energy- 1   Technology- 2   Timely Delivery- 3
Life cycle cost- 4   OMS offering- 5

2.10 Top detractor for growth of wind industry in US is
Policy Uncertainty- 1   Low PPA & Cheap Gas, coal, nuke- 2
High Cost of capital- 3   Fierce competition within wind industry- 4
Economic crisis- 5
(3) Indian New Entrant

3.1 What is the perception of quality of goods & services coming from Indian companies, in USA?
   Poor - 1  Sub-optimal - 2  Standard - 3  Good - 4  Excellent - 5

3.2 From Indian new entrant’s point of view the biggest challenge to do business in USA is
   Capital - 1  Attract HR - 2  Quality perception - 3  Logistics - 4
   Cultural aspects - 5

3.3 Do Indian New entrants perceive that US companies are open and unbiased to do business with them?
   Yes - 1  Somewhat - 2  No - 3  don’t know - 4

3.4 Are Indian new entrants in the US market adequately prepared to meet health, safety, environment and statutory legal & financial compliances?
   Yes - 1  Somewhat - 2  No - 3  don’t know - 4

3.5 The biggest organizational issue for Indian new entrant in the US market has to deal with is:
   Change Management - 1  Delegation & empowerment - 2
   Management style - 3  Inter-cultural aspects - 4
   Corporate Governance - 5

3.6 Biggest barrier to create one culture & one team between organizations in India and USA is
   Inability to harness cultural diversity - 1  Communication & language - 2
   Different Time Zone - 3  lack of shared corporate objective - 4

3.7 Banks, FIs and Insurance cos. Who presently provide array of services in India (e.g. debt, bond lines, insurance solutions - life, theft, performance etc.) in Indian market may not have business interest in US market. Is this a barrier to for entry & growth in US market?
   Yes - 1  Somewhat - 2  No - 3  don’t know - 4
3.8 Sub-contractors and vendors who provide array of services in India (e.g. project, engineering and OMS services etc.), may not have business interest in US market. Is this a barrier to for entry & growth in US market?

Yes 1  Somewhat 2  No 3  don't know 4

3.9 As a new entrant from developing economy i.e. India, would you consider attracting & retaining top local talent in the developed economy i.e. USA, a challenge for market entry & growth?

Yes- 1  Somewhat- 2  No- 3  don't know- 4

3.10 Established business model in Indian wind industry is providing 'concept to commissioning or End to End' solutions that is quite different from most accepted business model in US wind industry which is 'Supply, installation supervision and service'. Is it a challenge to adapt to disjointed value chain model that requires huge coordination & team work with 3rd parties unlike in India where entire value chain is controlled by wind turbine manufacturer?

Yes- 1  Somewhat- 2  No- 3  don't know- 4

3.11 Indian wind industry is driven by 'Capital Expenditure' based incentive mechanism (Accelerated Depreciation for Capex) to promote wind energy whereas US wind Industry is driven by "Generation Performance' (Product Tax credit) based incentive mechanism to promote wind energy. Does adapting to this change in market driver pose any challenge for market entry and growth?

Yes- 1  Somewhat- 2  No- 3  don't know- 4

3.12 Although its gradually changing over last few years , profile of Wind energy investors in India is primarily High net worth Individuals (HNIs) or Small & Medium Enterprises (SMEs) characterizing it almost like a retail market with large number of customers. Profile of wind energy Investors in the US primarily are large corporations in different sectors believing in large frame contracts with few customers. Does adapting to this significant change in customer profile pose any challenge for market entry and growth?

Yes- 1  Somewhat- 2  No- 3  don't know- 4

3.13 On ground project and site conditions in terms of wind speeds, temperatures, logistics, transportation, local compliances etc. are significantly in India and
US. Does adapting project and service offerings to this significant different market and site conditions pose any challenge for market entry and growth?

Yes- 1          Somewhat- 2          No- 3          don’t know- 4

3.14 As a result of significant difference in site conditions (e.g. weather, wind speed etc.) and statutory compliance norms (e.g. Grid codes, HSE practices etc.) than in India, product may have to undergo changes / modifications to suit to local market in terms of features, attributes characteristics etc. Does adapting to product modifications as per the market requirements and conditions pose any challenge for market entry and growth?

Yes- 1          Somewhat- 2          No- 3          don’t know- 4

3.15 Considering differences in Indian and US wind industry (e.g. Product, project & service requirements, distant customer profiles, different business models etc.) Sales, marketing and delivery processes may need to be modified. Does adapting to changes in business processes in line with market dynamics in US pose any challenges to market entry and growth?

Yes- 1          Somewhat- 2          No- 3          don’t know- 4

(4) Market Entry Strategies

4.1 How important it is to build local organization in US for the market entry?

Very Important- 1          Important- 2          Not Important- 3          don’t know- 4

4.2 Is alliance with local stakeholders (e.g. banks, insurance companies, etc.) in US critical for the market entry?

Yes- 1          May be- 2          No- 3          don’t know- 4

4.3 How important is international & local product certification for the success of maiden sales?

Very Important- 1          Important- 2          Not Important- 3          don’t know- 4

4.4 How critical is Balance sheet strength and financial health for a new entrant from India to get maiden order?

Very Important- 1          Important- 2          Not Important- 3          don’t know- 4
4.5 Do you agree that inter-cultural barriers can prove to a major hurdle in securing market entry for an Indian new entrant company in US?
Yes- 1  May Be- 2  NO- 3  Don't Know- 4

4.6 As a strategy how important it is to leverage Govt. channels e.g. Embassies, consulates, chamber of commerce etc. to facilitate market entry?
Very Important- 1  Important- 2  Not Important- 3  Don't know- 4

4.7 What would US customers find most attractive market entry proposition for Indian new entrant?
Special pricing & discounts on contracts- 1  Extended free OMS- 2
Unique technology concept- 3  Financing -vendor/ project / debt- 4

4.8 Most effective way of building brand equity in the US market is
Sponsorship of trade fairs & events- 1  Contributions in Seminars & conferences- 2  Self-financed show case project- 3
aggressive Lobbying with stakeholders- 4

4.9 The best way to secure market entry project is to
Concentrate on niche market / demography- 1  aggressive participation in all tenders & RFQs- 2  Concentrate on niche customer segment- 3  Work through existing global customers- 4

4.10 As a market entry strategy, which of the following could be best suited for breaking in to US wind industry?
Direct Entry- 1  Joint venture with local Co.- 2  Tender / RFP / RFQ route- 3  Value added resellers / Channel partners- 4
Strategic alliances with local co.- 5

4.11 Best way to secure maiden market entry contract is by
CXO level engagement & commitment- 1  Sweetening deal by extra guarantee & warrantee- 2  Sponsor India visit for Demonstrating capabilities- 3  Special introductory pricing- 4
Credits and/or Deferrer payment on performance- 5
4.12 market entry stage best people strategy for creating US organization is to
Create totally local organization- 1 Depute star performers in India to
US- 2 Combination of US & Indian personnel- 3 Harness talent
globally- 4

4.13 As a market entry strategy, how important it is to customize projects &
services to US market requirements?
Very Important- 1 Important- 2 Not Important- 3 don’t know- 4

4.14 How important it is to manage supply chain (e.g. purchase, production,
packaging, transportation, shipping, logistic etc.) for successful delivery, given
the cross continent nature of business.
Very Important- 1 Important- 2 Not Important- 3 don’t know- 4

(5) Market Growth Strategies

5.1 How important is local job creation for the growth of business in US?
Very Important- 1 Important- 2 Not so important- 3 don’t Know- 4

5.2 How critical is local manufacturing / sourcing to growth of business?
Very Important- 1 Important- 2 not so important- 3 Don't Know- 4

5.3 Would listing at the local capital markets give significant boost to growing
business?
Yes- 1 May Be- 2 No- 3 Don't Know- 4

5.4 Is it important to introduce new products regularly to capture higher share of
market?
Very Important- 1 Important- 2 not so important- 3 Don't Know- 4

5.5 From business growth stand point how important it is to create Operations,
Maintenance and service excellence center locally in US?
Very Important- 1 Important- 2 not so important- 3 don’t Know- 4
5.6 From business growth stand point how important it is to create R&D and engineering excellence center locally in US?

   Very Important- 1   Important- 2   not so important- 3   don't Know- 4

5.7 From business growth stand point how important it is to create strategic alliances with vendors & sub-contractors in US?

   Very Important- 1   Important- 2   not so important- 3   don't Know- 4

5.8 From business growth stand point how important it is to be in forefront of lobbying with policy, regulators and law makers in US?

   Very Important- 1   Important- 2   not so important- 3   don't Know- 4

5.9 As a market growth strategy, which of the following could be best suited for sustainable growth in US wind industry?

   Solo investments for deeper penetration- 1   Joint venture with local
   Co. - 2   Tender / RFP / RFQ route- 3   Value added resellers / Channel partners- 4   Strategic alliance with local co.- 5

5.10 For the business growth indicator for a strong brand equity in the market is:

   Performance track record of products- 1   No. of satisfied customers- 2
   No. of total installations & market share- 3   Infrastructure & capabilities of organization- 4   financial performance- 5

5.11 At market growth stage best people strategy for creating US organization is to

   Create totally local organization- 1   Depute star performers in India to US- 2   Combination of US & Indian personnel- 3   Harness
talent globally- 4

5.12 For the business growth most suited business model is

   Equipment Supply only- 1   Co-development of project- 2   Complete project Development- 3

5.13 As a business growth strategy how important it is to forge partnership with banks & FIs for financing?

   Very Important- 1   Important- 2   not so important- 3   don't Know- 4
5.14 As a business growth strategy how important it is to partner with key customers such as Utilities, Oil & Gas Companies?

   Very Important- 1    Important- 2    Not so important- 3    don’t Know- 4

5.15 As a business growth strategy how important it is to institutionalize Key Account Management for global customers?

   Very Important- 1    Important- 2    not so important- 3    don’t Know- 4

5.16 As a strategy how important it is to leverage Govt. networks, bi-lateral forums, political events etc. to facilitate business growth?

   Very Important- 1    Important- 2    not so important- 3    don’t Know- 4

5.17 As a strategy to sustain growth how to counter competition from Substitute products, other RE sources such as solar?

   Leveraging technology- 1    continuous Cost reduction- 2    Innovative business models-3    Value engineering- 4    Crashing project execution time- 5

5.18 As a strategy to sustain growth how to counter intense competition from within wind industry in US?

   Strong Customer relationships- 1    Product differentiators- 2    Innovative business models-3    Service differentiators- 4    Creating a niche market- 5

5.19 As a strategy to sustain growth how to counter potential threat arising from vendors by way of cost, supplies, technology etc.?

   In-house component sourcing- 1    Multiple vendor policy- 2    Long-term Frame contracts- 3    Equity participation- 4

5.20 As a strategy to sustain growth how to deal with aggressive bargaining power of customers?

   Strong Customer relationships- 1    Global Account Management- customer bank- 2    Long-term Frame contracts- 3    Creative solutions e.g. Penalty & Bonus formula- 4    Creating a niche market- 5
Annexure - II
TECHNICAL SPECIFICATION OF S64 (1250 kW) WTG

ROTOR
- Diameter : 64 m
- No. of Rotor Blade : 3
- Orientation : Upwind/Horizontal axis
- Rotational Speed : 13.9 / 20.8 rpm.
- Rotational Direction : Clockwise
- Rotor Blade Material : GRP
- Swept area : 32 18 m²
- Hub Height : 65 m
- Regulation : Pitch regulated

OPERATIONAL DATA
- Cut in wind speed : 3 m/s.
- Rated wind speed : 14 m/s.
- Cut off wind speed : 25 m/s.

GEARBOX
- Type : Integrated 3 Stage 1 planetary & 2 helical
- Gear ratio : 1: 74.917
- Manufacturer : Flender - Winergy
- Nominal load : 1390 KW
- Type of cooling : Oil cooling system, Forced lubrication

GENERATOR
- Type : Asynchronous 4/6 pole
- Rotation speed : 1010/1515 RPM
- Rated output : 300/1250 kW
- Rated voltage : 690 V
- Frequency : 50 Hz
- Insulation : Class "H"
- Enclosure Class : IP 56
- Cooling system : Air cooled
OPERATING BRAKES

- Aerodynamic brake: 3 Independent systems with blade pitching
- Mechanical brake: Spring powered disc brakes, hydraulically released, fail safe

YAW DRIVE

- Method of operation: 4 Active electrical yaw motors
- Bearing type: Polyamide slide bearing

CONTROL UNIT

Control unit has a microprocessor control with graphic backlit LCD display indicating operation condition. Control includes thyristor switchgear watchdog for operation, monitoring, log with real time, local control and servicing interface. Optional remote monitoring & operation. UPS back up system.

REACTIVE CURRENT COMPENSATION

- Compensation: Dynamic & Intelligent, with PF greater than 0.9

SAFETY SYSTEMS

1. Brake System:
   Automatic application by synchronous hydraulic control of blade pitching in case of:
   - Vibration or shock loading
   - Over temperature of the gearbox or generator failure of the thyristors & control in case of wind speed experienced is in excess of 25 m/s.
   - Variation in the Rated Voltage Range
   - Variations in the Frequency range
   - Asymmetric phasing
   - Line interruption- with automatic reconnection

2. Brake System: Spring applied hydraulically released disk brake.

TOWER

- Type: Free standing, Tubular, MS steel
- Tower Height: To suit hub height
- Construction: Flange & Bolts
- Erection: With crane
- Design: GL special class
Annexure- III

Wind Power Project Pricing Overview Template Instructions

Section 1: Project Overview

This section is provides the basic information about the project and its scope.

- **Country**: Select country from the drop down list
- **Project No**: Insert project number used for internal tracking within the region
- **Project Name**: Insert project name
- **Customer**: Insert customer name
- **Project Location**: Insert project location (Country, State and city)
- **Type of Turbine**: Insert turbine class
- **Item No**: Select full WT description from drop down list (the selection available is based on the approved product list from operations. If you need to include variations to the WT (HH or other options) please refer to “STANDARD WT” below.
- **Wind class of Site**: Select wind class at site from drop down list.
- **No. Of Turbines**: enter in the total no of WT for the project
- **No. Of MW**: enter in the total MW for the project
- **Standard WT**: The box for “ITEM NO” above allows users to select from the standard product list. If you are using a standard WT then check the “Yes” box. If you are using a non-standard WT (e.g. a differing hub height or additional options to be included in the nacelle), then check the “No” box. If you check the “No” box then a further field becomes available where you should describe the non-standard attributes.
- **Project Scope**: Using the check boxes the scope of the project should be specified as supply only, supply and erect or full EPC. Use the tower check boxes to denote if OEM will also be supplying the towers.

- **Type of Offer**: The check boxes should be used to describe the status of the pricing overview, i.e. if the numbers are based on a non-binding quotation to the customer, a formal quotation or the final contract pricing.

### Section 2: Pricing Overview

This section should include the high level project price and cost information.

- **Currency of the Quotation Prices**: all projects should be quoted in the functional currency.

- **Currency of the Cost / Transfers Price**: please indicate the currency that your transfer price is denominated in.

- **Rate of Exchange**: indicate the exchange rate assumed above.

- **Total Project Sales Price (ex. OMS)**: the pricing section should be completed using the costs relevant to the scope that OEM is offering the customer. The figure quoted as the total project sales price should exclude OMS.
### OEM Costs: this section should include the costs of supply of components from SEL. The approved transfer price should be used and the lines for discount and options should be used to show any approved project specific discount that have been granted by OEM and the costs of any additional options that are not included in the standard transfer price.

### Subsidiary Supply: this section should be used to specify those costs that will be incurred by the subsidiary for project elements that are supplied by the subsidiary. The Document ref sections should be used to reference the total figures appearing in this document back to the source document or model. Thus anyone reading the overview document will then be able to drill deeper into the models and assumptions if they so desire.

### Warranty: A standard warranty of two years is assumed as the standard warranty on offer. If an extended warranty is being offered please indicate the number of additional years using the drop down box. The value appearing for extended warranty should then be equal to the total cost for the extended period and not expressed as the cost per year.

### BoP Costs: This section should be used to indicate all BoP costs. BoP will include any civil and electrical works. As before the “Document Ref” boxes should be used to reference back to the more detailed models being used.
- **OMS**
- **Standard Service fee (years 1 and 2)**: Please insert the total costs for years 1 and 2
- **Extended Service fee**: If an extended warranty is being selected then please insert the total price for all extended years. Please then indicate the number of additional years being purchased by the customer.
- **Indexed by**: If the contract assumed a fixed price increase or an increase based on an index please indicate the % increase assumed in the extended service fee calculation.
- **Estimated % Margin**: An estimated contribution margin should be entered
- **Estimated Average CM**: This is a calculated field and is simply an average of the contribution margin averaged out over the total period (i.e. 2 year standard plus any additional extended years)

**Section 4: Competitive Position**

<table>
<thead>
<tr>
<th>Product</th>
<th>Hub Height</th>
<th>No of WT</th>
<th>Est Unit WT Price</th>
<th>Total installed cost for customer</th>
<th>Customer NPV</th>
<th>Customer IRR</th>
<th>Profitability Index</th>
<th>Cost per kWh</th>
<th>Rank</th>
<th>Price Differential</th>
</tr>
</thead>
<tbody>
<tr>
<td>S64</td>
<td>V12-800</td>
<td>3</td>
<td>1,054,200</td>
<td>2,300,000</td>
<td>50,000</td>
<td>5</td>
<td>1</td>
<td>x</td>
<td>x</td>
<td>200,000</td>
</tr>
</tbody>
</table>

This section is used to examine the competitive position of OEM against the known competition.

- **Product**: Identify the WT models being offered by the competition
- **Hub Height**: Specify the HH
- **No of WT**: Enter in the estimated no of WT being offered by the competition.
- **Total Unit WT Price**: For OEM this is a calculated field as the project price divided by the no of WT offered. You should estimate the same for the competition and in the process attempt to normalize the scopes being offered so that the comparison is on an apple to apples basis.
- **Total installed cost for customer**: This is an estimate of the total project costs for the customer taking into account the scope of OEM supply and then any additional works that the customer may be responsible for.
- **Customer NPV:** This is an estimate of the customer’s NPV. The same assumptions need to be made with regard to the discount rate etc. for each competitor so that OEM’s offer can be compared with that of the competition on a like for like basis.

- **Customer IRR:** As above but a calculated IRR from the customer’s point of view.

- **Profitability Index:** A useful measure if the capital outlay is not the same for each competitor offering. This divides the NPV by the initial total project costs so that we can see for each unit of initial investment, what the expected NPV “return” would be.

- **Cost per kWh:** Estimated cost per kWh from the customers perspective. Should be based on a total cost and not just WTG supply.

- **Rank:** After this analysis is completed we should rank each offering to see where we stand relative to the competition.

- **Price Differential:** An estimate of the price increase or decrease necessary to make the customers decision marginal. (i.e. where OEM’s offering is as competitive as the next best alternative) – If the customer’s main criteria are cost per kWh then it may be possible for us to raise our prices and still be cheaper on a cost per kWh than the next best alternative.

**Section 4: Approvals**

Depending upon the size of the project various levels of approval are required. The various levels and those required to sign off are detailed in the “Delegated Authority Matrix” for each subsidiary. The overview sheet should be printed out and then those required approvers should provide a physical signature.
# Annexure - IV

## SALES QUESTIONNAIRE

**Purpose:** The purpose of this questionnaire is to precisely define the requirements of the proposed Wind power project and establish a mutual understanding of the Project between Seller Company (OEM) and the Customer.

**Main Subject:** This form defines the information required to perform a preliminary evaluation of the project in question. We kindly ask you to fill in the form and return it to the Central Marketing in Head Quarter of OEM or OEM company representative maintaining contact with you.

### Project Description

1. Customer name:

1.a Project name:

1.b The maximum capacity for the grid connection (MW):

1.c The maximum capacity for turbine/nameplate (MW):

1.d Maximum rotor diameter permitted (meters):

1.e Maximum tip height permitted (meters):

1.f Maximum hub height permitted (meters):

2. Project Scope:

   *Complete the table in Appendix 1.*

3. Wind & Site Conditions:

   *Complete the table in Appendix 2 and describe any special conditions.*

4. Project Location (nearest town):

   *Please provide us with a map of the site.*

5. Power Purchase Agreement (PPA) Provider:

   *Please advise status of the PPA.*

6. Grid Specifications:

6.a Please advise the voltage level of the grid:
6.b Please advise the net frequency (Hz):

6.c Please specify preferred solution (according to attached document “LVRT-Behavior Variants S88-2.1 MW, rev.1).
- [ ] Grid Basic
- [ ] Grid Standard
- [ ] Grid Excellence

7. Project Schedule:
   Complete the table in Appendix 3.

8. Special/Local conditions:
### Project Scope

<table>
<thead>
<tr>
<th>Project Scope</th>
<th>Customer to indicate</th>
<th>OEM</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Supply of WTGs (CPT nearest suitable harbor)</td>
<td>X</td>
<td></td>
<td></td>
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<tr>
<td>Harbour Handling</td>
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<td>Prices of harbour handling will be excluded from all non-binding quotations.</td>
</tr>
<tr>
<td>Transport from local port to Site</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Supervision of Installation</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Installation incl. cranes</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Commissioning</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Training</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Transformer :</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>- internal in Tower</td>
<td></td>
<td></td>
<td>Please indicate voltage level for transformer (20 kV/30 kV). Please indicate preferred transformer solution.</td>
</tr>
<tr>
<td>- External in Kiosk</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Maintenance &amp; Service (M&amp;S)</td>
<td>X</td>
<td></td>
<td>Please indicate number of years for which M&amp;S is requested.</td>
</tr>
<tr>
<td>Service lifts</td>
<td>X</td>
<td></td>
<td>Please specify requirements</td>
</tr>
<tr>
<td>Aviation lights</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Civil Works on Site (Roads, Foundations, Ditches)</td>
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<td></td>
<td></td>
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<tr>
<td>Electrical Works on Site</td>
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<td></td>
<td></td>
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<tr>
<td>High Voltage Substation</td>
<td></td>
<td></td>
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<tr>
<td>Grid Connection from High Voltage Substation</td>
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</table>
- **Wind & Site Conditions**

<table>
<thead>
<tr>
<th>Climatic and Site Conditions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Site</td>
</tr>
<tr>
<td>Yearly average wind speed at hub height (m/s)</td>
</tr>
<tr>
<td>Characteristic turbulence intensity acc. to IEC 61400-1 (15 m/s)</td>
</tr>
<tr>
<td>Air density kg/m³ average</td>
</tr>
<tr>
<td>Temperature min (°C)</td>
</tr>
<tr>
<td>Temperature max (°C)</td>
</tr>
<tr>
<td>Height above sea level (m)</td>
</tr>
</tbody>
</table>

In order to perform an energy prediction, develop a micro-siting and check the suitability of a WTG for site specific conditions the following information is as a minimum required:

1. Paper maps showing the height contour lines.
   - The scale of the map should be ideally 1:25000.
   - Magnetic declination (True North and Magnetic North arrows) should be indicated.
   - The height contours should be ideally given at least every 10m.
   - The map should cover an area of minimum 10km around the site.
   - The coordinates of the map should be clearly visible at the corner of the map.
   - Information about the coordinate system and datum.
   - The site boundary should be clearly marked.
   - Any restrictions like for example houses should be marked on the map, preferably with coordinates and their level of involvement for assessing noise requirements.
   - Ideally this map should also be scanned in as *.tif or *.jpg file
   - 3-dimensional digital height contours as *.dxf, *.dwg, *.dem or *.map fulfilling the same requirements as above preferably with higher resolution contour files covering at least the site boundary (2m contours).
2. Turbine Location Information
   - Spreadsheet of turbine coordinates also indicating the coordinate system and datum
   - If no turbine coordinates are available, clear information regarding site boundaries and the area available for wind turbines needs to be provided. This should be in a scanned map format with a coordinate system showing applicable restricted areas.

3. Measured on-site data covering minimum 1 year
   - Precise position, ideally in the co-ordinate system the map is in
   - Measurement heights and measurement units (m/s or mph?)
   - Measurement period
   - Raw data (time series), which means an Excel spreadsheet or an ASCII file listing date, time, measured wind speed and direction for every 10-minute or 1 hour depending how the logger is set up
   - Information about calibration if available including copies of the calibration certificates if available
   - Temperature data if available

4. Photos
   - Of the entire mast in total
   - Panoramic photos around the mast
   - Of the side booms (with orientations noted if possible)
   - Of the top
   - Of WTG positions
   - Of relevant features in the terrain which may contribute to abnormal turbulence, e.g. cliff or plateau edges, trees
   - Aerial photos of site if possible to assist in building a roughness map.
   - Panoramic photos from key vantage points on site to assist in building a roughness/obstacle map.

5. Long-term data
   - Position (coordinates, coordinate system and datum)
   - Data either in the same form like the on-site measured data or alternatively monthly mean values of the wind speed
6. Predicted wind speed and site climate
   • Long term mean wind speed at measurement height
   • Long term wind rose and frequency distribution at measurement height and/or at hub height.
   • Long term wind shear and associated X & Y levels.
   • Air density
   • Extreme gusts calculations
   • Extreme temperatures and their time of year
   • Turbulence Intensity at 15m/s at HH
   • Maximum inflow angles at HH
   • Any other extreme conditions to which the turbines will be exposed (icing, heat, seasonal inverted shear, etc.)

   • Project Schedule

<table>
<thead>
<tr>
<th>MILESTONES</th>
<th>Prepared/ Obtained</th>
<th>Expected date</th>
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<tbody>
<tr>
<td>Site Layout Finalized</td>
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<tr>
<td>Permits :</td>
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<td>- Right of land/Land leasing agreement</td>
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<td>- Building permit</td>
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<td>- Approval from local authority</td>
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<td>- Heritage/nature clearance</td>
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<td>- Grid connection agreement (PPA)</td>
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<td>Notice to proceed on WTG Order</td>
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<td>Project Roadways Complete</td>
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<td>WTG Foundations Complete (ready to accept WTGs)</td>
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<td>Electrical Infrastructure Complete</td>
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<tr>
<td>Power available at site to WTGs (Substation Complete)</td>
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<td>Deadline for delivery of WTGs to site</td>
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<td>Deadline for Project Operational</td>
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Annexure- V

TERM SHEET FOR __________ WIND POWER PROJECTS (25Mw + in Size)

Owner:

Contractor: ABC Wind Energy Corporation (OEM)

Project:

Location:

Effective Date:

Notice to Proceed: On or before __________

Scope:
Contractor will furnish and install __________ ________ wind turbines ("WTG's"), Including but not limited to __________ ________ tubular towers; controllers; interconnecting cabling within the towers; control and monitoring system including central computer (SCADA) to include on-site server, processing and reporting software and appropriate licenses; remote PC system (understood to be software, not computer itself) all conforming to the specifications set out in Appendix __; installation (incl. crane), start-up, testing, commissioning, of the WTG's, supply of ___ templates for the foundations; a list of recommended spare parts; supply of one set of special tools for the O&M (special tools means tools that are not readily available from third parties within the U.S.); specifications for the road and WTG crane pad dimensions and WTG foundation loads; and all other reasonably necessary deliverables and services to complete the installation of the wind turbines in accordance with Contractor's quality assurance procedures. The Scope includes CIP, according to Incoterms 2000, delivery of all equipment to the site and all import duties and customs and any taxes levied outside the respective State locations. The Scope terminates at the bottom (flange) of the tower and the circuit breaker/controller in the tower. During the project engineering and permitting process Contractor will provide Owner with all reasonable necessary support. The scope also includes instrumentation for _____ met masts to be used for the Power Curve Tests and other work and services reasonably necessary to complete the work in accordance with Prudent Wind Industry Practice, which shall be defined as meaning the standards and practices that are widely accepted by the wind energy industry for wind projects of this size.

“Balance of Plant” ("BOP") work is expressly excluded. BOP work shall include, but not be limited to: civil work, roads, foundations, grading, grouting, electrical work, transformers, substations, grid interconnect, maintenance building, supply of met masts required for power curve testing, fiber-optic cabling between WTG's, and other work reasonably necessary to complete the BOP in accordance with Prudent Wind Industry Practice.
**Price:** The Pricing is attached in Appendix “__“ – Pricing.
If Owner elects to cancel the Term Sheet, Owner will be obligated to pay to Contractor a non-refundable fee pursuant to Appendix ___ – “Termination Schedule” attached hereto.

**M&S:** Contractor offers to do the Operations, Maintenance & Service on the turbines for a price of _____ per year per WTG for the duration of the Base Warranty Period, such price to be increased annually in accordance with the CPI Index. This includes all scheduled and unscheduled inspections and repairs including all parts and consumables, and operation of the turbines. The scope of the Maintenance and Service work is further elaborated in Appendix “__”.

**Milestone Schedule:** The Project Schedule is attached hereto as Appendix __.

- Start Construction (Refer to Project Schedule)
- Foundations complete Prior to WTG Delivery
- Temporary Grid Energization (Refer to Project Schedule)
- Start wind turbine installation (Refer to Project Schedule)
- Permanent Project Energization (Refer to Project Schedule)
- Mechanical Completion of all WTG’s (Refer to Project Schedule)
- Guaranteed Facility Substantial Completion (Refer to Project Schedule)
- Final Acceptance (Refer to Project Schedule)

**Payment Terms:** Progress payments based on milestones achieved:

- Notice to Proceed : 20 %
- WTGs delivered to the site : 40% (partial payment per WTG applicable)
- Towers delivered to the site: 20% (partial payment per tower applicable)
- Mechanical Completion all WTGs:10% (partial payment per WTG applicable)
- Facility Substantial Completion: 5%
- Final Acceptance 5%

Contractor, upon completing items (i), (ii), and (iii) of the Final Completion milestones, reserves the right to submit to Owner, an Irrevocable Letter of Credit in form and substance and from a Bank acceptable to the Owner in the value of 5% of the contract price in return for the payment of the Final Acceptance amount. 100% of this Letter of Credit will be returned upon Final Acceptance.

**Payment Security:** Upon execution of a WTG Supply and Installation Agreement, Owner agrees to provide Contractor with an irrevocable letter of credit for the benefit of Contractor in an amount equal to 80% of the contract value and in a form reasonably acceptable to Contractor.
**Force Majeure:** Events beyond the Parties reasonable control, including but not limited to: natural disasters, fire, lightning, icing, flood, earthquake, icing, explosions, acts of God or the public enemy, strikes and lockouts, vandalism, blockages, insurrections, riots, war, sabotage, wind speeds in excess of 10m/s for installation and 15 m/s for commissioning, excessive or insufficient wind, action of a court or other public authority, and action or inaction by any Federal, state or local legislative body or executive, administrative, or judicial agency or body.

**Mechanical Completion:** Shall occur when (i) each WTG or other component is assembled, installed and erected so as to be demonstrably substantially completed in accordance with the Installation Procedures, Technical Specifications, the Mechanical Completion Checklist, and the other requirements of this Agreement; (ii) all materials and equipment associated with such WTG or other component have been installed substantially in accordance with Mechanical Completion Checklist, applicable quality assurance procedures, and the other requirements of this Agreement; (iii) the WTG is ready to commence commissioning and testing; and (iv) Owner has countersigned a Mechanical Completion Certificate with respect to such WTG.

**PTC Damages:** Production Tax Credit Liquidated Damages. Owner and Contractor acknowledge that Commissioning of each Wind Turbine must occur by [December 31, ____] (the “PTC Deadline”) so that Owner may qualify for the Production Tax Credits under the Internal Revenue Code. Should the Contractor fail to Commission any Wind Turbine by the PTC Deadline, and as a result thereof the Owner is unable to qualify for the Production Tax Credits for such Wind Turbine, the Contractor shall pay Owner as liquidated damages for such failure, and not as a penalty, [an amount equal to $_______] for each Wind Turbine which has not been Commissioned on or before the PTC Deadline and for which the Production Tax Credits are not available (the “Production Tax Credit Liquidated Damages”). The Owner and Contractor agree that the liquidated damages identified in this Section are a good faith estimate of the damages the Owner would suffer in the event Contractor fails to meet the PTC Deadline. To the extent that the Production Tax Credits are renewed and the deadline for the qualification for Production Tax Credits is extended, or the Owner otherwise qualifies for the Production Tax Credits, the Production Tax Credit Liquidated Damages shall not apply. The Production Tax Credit Liquidated Damages shall constitute Owner’s sole and exclusive remedy should Contractor fail to meet to the PTC Deadline.

**Facility Substantial Completion:** Shall occur when (i) all of the WTGs and all Work has been installed and performed in accordance with the Agreement and have achieved Mechanical Completion, (ii) all components of the Facility are mechanically, electrically and structurally sound, operate as a single unit capable of generating electrical energy for delivery to the grid-interconnection, (iii) the SCADA system has been installed, tested and commissioned, and provides fully functional control, data logging, and report generation capabilities for all WTG’s, (iv) Contractor has prepared and submitted the final punch list for the Facility and it has been approved by Owner,
(v) Facility shall be capable of continuously delivering power, and (vi) all documents per the Turbine Supply Agreement have been delivered.

**Final Completion:** Shall occur when (i) final lien waivers and releases have been delivered, (ii) Contractor has delivered the Job Books and as-built drawings, (iii) all Contractor’s supplies, personnel and rubbish have been removed from the site, (iv) all punch list items have been completed (v) the FPCT has been completed.

**Final Acceptance:** Shall occur upon Owner’s written acknowledgement that Final Completion has been met.

**Guaranteed Facility Substantial Completion Date:** The date for Facility Substantial Completion shall be based on a Notice to Proceed by ______ or earlier, Completion of all Foundations prior to scheduled WTG delivery, and the Permanent Project Energization pursuant to the Project Schedule attached hereto as Appendix ___.

**Power Curve Tests:** The Contractor, will perform a Facility Power Curve Test (“FPCT”) on a number of the WTG’s to be agreed upon and selected by Owner and Contractor (the “Nominated Turbines”), in accordance with Appendix “__”, at the sole cost and expense of the Contractor, after Facility Substantial Completion but prior to Final Completion. Such FPCT will be monitored / supervised by a committee with representation of the Owner and the Owner’s Engineer. The testing will be performed under the procedures described in the attached Appendix ______.

Any modifications or improvements performed on the Nominated Turbines to pass the Power Curve Tests must be performed on the balance of the wind turbines.

**Sound Level Test:** Contractor guarantees a sound power level as defined in Appendix “__” - WTG Main Specifications (in accordance with IEC 88/48/CDV/2 standard). If Owner has reasonable doubts about the Guaranteed Sound Level of the WTGs, Owner may select a Qualified Engineer who is not in direct competition with the Contractor, to perform a Sound Level Test (“SLT”) within the first 12 months after Facility Substantial Completion. If the WTG(s) fails the SLT, the Contractor will be liable for all of the cost of the SLT. In case of failure of the SLT, Contractor must, within 90 days, repair at its sole expense the WTGs to meet the Guaranteed Sound Level: any repairs will be repeated until the WTGs meet the Guaranteed Sound Level. The Sound level test will be conducted in accordance with IEC’s “Recommended Practices for Wind Turbine Testing and Evaluation”. Owner will have the right to choose one (1) turbine for SLT. If the chosen turbine fails the SLT, Contractor will be liable to Owner for reasonable direct consequences of the failed SLT. In such event, Owner may issue a shutdown notice if any of the Owner’s permits are breached as a result of such failed SLT and any downtime associated with such failed SLT, will be counted as manufacturer downtime pursuant to the Availability Warranty.
**Warranties:** Contractor warrants that all equipment is (i) new and of good quality, (ii) the work will be performed in a good and workmanlike manner, (iii) the work and materials will be free from defects in design, materials and workmanship, (iv) the WTG’s and SCADA system will conform to Appendix “__”- WTG Main Specifications and to Appendix “__”- WTG SCADA Specifications, (v) the work has been completed to Good Utility Industry Practice. The Base Warranty Period commences on the date that: Facility Substantial Completion has been achieved and continues for two years (the “Base Warranty Period”). Contractor shall, at its own cost and expense (including the cost of labor and equipment) repair or replace with materials of new and good quality any work or materials which fail to comply with the warranty during the warranty period. To the extent that standard component third party component warranties exceed the Base Warranty Period, Contractor will make commercially reasonable efforts to assign such warranties to Owner. Further, in the event of Contractor’s insolvency, the above warranties, to the extent transferable, will be assigned to Owner.

**Specifications:** Contractor will not change approved WTG Specifications without the prior written approval by Owner.

**Availability Warranties:** Contractor guarantees that the Measured Average Availability of the WTGs will not be less than 93 % for the first six months after Facility Substantial Completion and will not be less than 97 % for all 6-month periods thereafter for the balance of the Base Warranty Period (“Guaranteed Average Availability”).

The definition of manufacturer’s downtime and specific operational requirements and Owner’s obligations are summarized in Appendix _“Project Availability and Owner Interface”_.

**Spare Parts:** Contractor will supply a recommended spare parts list for the project and maintain an inventory of spare parts at Contractor’s sole expense, for the duration of the Base Warranty Period to insure the proper operation of the Project. At the end of the Base Warranty Period, Owner may elect to purchase the remaining inventory of spare parts at the pre-agreed pricing subject to an annual escalation of the CPI.

**Limit of Liability:** Subject to the various provisions covering limitations to the different types of liquidated damages, losses from indemnity, and other similar provisions, the maximum aggregate liability of Contractor pursuant to this Agreement, regardless of the type of claim, is 100% of the Contract Price, as adjusted for Change Orders.

**Consequential Damages:** Neither Party shall be liable for incidental, special, indirect or consequential damages of any nature, exclusive of those liquidated damages contemplated by the Production Tax Credit Warranties.

**Termination by Owner:** Owner may terminate this Agreement for: Contractor’s inability to perform (insolvency); failure to perform (misrepresentation, breach of law,
failure to perform Work on time or to correct defects, failure to pay Subcontractors or other material breach).

**Insurance:** Owner will provide a builder’s all-risk and general liability insurance for the Project covering Contractor’s work, Contractor and all of Contractor’s Sub-Contractors.

**WTG Design Escrow Agreement:** WTG design documentation will be placed in escrow pursuant to a WTG Design Escrow Agreement acceptable to both parties.

**Termination by Contractor:** Contractor may terminate on sixty (60) days’ notice if Owner fails to pay invoices within sixty (60) days; for material breach; if the Work is suspended for more than six (6) continuous months; if Force Majeure interrupts the Work for six (6) continuous months; for Owner’s insolvency

**Parent Guarantee:** Contractor will provide a parent company guarantee for performance under the agreements.

**Arbitration:** Disputes will first be referred to senior representatives of each of the parties; if senior representatives are unable to resolve within forty-five (45) days, such dispute shall be submitted to arbitration. Arbitration shall be conducted in accordance with the Arbitration Rules of the American Arbitration Association.

**Applicable Law:** The agreement shall be governed by, construed and enforced in accordance with the laws of__________.

**Contract Form:** The other provisions of the Agreement between the Parties shall be negotiated between the Parties in good faith. The Parties will conclude a WTG Supply and Installation Agreement prior to the issuance of a Notice to Proceed. The provisions of the Maintenance & Service Agreement will also be negotiated in good faith in order to maximize the production from the facility.

**Contracts:** The following agreements are to be negotiated in good faith and concluded prior to the issuance of the Notice to Proceed:

1. WTG Supply and Installation Agreement
2. Maintenance & Service Agreement
3. Warranty and Revenue Reimbursement Agreement
4. Payment Guaranty Agreement

**Appendices:** The following appendices will be included as part of this Term Sheet:

1. Term Sheet Pricing
2. FPCT Power Performance Document (Draft)
3. Operations and Maintenance Term Sheet. (Draft)
4. Project Availability and Owner Interface (Draft)
5. Downtime Allocation Table (Draft)
6. Climatic Wind Data and Site Conditions
7. WTG Main Specifications and Power Curve (Draft)
8. WTG SCADA specifications (Draft)
9. Contractor’s Parent Guaranty (Draft)
10. Termination Schedule
11. Project Schedule
12. Owner's Letter of Credit (Draft)
13. Contractor’s Account Information
14. Insurance (Draft)

This Term Sheet shall be binding upon both Parties until the execution of a WTG Supply and Installation Agreement. Accordingly, this Term Sheet will be null and void upon the execution of the WTG Supply and Installation Agreement.

Buyer

Contractor
Annexure - VI
TECHNICAL DUE-DILIGENCE STUDY QUESTIONNAIRE

SECTION 1: MECHANICAL SYSTEM OVERVIEW

1 General Specifications
   1.1 Power output
   1.2 Height
   1.3 Diameter
   1.4 Speed input/output
   1.5 Tip Speed
   1.6 Voltage
   1.7 Noise
   1.8 Max wind
   1.9 Min wind
   1.10 Cut out wind velocity
   1.11 Cut in wind velocity
   1.12 What is the maximum wind velocity that the tower/blades can withstand?
   1.13 What is the minimum temperature that the turbine can be started?
   1.14 What failure modes and effects have been reviewed? What is the mitigation?
   1.15 What is the weak link in the rotating system?
   1.16 What is the governing code or standard that the wind turbine is designed to?
   1.17 Is dynamometer testing used for the design?

2 Nacelle
   2.1 Who is the supplier?
   2.2 Is it heated?
   2.3 What is the housing material?
      2.3.1 Is it heated and insulated? How?
   2.4 Base Frame
      2.4.1 How rigid is the base?
   2.5 Material
2.5.1 What is the material ASTM#?
2.5.2 What is the material hardness?
2.5.3 What is the fracture toughness?

2.6 Method of Construction
2.6.1 Is it welded, bolted, cast etc.?

2.7 Design Methodology
2.7.1 Finite element analysis?
2.7.2 Fatigue testing?
2.7.3 Load testing?
2.7.4 What is the snow/ice loading capability?
2.7.5 Is it designed for low temperature?

2.8 Alignment Methodology
2.8.1 How are the major components aligned?
2.8.2 How are the major components mounted?

3 Rotor

3.1 Who is the supplier?

3.2 Has a torsional analysis been done?

3.3 Has a lateral analysis been done?

3.4 Has the rotating element, bearings, blades, couplings, and gearbox been designed for generator short circuit loads?

3.5 Blades
3.5.1 Are the blades a composite material design?
3.5.2 Material
   3.5.2.1 What are the materials for the skin (fiber and resin)? The frame?

3.5.3 Method of Construction
   3.5.3.1 Frame and hub welded? Foil- vacuum bag, hand lay up?

3.5.4 Design Methodology
   3.5.4.1 Finite element analysis?
   3.5.4.2 Fatigue testing?
   3.5.4.3 Load Testing?
   3.5.4.4 What is the overall safety factor at maximum wind velocity-rotating and static?
   3.5.4.5 Is it designed for low temperature?
   3.5.4.6 What happens if the blades ice up?
   3.5.4.7 What is the aerodynamic design methodology?
3.5.4.8 Is there wind tunnel testing?

3.5.5 Coating
  3.5.5.1 Is there UV protection?
  3.5.5.2 Ice protection?

3.6 Hub
  3.6.1 How is the hub mounted to the main shaft?
  3.6.2 What is the seal configuration?
  3.6.3 Material
    3.6.3.1 What is the material ASTM#?
    3.6.3.2 What is the material hardness?
    3.6.3.3 What is the fracture toughness?
  3.6.4 Design Methodology
    3.6.4.1 Finite element analysis?
    3.6.4.2 Fatigue testing?
    3.6.4.3 Load testing?
    3.6.4.4 Is it designed for low temperature?

3.7 Bolting- Blade to Hub
  3.7.1 What is the material ASTM#?
  3.7.2 What is the material hardness?
  3.7.3 Design Methodology
    3.7.3.1 Finite element analysis?
    3.7.3.2 Fatigue testing?
    3.7.3.3 Load testing?
    3.7.3.4 Is it designed for low temperature?

3.8 Main Shaft
  3.8.1 What are the safety factor and maximum power and wind velocity?
  3.8.2 Material
    3.8.2.1 What is the material ASTM#?
    3.8.2.2 What is the material hardness?
    3.8.2.3 What is the fracture toughness?
  3.8.3 Design Methodology
    3.8.3.1 Finite element analysis?
    3.8.3.2 Fatigue testing?
    3.8.3.3 Load testing?
    3.8.3.4 Is it designed for low temperature?

3.9 Main Bearing
3.9.1 Who is the supplier?
3.9.2 Has there been any false brinelling when the rotor is static?
3.9.3 Style
   3.9.3.1 What is the bearing number?
   3.9.3.2 What is the maximum load?
   3.9.3.3 What is the L10 life at maximum load?
3.9.4 Housing
   3.9.4.1 How is the bearing housing mounted to the base?
   3.9.4.2 How is the bearing lubricated?
   3.9.4.3 What are the housing seals?
3.10 Couplings
3.10.1 Low Speed
   3.10.1.1 Who is the supplier?
   3.10.1.2 What is the coupling style - elastomer, rigid, gear, and disc?
   3.10.1.3 Is it lubricated or dry?
3.10.2 High Speed
   3.10.2.1 Who is the supplier?
   3.10.2.2 What is the coupling style - elastomer, rigid, gear, and disc?
   3.10.2.3 Is it lubricated or dry?
3.11 Power/speed regulation method
3.11.1 Passive stall, active stall, variable speed?
3.11.2 Pitch regulation system
   3.11.2.1 Is it hydraulic, electric, or mechanical?
   3.11.2.2 How is the emergency stop activated?
   3.11.2.3 Is it fail-safe?
4 Gear Box
4.1 Who is the supplier?
4.2 What is the gearbox style - planetary, helical etc.?
4.3 Are the gearboxes designed to AGMA standards?
4.4 What is the overall safety factor at maximum speed and power?
4.5 Bearings
   4.5.1 Are the bearings sleeve or rolling element?
   4.5.2 If rolling element then: What are the bearing numbers?
   4.5.3 What are the Loads?
4.5.4 What are the L10 lives?
4.5.5 If sleeve what are the pressure loads?
4.5.6 What are the AGMA ratings?
4.5.7 What are the design temperatures?

4.6 Gears
4.6.1 Teeth
   4.6.1.1 What is the AGMA rating for the teeth?
   4.6.1.2 What is the surface hardening method for the teeth?
4.6.2 Blanks
   4.6.2.1 Are the blanks forged
4.6.3 Shaftsing
   4.6.3.1 What is the material ASTM#?
   4.6.3.2 What is the material hardness?

4.7 Gearbox Lubrication System
4.7.1 Is the lubrication system forced or splash?
4.7.2 Filtration method?
4.7.3 Pressure regulation?
4.7.4 Cooling?
4.7.5 Is the lubrication system integral with the generator lubrication system?

5 Braking System
5.1 Who is the supplier?
5.2 Main system
   5.2.1 What is the breaking system?
   5.2.2 Is it fail-safe?
5.3 Emergency system
   5.3.1 What is the breaking system?
   5.3.2 Is it fail-safe?

6 Yaw System
6.1 Who is the supplier?
6.2 Method (i.e. worm, ring gear)?
6.3 Bearings (Rolling element)?
6.4 Breaks (Is there a break if the control system fails)?
6.5 Motor (Electric or hydraulic)?
6.6 Twisting Guard?
7 Tower

7.1 Who is the supplier?

7.2 What are the fundamental natural frequencies of the tower?

7.3 What happens if the tower gets covered in ice?

7.4 Material
   7.4.1 What is the material ASTM#?
   7.4.2 What is the material hardness?
   7.4.3 What is the fracture toughness?

7.5 Method of Construction
   7.5.1 I.e. rolled plate, welded?

7.6 Design Methodology
   7.6.1 Finite element analysis?
   7.6.2 What is the factor of safety at maximum wind velocity?
   7.6.3 Fatigue testing?
   7.6.4 Load testing?
   7.6.5 Is it designed for low temperature?

7.7 Base Bolting
   7.7.1 Material ASTM#?
   7.7.2 Nominal stretch?

7.8 Grouting
   7.8.1 Type - epoxy/cement?
   7.8.2 Pour procedure?

7.9 Surface Treatment
   7.9.1 Anti-ice?

8 Crane

8.1 Who is the supplier?

8.2 What components can be lifted for maintenance?

8.3 Electric, hand operated?

8.4 Load Capacity

9 Maintenance

9.1 Preventative Maintenance
   9.1.1 Is there a PM program for lubrication, vibration measurement, performance testing, intrusive inspection?
   9.1.2 Are there any components that are changed out on a time interval basis?
9.1.3 Does the vendor have a maintenance contract option?
9.1.4 What qualifications are required for maintenance personnel?

9.2 Inspection
9.2.1 Which components need to be inspected on a time basis?
9.2.2 Who does the inspection?
9.2.3 What qualification procedures are in place for inspections?
9.2.4 How are the blades, hub, and tower inspected?

10 Spare Parts
10.1 Which components need to be changed on a regular Basis?
10.2 What spare parts should we keep?
10.3 What is the delivery for the major components?
10.4 Do you have an exchange program?

11 Operational History
11.1 How many turbines are installed?
11.2 How long have they been running?
11.3 What preventative maintenance have you done? What were the findings?
11.4 Have there been any failures?
11.5 Have there been any vibration problems?
11.6 What is the average availability?

12 Technical Support
12.1 What technical support is available?
12.2 Are there service representatives in Canada?
12.3 If we have a failure what is the procedure for investigation and repair?

SECTION 2: ELECTRICAL SYSTEMS OVERVIEW

In addition to the following, please complete the appropriate data sheets in appendix A
Alternator General Data

12.4 Manufacturer and Factory location?
12.5 Is it CSA Approved?
12.6 Type (Squirrel Cage/Wound Rotor/Synch etc.)?
12.7 Rating(s): Volts/Amps/Kw
12.8 Operating rpm(s)
12.9 Efficiency/Power Factor at 100% load
12.10 Weights
12.11 How many RTDs stator/bearings
12.12 Applicable standards (NEMA/API/IEC etc.)
12.13 Enclosure/Cooling method (IP/IC)
12.14 Stator/rotor form/random wound?
12.15 Temperature Rise stator/rotor by __________/____________ RTD/Res?
12.16 Insulation Class stator/rotor?
12.17 $\text{WR}^2$ at rpm __________
12.18 Bearings Babbitt/Anti Friction (Types?)
12.19 Lubrication (Oil/Grease, types, supply)
12.20 Maximum permitted over speed ______________ %
12.21 Maximum/Minimum operating ambient temperature?
12.22 Maximum/Minimum storage ambient temperature?
12.23 Minimum starting temperature?
12.24 What are the forces during a terminal box short circuit?
12.25 Does it have an anti-condensation heater?

13 STARTING METHOD

13.1 How started? (SCR soft start/DOL/Wind to operating speed/other)?
13.2 Maximum starting kVA?

14 OUTPUT POWER CONTROL

14.1 Describe how output kW controlled
14.2 Describe how output VAR/PF controlled
14.3 List output harmonic currents
14.4 Maximum short circuit amps?
14.5 How does unit interact with utility and other units in farm?
14.6 Submit block diagrams if necessary

15 STEP UP TRANSFORMER

15.1 Manufacturer / location?
15.2 KVA?
15.3 Impedance ____________%
15.4 Maximum output voltage available?
15.5 Connection?
15.6 Type (Air/liquid cooled, fans etc.)
15.7 LV BIL ___________ kV
15.8 HV BIL ___________ kV
15.9 Temperature Rise?
15.10 Taps?
    15.10.1 Physical Location

16 AUXILIARIES

16.1 Auxiliary Power Supply source?
16.2 Required auxiliary voltage?
16.3 List auxiliary loads and kVA
16.4 Is UPS included, and what is supplied by the UPS?
16.5 What is UPS power loss life?

17 OTHER

17.1 Include list of what items are proposed
17.2 Describe Power Switchgear
17.3 Submit Single Line Diagram showing all major equipment
17.4 Power Cable number/sizing
17.5 Show interconnections to utility system
17.6 How is package Type Tested?
17.7 How is package Production Tested?
17.8 Describe Lightning protection system
17.9 Supply other data as manufacturer feels necessary
18 Control System Overview

This section refers to the overall controls required for normal and safe operation of the Wind Turbine Generator (WTG). As a minimum, it would include the yaw controller, the generator speed controller, the blade pitch controller (if so equipped), the control of the inverters, the environmental measurement devices and controls, and the safety controls.

18.1 Please describe the architecture of the control system. This description should include a listing of hardware, the functions within the hardware (overview) and the communications network between the various hardware controllers. In addition, please describe where the safety functions reside and how signals (transducers) are shared between the control system and the safety system.

18.2 Please provide a listing of the environmental limits for each controller. Include the fail states if these environmental limits are exceeded (including impact on the WTG operation).

18.3 Please define the failsafe state/method for the safety functions. This should include the controller itself (internal diagnostics), the I/O outputs, and behavior on loss of communications.

18.4 Please provide the RFI, magnetic and lightning protection levels and specifications for all control systems.

18.5 Please describe how the various control systems are interconnected between each other within the WTG.

19 Control of the Blades

This section would provide more in-depth description of the control of the blade pitch.

19.1 Are Blade Tip Air Brakes utilized? If so, how are they activated? Please describe the failsafe design.

19.2 What is the blade pitch control method (active pitch, passive stall, active stall)?

19.3 What is the failsafe behavior of the blade pitch control? Include as a minimum, the behavior on loss of electrical power, loss of hydraulic power (if used for blade control), and loss of the controller.

19.4 Describe how the over-speed control functions. Include in the description the failsafe behavior.

19.5 What control system features have been incorporated to prevent excess
vibration of the supporting structure for passive pitch blades at the wind speed where the blades pitch (if so equipped)?

19.6 How is the blade revolution speed measured?

19.7 How is the blade over speed and under speed measured and controlled?

19.8 How are the emergency stops activated? Describe the fail-safe operation of these emergency stops.

19.9 What is the maximum wind speed for which the brake(s) are designed to hold against?

19.10 How is the acceleration/deceleration controlled? What is the maximum rate of change of acceleration? Of deceleration?

19.11 Is impact on the blades sensed? How is blade rotor imbalance sensed and how does the control system respond to this sensed imbalance?

20 Yaw Control

This section would provide more in-depth description of the yaw control including the required auxiliary systems.

20.1 How is the yaw control implemented (e.g.: hydraulic versus electric)?

20.2 What is the resolution of the adjustments?

20.3 Is there any failsafe design implemented and what is it?

20.4 Is the yaw control also part of the over speed protection?

20.5 With passive pitch blades, is the yaw control used to help control vibration at the wind speed where the blades start to pitch?

20.6 What is the impact on the yaw control functionality if there is a problem with the cable twist transducer?

21 Generator Control

This section would provide details on how the generator is controlled and advantages of the control to ensure the high availability of the WTG.

21.1 What type of generator is used (constant speed versus variable speed)?

21.2 How the operational limitations of the generator are controlled (cut-in/cut-out)?

21.3 How is the required VAR controlled? What is the response of the VAR control?

21.4 How does the generator control cope with electrical grid fluctuations?

21.5 What advanced features are present to cope with fluctuations in both the wind speed and the electrical grid to help ensure a high on-line time?

21.6 How are the operational limits of the generator controlled (e.g.: low-
temperature start, high-temperature cut-out)?

22 Power Control and Connection to the Grid
This section would describe how the control system would automatically place a WTG into an electrical grid. All manual intervention should be included and fully described.

22.1 Please describe how the WTG connects to the grid. Assume a scenario where the WTG is not turning due to no wind and then the wind velocity exceeds the minimum requirement thus allowing the WTG to generate electricity.

22.2 Please describe the interconnections and the steps for a wind farm to simultaneously connect to the grid. Again, assume the complete wind farm is not generating power. All the WTG then come-on line simultaneously. How is the order of WTG connection to the grid determined (lead WTG versus lag WTG’s)?

22.3 How does the cut-in and cut-out of the generator from the grid impact the blade controls? What is the behavior and the time-lag associated with this behavior? Is this a feedback control strategy or a feed-forward control strategy? Please describe.

23 Lightning Protection and Reporting
This section addresses the need to protect the WTG instrumentation and controls from the effects of lightning. Protection must be afforded to the effects of both direct and near-by lightning hits.

23.1 Please describe how lightning protection for the control system is implemented?

23.2 Please describe if lightning hits are detected and reported? How is this accomplished (e.g.: instrumentation technology used)?

23.3 What design aspects have been incorporated in the control systems inter-connects to minimize the impact of lightning (e.g.: copper versus fiber wiring)?

24 Connection of the WTG Control Systems to an External Host System
For optimal operation of a wind farm (greater than 1 WTG), an external monitoring system is utilized. These questions are looking for details on communication and monitoring options.
24.1 Please describe how the WTG control system(s) and safety system(s) are connected to a downstream wind farm monitoring system? Include which protocols are available.

24.2 Please describe the present plans for implementation of IEC 61850, IEC 61400-25 and OPC as communication protocols for connection between a WTG control system and third party wind farm monitoring system.

24.3 Please list all wind farm-monitoring systems (both yours and third party) that have been successfully implemented with your WTG and control system(s)/safety system(s).

24.4 What equipment monitoring data is available to an external system? Please provide a list divided into major equipment types (generator, gearboxes, bearings, auxiliary systems, etc.), electrical (breaker status, tie breaker, transformer) and performance of the WTG (kW production, VAR control, wind direction, wind speed, yaw position, hours worked, operating mode, etc.) and list of remote controls that may be sent to the local WTG control systems.

24.5 If communications is lost between the host system and the local WTG control systems(s), what is the impact on the operation of the WTG?

24.6 What are the length restrictions for communication connections between the WTG control system(s) and the remote monitoring system? What technology has successfully been used to connect to your WTG control system(s) and within what limitations?

25 Auxiliary Systems

25.1 What auxiliary systems does the control system monitor and control (or use as inputs for control of main systems)?

25.2 Does the control system respond to vibrations of the gearbox, low-speed, and high-speed drive shafts? What is the response?

25.3 Does the control system monitor stresses within the main components (e.g.: stresses in the drive shafts, stresses in the blades, stresses in the structure)? What is the control system response to monitored stresses?

26 Advanced Controls

26.1 What advanced controls have been implemented using your equipment? Looking for items such as compensation for wake effects from other wind turbines, optimization for blade angle control for wind speeds below rated power, tracking of lifetime loading of identified critical components, optimizing the efficiency of the energy production, etc.
## APPENDIX A: ELECTRICAL DATA SHEETS

### ALTERNATOR DATA (SYNCHRONOUS MACHINE ONLY)

<table>
<thead>
<tr>
<th>NAMEPLATE DATA</th>
<th>MVA</th>
<th>MW</th>
<th>PF</th>
<th>KV</th>
</tr>
</thead>
</table>

- **Synchronous Speed (rpm)**
- **Short Circuit Ratio**
- **Inertia Constant H** (MW-SEC./MVA) (generator and turbine combined)

### PERCENT

- Poitier Reactance $X_p$
- Stator Leakage Reactance $X_l$
- Negative sequence resistance $R_2$
- Zero sequence resistance $R_0$

### AT RATED CURRENT

- Direct axis synchronous reactance $X_{d}$
- Direct axis transient reactance $X'_{d}$
- Direct axis sub-transient reactance $X''_{d}$
- Quadrature axis synchronous reactance $X_q$
- Quadrature axis transient reactance $X'_{q}$
- Quadrature axis sub-transient reactance $X''_{q}$
- Negative sequence reactance $X_2$
- Zero sequence reactance $X_0$

### AT RATED VOLTAGE

- Direct axis synchronous reactance $X_{d}$
- Direct axis transient reactance $X'_{d}$
- Direct axis sub-transient reactance $X''_{d}$
- Quadrature axis synchronous reactance $X_q$
- Quadrature axis transient reactance $X'_{q}$
- Quadrature axis sub-transient reactance $X''_{q}$
- Negative sequence reactance $X_2$
- Zero sequence reactance $X_0$

### Armature dc resistance $R_a$ (ohms at 100°C, per phase)
| **Field resistance** $R_f$ (ohms at 25°C) |
| **Direct axis transient short-circuit time constant** $T'_d$ (seconds) |
| **Direct axis sub-transient short-circuit time constant** $T''_d$ (seconds) |
| **Quadrature axis transient short-circuit time constant** $T'_{q}$ (seconds) |
| **Quadrature axis sub-transient short-circuit time constant** $T''_{q}$ (seconds) |
| **Direct axis transient open-circuit time constant** $T'_{do}$ (seconds) |
| **Direct axis sub-transient open-circuit time constant** $T''_{do}$ (seconds) |
| **Quadrature axis transient open-circuit time constant** $T'_{qo}$ (seconds) |
| **Quadrature axis sub-transient open-circuit time constant** $T''_{qo}$ (seconds) |
| **Armature short-circuit time constant** $T_a$ (seconds) |
| **Loss of full load, Speed rise (transient Delta t)** |

### MACHINE DATA (INDUCTION MACHINE ONLY)

<table>
<thead>
<tr>
<th><strong>NAMEPLATE DATA</strong></th>
<th>MVA</th>
<th>MW</th>
<th>PF</th>
<th>kV</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Torque at Synchronous Speed (pu)</strong></td>
<td></td>
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<td></td>
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<tr>
<td><strong>Mechanical Power Used at Synchronous Speed (MW)</strong></td>
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<tr>
<td><strong>Inertia Constant H</strong> (MW-SEC./MVA) (generator and turbine combined)</td>
<td></td>
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<tr>
<td><strong>REACTANCES IN PERCENT</strong> (include both saturated and unsaturated)</td>
<td></td>
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<tr>
<td><strong>RATED CURRENT</strong></td>
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</tr>
<tr>
<td><strong>RATED AT VOLTAGE</strong></td>
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</tr>
<tr>
<td><strong>Stator Leakage Reactance</strong> $X_l$</td>
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<tr>
<td><strong>Negative sequence resistance</strong> $R_2$</td>
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<td><strong>Zero sequence resistance</strong> $R_0$</td>
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<tr>
<td><strong>Synchronous reactance</strong> $X$</td>
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<tr>
<td><strong>Transient reactance</strong> $X'$</td>
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<tr>
<td><strong>Sub-transient reactance</strong> $X''$</td>
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<tr>
<td><strong>Positive sequence reactance</strong> $X_1$</td>
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<tr>
<td><strong>Negative sequence reactance</strong> $X_2$</td>
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<tr>
<td><strong>Zero sequence reactance</strong> $X_0$</td>
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</tbody>
</table>

| **REACTANCES AT RATED CURRENT** |
| **RATED AT VOLTAGE** |
| **Synchronous reactance** $X$ |
| **Transient reactance** $X'$ |
| **Sub-transient reactance** $X''$ |
| **Positive sequence reactance** $X_1$ |
| **Negative sequence reactance** $X_2$ |
| **Zero sequence reactance** $X_0$ |

**Transient short-circuit time constant** $T'$ (seconds)
<table>
<thead>
<tr>
<th>Description</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sub-transient short-circuit time constant $T''$ (s)</td>
<td></td>
</tr>
<tr>
<td>Transient open-circuit time constant $T'_o$ (s)</td>
<td></td>
</tr>
<tr>
<td>Sub-transient open-circuit time constant $T''_o$ (s)</td>
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</tr>
</tbody>
</table>

### DATA FOR POWER ELECTRONICS OUTPUT ONLY

<table>
<thead>
<tr>
<th>NAMEPLATE DATA</th>
<th>MVA</th>
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</tr>
<tr>
<td></td>
<td>PF</td>
<td></td>
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<tr>
<td></td>
<td>kV</td>
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</tbody>
</table>

Supply details of short circuit capabilities and time constants