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Performance Anxiety:
Wind Power Project Performance Guarantees

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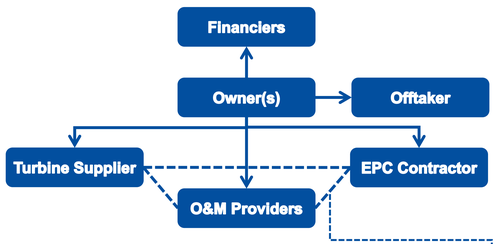
BACKGROUND

Ensuring that wind power projects are operating and perform as intended is a primary interest to all key project parties. For this reason, commercial agreements typically include performance guarantees for wind turbines. This is to ensure the quality of equipment at installation and throughout the project life. However, there is considerable variability in the contractual arrangements and coverage terms included if guarantees are not met. This presentation identifies key project parties, discusses primary performance concerns throughout the different phases of a wind power project, and the corresponding coverage mechanisms.

OBJECTIVE

1. Discuss interactions between key project parties;
2. Describe key performance concerns and corresponding guarantees throughout the various phases of a project; and
3. Discuss coverage mechanisms for each performance guarantee.

KEY PROJECT PARTIES



Owner(s)
Entity that has either developed or purchased the project

Financiers
Party that has provided either debt or equity financing to the project

Offtaker
Engaged in a power purchase agreement (PPA) with the Owner

Turbine Supplier
Party that manufactures, delivers, and commissions wind turbine generators (WTGs)

EPC Contractor
Provides engineering, procurement, and construction (EPC) for the balance of plant (BOP) of the project

O&M Provider
Performs routine operations and provides planned and unplanned maintenance services

Special Considerations
Turbine Supplier, EPC Contractor, and O&M Provider may all be the same entity, which can effect the guarantees and coverage.

PROJECT PHASES AND PERFORMANCE CONSIDERATIONS

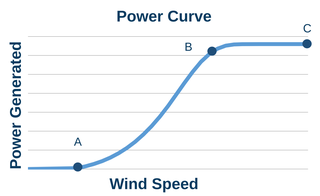
Development

The wind turbine model is selected in the development phase. A primary factor of the selection process is the performance of the wind turbine model in consideration site-specific wind conditions.

Wind turbine suppliers develop curves that represent the energy production of the wind turbine model in relation to the wind speed. The industry standard for developing these power curves is IEC 61400-12 Part 1.

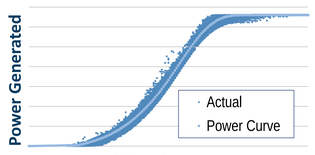
The elements of a typical power curve are shown in the figure below.

A = Cut-In Wind Speed
B = Maximum Power Output
C = Cut-Out Wind Speed



Construction & Commissioning

Power Curve Test
Demonstrates installed project WTGs produce energy at a capacity corresponding to the power curve.
- Contractual testing methodology
- Guarantee between 98% and 100%
- Sample turbines independently selected
- Often optional and at Owner's expense
- Other project parties may have leverage



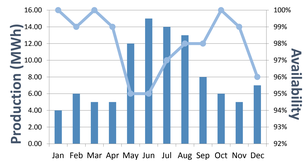
Reliability Run Test
Demonstration that the project is operating properly.
- Test period (120-168 hours)
- Minimum availability
- SCADA system confirmed

Special Considerations
Full-wrap EPC vs. separate agreements

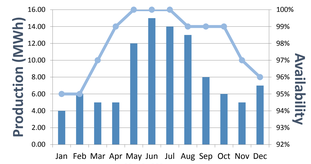
Operations

Operational performance is assessed by measuring the amount of time that the WTGs are able to produce energy (**availability**). Modern availability guarantees are around 98%.

Time vs. Production
Wind resource is variable. Time-based availability may inaccurately reflect the lost output. See two examples of a project with annual production of 100 GWh at 100% availability:



- **Average Availability** = 98%
- **Total Production** = 97.4 GWh



- **Average Availability** = 98%
- **Total Production** = 97.4 GWh

Special Considerations: Warranty Period
For a period (typically 2 years), the obligations of the EPC Contractor and Turbine Supplier carry over for the initial period of operation, and typically include:
- Equipment and work warranty
- Serial defects warranty
- Sound level warranty
- Availability warranty*
- Power curve warranty*

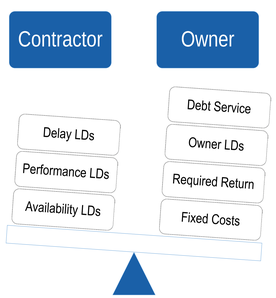
*Not typical unless Turbine Supplier provides O&M services

Special Considerations: Service Provider
The performance strategy and coverage can vary significantly depending on the O&M Provider that is selected:
- Turbine Supplier
- Independent Provider
- Self-Performed
- Combination

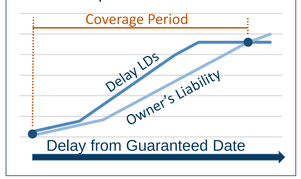
The term for O&M providers is usually 5 or 10 years. The Owner may choose to change the arrangement at this time depending on operating history.

COVERAGE MECHANISMS

Components of Coverage
Project Parties are subject to liquidated damages (LDs) for failure to fulfill their obligations. LDs are defined and understood by all parties to represent fair compensation for the shortcoming and are expressly not intended to be considered as a penalty.



Delay Coverage
If the operation of the project is delayed, the Owner's liabilities during the delay should be covered for a reasonable period.



Capacity Coverage
Production covered by the **power curve guarantee**, and should compensate the Owner for shortfalls over the project's **full operating life**.

$$PC\ LD = \left(1 - \frac{MP}{GP}\right) * Revenue$$

- PC = Power Curve
- MP = Measured Production (including uncertainty)
- GP = Guaranteed Production
- Revenue = PPA Payments, PTCs, other attributes

Availability Coverage
The **availability guarantee** should compensate for revenue lost during the time **period of unavailability.**

$$Availability\ LD = \left(\frac{GA}{MA}\right) * Revenue$$

- GA = Guaranteed Availability
- MA = Measured Availability
- Revenue = PPA Payments, PTCs, other attributes
- **Availability Bonus:** Sometimes offered if MA > GA.

Other Important Commercial Terms
- **Limitations of Liability:** EPC Contractor, Turbine Supplier, and O&M Provider should fully compensate for shortfalls.
- **Financial Securities:** Bond, letter of credit, parental agreement, etc., should be in the amount of the limitation of liability.
- **Default:** Provisions for events of default, cure, duration of cure, termination, and release of financial security.
- **Dispute resolution:** negotiation, mediation, arbitration, etc., should be reviewed to ensure enforceability.
- **Force Majeure:** Reasonable inclusions of no-fault events.

CONCLUSIONS

- All wind power projects require the interaction of several key project parties. A well-performing project requires the interactions to be well understood and agreed upon in advance.
- Owners select a WTG to fit their project for a number of reasons. One primary reason is that the Turbine Supplier's technical specifications (including the power curve) are appropriate for the site-specific conditions.
- Before a project is turned over from the installation contractors to the Owner, it must be demonstrated to be operating properly by means of a reliability run test.
- Power curve tests demonstrate that that the project WTGs can operate at the production capacity specified by the Turbine Supplier's power curve.
- Power curve tests are often optional and conducted at the expense of the Owner. Thus, the Owner may desire to forego the test, but it may still need to be performed as a requirement of the Financiers.
- During the operation phase, the primary measure of performance is availability. However, simple time-based availability may not capture production loss adequately. Therefore, some O&M Providers are offering more sophisticated availability guarantees that consider the expected production during the period.
- The O&M Provider selected effects the operating strategy and coverage.
- LDs are the means of compensation for not achieving guarantees. In general, LDs should be balanced against the liabilities that they are offsetting.
- Delay LDs should cover the Owner for a sufficient period that they can seek an alternate contractor, power curve LDs should cover the lost revenue corresponding to the production shortfall for the project's full operating life, and availability LDs should cover revenue loss for the period of unavailability.
- Important commercial terms relevant to performance guarantees should be carefully reviewed, including limitations of liability, default, dispute resolution, and force majeure.
- Financial securities should be provided in the full amount of the limitation of liability.

BIOGRAPHY

Mr. Coologeorgen is a Senior Management Consultant with a background in structural engineering. He currently acts as a lead engineer for multiple independent engineering review assignments that support power plant project financing. He coordinates with teams of consultants to conduct due diligence, construction monitoring, and operations monitoring technical reviews of power plant facilities. These reviews include examination of design-basis documents and existing installations to assess quality of design and performance. These reviews also include critical project contracts to assess their scope, schedule, and warranties. Additionally, he performs construction monitoring and oversight to assess the status of project construction with regard to schedule, budget, and conformance to technical designs and specifications.

CONTACT INFORMATION

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