Extending the Production Life of Turbine Converters and Generators

Michelle M Schwery [1], Sascha Hillenbrand[2] Jari-Pekka Matsinen[2] Priit Noor[2] Jacim Jacimovic[2] Jamie A Robinson[1]
1 16250 W Glendale Drive, New Berlin, WI 53151
2 ABB Oy Strömbergintie 1 B 00380, Helsinki, FINLAND

SUMMARY

A proactive approach to lifecycle management offering alternative methods to secure operational continuity and extend the life of your turbine drivetrain system. Many turbine converters and generators approaching their end of life can be upgraded for improved reliability and extension of life to continue output without the need for replacement. Migration through Modernization (HW Retrofit/Upgrade) solutions for Converter products can reduce downtime by keeping your existing structure and still having the latest technological innovations inside. With generators, extensive data on the causes of failures, show that the stator is the component most likely to fail during its lifecycle phase. By identifying product and component obsolescence, you can improve usability, reliability, performance, and safety with new features from proven technology to help you manage the lifecycle of your equipment, improve energy efficiency of your Levelized Cost of Ownership (LCOE), enable availability and have a lower total cost of ownership.

$$LCoE_{lifetime} = \frac{CAPEX_{lifetime} + OPEX_{lifetime}}{AEP_{lifetime}}$$

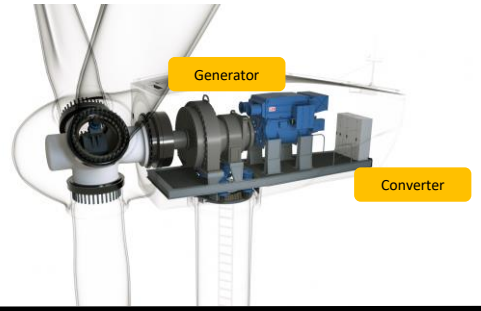
Overall Equipment Effectiveness (OEE)

CHALLENGES AND LIMITATIONS

Availability - Wind turbine mechanical and electrical drivetrain failures account for the majority of OPEX and downtime cost per year. Excessive stress accelerates the wear and tear of electrical drivetrain subcomponents, resulting in decreased reliability, unexpected downtime events, and major corrective actions.

Performance - Over time, a turbine's power generation performance deteriorates, resulting in inefficient operation and productivity loss. Every year, more installations reach the age of 20 years, then there are newly constructed onshore windfarms. This creates a need for modernization and performance improvement services to be available. This is needed to maintain productivity and extend system lifespan.

Quality - Optimizing wind farm reliability, ensuring high performance, and performing maintenance timely manner enables wind farms to last longer. Traditional operations must create space for reliability centered maintenance operations, that are enabled by digitalization.



OPTIMIZATION SCENARIOS

Availability
The converter is estimated to contribute 50%, generator 40% and others 10% of all electrical drivetrain failures, and condition-monitoring can statistically reduce failure rate and related unplanned downtime by 25%, and further reduce planned downtime by 50%. By modernizing the equipment, both converter and generator, lifespan is brought back to like new conditions, potential doubling the longevity of the equipment.

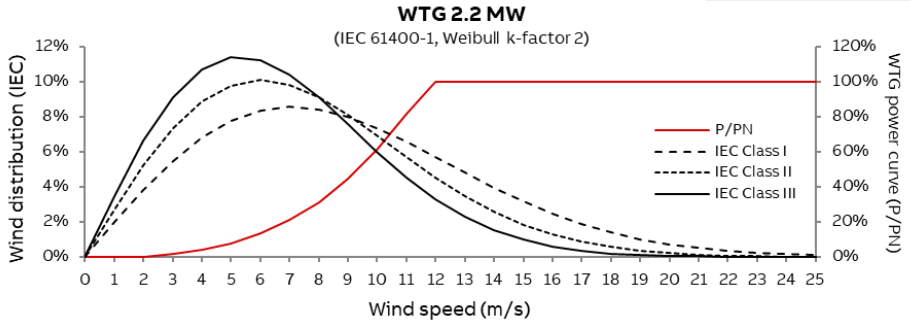
10 x = Wind farm (10 wind turbines) overall profitability can be increased by more than 222k USD/year

Performance
Because of increased technical availability, turbine performance can be increased by more than 4%, resulting in increased turbine annual energy production due to the additional availability from the modernization without the additional production capacity. With the modernized equipment, and latest technologies, the power curve upgrade improves turbine power production capacity by 10% (from 2MW to 2,2MW), and the turbine overall AEP can be increased by more than 15% (other assumptions from Scenario 1# remain unchanged).

10 x = When compared to Scenario 1#, the overall profitability of a wind farm can be increased by an additional 200k USD / year.

Quality
With a solid lifecycle plan that can extend the life of electrical drivetrain components by up to 10 years. In that case, the turbine can continue to operate with the same performance for another 10 years.

10 x = When compared to Scenario 2#, the overall profitability of a wind farm can be increased by an additional 330k USD / year.



Scenario for IEC Class II turbine with 2 MW electrical drivetrain

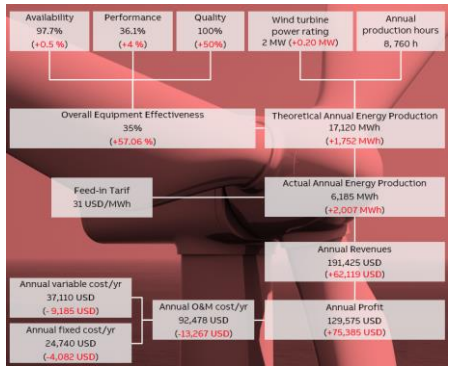
Time over the year for production:	8760 h
Unplanned downtime (breakdowns):	150 h *
Planned downtime (scheduled maintenance):	50 h
downtime over the year:	200 h
Availability (A):	98%
Performance (P):	36%
Quality (Q):	100%
Overall Equipment Effectiveness (OEE):	35%

* The average time lost due to electrical drivetrain failure is assumed to be 33%.

Impact of Change

After modernization of components with latest technology

- Reliability improvements (IGBT, PCBA, du/dt filter, DC caps)
- Performance improvements
- Life cycle service support extension of 10+ years



CONCLUSIONS

Reliability

Reliable operation of turbine is vital in the generation of wind power as it impacts the Annual Energy Production (AEP). Because wind turbines are designed with expected lifespans of several decades, longevity and uptime is crucial for effective, safe and profitable operation.

Life-cycle management

Owners and Operators need the most appropriate lifetime extension (LTE) approach for wind turbine electrical drivetrain based on its condition, which preserves resources and lowers the wind farm's carbon footprint, enabling the transition to a more circular wind economy.

Partnerships

Owners and Operators can maximize the life-cycle profit of their wind farms electrical components through a low levelized cost of electricity (LCoE) and continuous operation with the highest efficiency through taking the older technology, modernizing both components and technology.

CONTACTS

Laura.ortiz@us.abb.com
Timothy.Saleeby@us.abb.com