



Wind Turbine Optimization

Contents

Wind Turbine Optimization	3-4
Advanced Controls	5-6
Load Simulations	7-8
Optimized Experience	9-10

Wind Turbine Optimization

The Value of Optimizing

Wind Turbine Optimization is an important part of Mita-Teknik's business setup and an important means to reach our overall mission to Make Wind Competitive.

We constantly strive to improve the competitiveness of our customers' products, and by applying advanced control integration knowhow and services, we are able to reduce loads and/or improve energy production and hereby reduce the cost of energy (CoE).

Cost and Production benefits to be gained using advanced controls:

Increased Production

- › Power Curve (AEP), 2-3% annual production increase

Cost Savings

- › Rotor, 5-15% cost savings
- › Tower & Foundation, 10-20% cost savings
- › Drivetrain, 10-20% cost savings

We provide outstanding value through quality engineering solutions focusing on high efficiency, low cost of energy, world-class product innovation and robust strategic implementation.

Bringing in Knowhow

Mita-Teknik acquired WindNordic in October 2013, which meant that key employees, knowhow and skills were added to strengthen the Mita-Teknik organization and portfolio.

Our Optimization team have more than 60 years of combined experience in the wind industry, and it is this experience we apply to every project.

The addition of skills and people means that we are now able to prioritize WT Optimization as a separate business area, and deliver a wide range of different services to accommodate the specific customer's project needs.

Our services include:

- › Load calculation and optimization
- › Control algorithm design and optimization
- › Feasibility Studies
- › Project Management
- › Cost of Energy Analysis
- › Wind turbine concept studies
- › Wind turbine Cost of Energy optimization

Our experts in Load- and Control Optimization engage in close dialogue and interactive process with our customers in order to take all factors and possibilities into account. In this way we find the optimal turbine level solution - tailored to your specific need and market.

We want to be the preferred partner in the wind industry and we constantly work at optimizing the way *We Make Wind Competitive*.

Advanced Controls

Reducing the Cost of Energy

A turbine control system consists of software and hardware used to operate the turbine machinery. This includes algorithms and drives for controlling main turbine blade pitch, rotor speed, generator power and yaw positioning but also the supporting functions such as cooling, lubrication, power supply etc.

We design control algorithms to govern the turbine blade pitch, rotor speed and generator torque. These key characteristics have a high influence on the turbine's mechanical load and power performance. Therefore it is vital that this part of the control system is included in the early design evaluation stages.

With our experience in the wind industry we know the potential challenges your equipment will face and we have most likely already developed methods for handling them. Our competent engineers and technicians are dedicated to ensure that your final product is of high innovative quality, always cost-effective, easy to incorporate and maintenance friendly.

Our services include:

- › Robust main power & pitch control for optimal power production
- › Individual pitch control to reduce nacelle tilt & yaw loading and blade loads
- › Drive train damping to reduce wear on gearbox
- › Condition based operation to reduce loading in rare but critical events such as extreme turbulence, shear or severe wake situations
- › Active tower damping to reduce the tower fatigue loads
- › Advanced stop functions for normal control as well as protection system

Mita-Teknik applies both classical controllers (PID) and modern model based controllers. We have specialized in load reducing control features, which come as add-ons to existing controllers.

We deliver a complete "State-of-the-Art" control strategy and systems for wind turbines. They all ensure safe and reliable operation of wind turbines around the world.

WP4200 - The Optimal Control Platform

Advanced control software requires advanced and powerful control hardware. The WP4200 MK II control platform provides the advanced features and the power you need to control your turbines.

Advantages of the WP4200 Control Platform:

- › High-speed multi core processor (CPU & DSP)
- › Well suited for Individual Pitch Control
- › High level of software/hardware flexibility
- › Fast floating points for running advanced algorithms
- › Tailor made for wind turbines

Great people and great systems yield great results. It is one of the key drivers to our success and continued development.

Load Simulations

Load Simulations

Wind turbines are exposed to high static- and dynamic loads during their service life. The nature of the aerodynamic and structural loads depends highly on the design and layout of the wind turbine as well as the often complex site and soil conditions both on- and offshore. The ability to forecast and simulate these loads is key in any successful wind turbine development.

Control strategies developed by Mita-Teknik are founded on and integrated with aero-elastic load models and are easily incorporated into new or existing wind turbine control platforms.

Our services include:

- › Aero elastic simulation and analysis
- › Design load spectra according to IEC, GL etc.
- › Stability- and system frequency analysis
- › Safety strategy analysis

Aero-elastic load simulation codes are used for load calculations in accordance with state of art guidelines and requirements by type certifying bodies. Loads generated for concept studies and full type certification comply with IEC 61400 and/or GL requirements.

Our highly experienced Optimization Team has successfully applied load simulation control strategies to several wind turbine projects for customers all around the world.

Our Optimization services reduce the cost of energy and improve the competitiveness of our customers' products.

We work with all types of wind turbines, ranging from smaller sized kW to multi MW wind turbines - so no matter which setup you have, we can help you cut costs and reduce the overall cost of energy.

We provide outstanding value through solutions focusing on high efficiency, low cost of energy, world-class product innovation and robust strategic implementation.

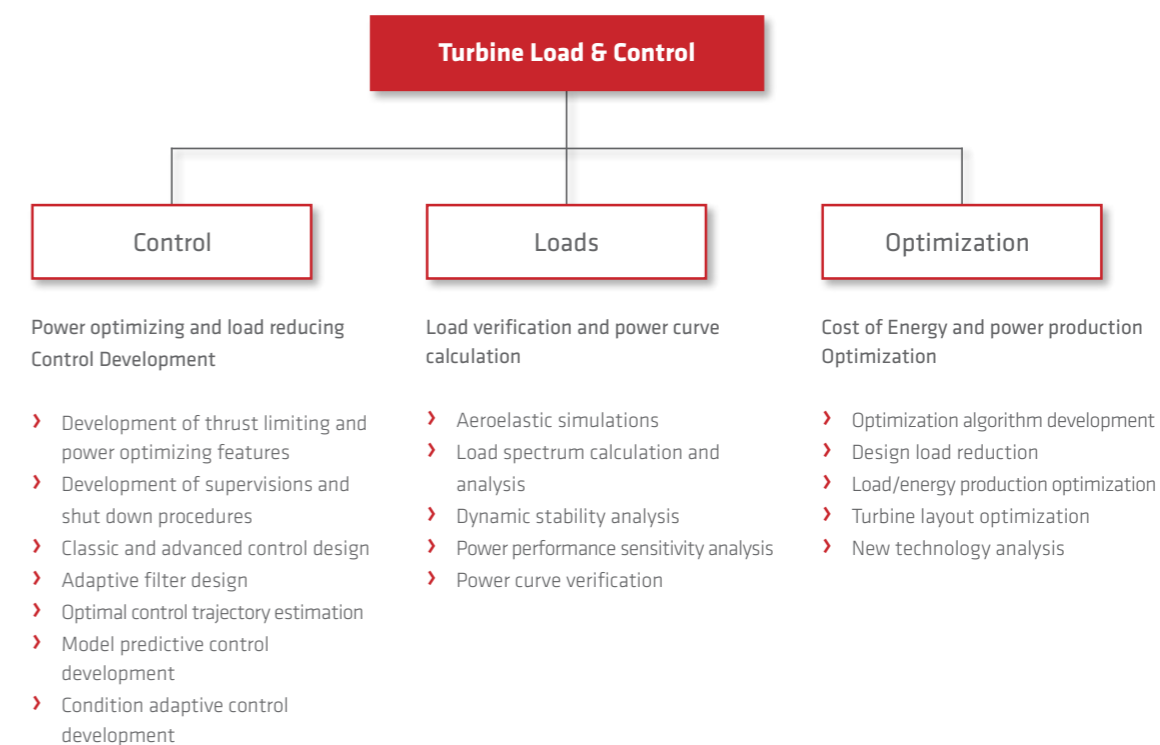
Optimized Experience

Scope of Competencies

The skills and experience of our dedicated engineers enable us to provide a wide selection of Turbine Load and Control competencies, which cover; Control, Loads and Optimization.

We have applied these competencies on projects ranging from small kW turbines to large MW turbines, and reduced costs, optimized production and increased profits for developers and owners.

Integrating advanced control algorithms during turbine design or upgrades reduce loads and/or improve the energy production of the complete wind turbine system for an overall reduction in Cost of Energy.



We strive to improve the competitiveness of our customers by contributing with essential turbine optimization knowhow.



We Make Wind Competitive

Learn more at www.mita-teknik.com