



Yokogawa Wind Power Solutions

Wind power is a clean, renewable and cost-effective method of generating power.
As system production costs decrease and the world turns to renewable energy, larger wind power farms are being built and are starting to encounter challenges in safety and operation efficiency.

Yokogawa wind power solution can improve your plant assets by monitoring, controlling and optimizing the operation from field to community level with comprehensive communication interfaces that can be connected to third-party equipment in your plant.

Of course, as with any Yokogawa system, the highest level of reliability is attained to ensure that your plant assets operate at their maximum potential.

Enterprise Automation Solution

Safety and compliance are becoming increasingly important in industrial plants. In order to help improve management, Yokogawa offers an enterprise system that can integrate, monitor and control the customer's entire plant from a single remote location with redundancy provided.



Wind Turbine Control System (STARDOM FCN)

Yokogawa's highly-reliable hybrid PLC is used in large numbers in many countries and diverse industries. The high-speed CPU supports a wide range of interfaces such as CANopen, DNP3, Modbus, dedicated pulse module for rotation speed measurement, and SOE function, making it suitable for wind turbine control.



Data Collection and Local Control

Yokogawa's edge controller "e-RT3" is made to run 24/7 and is ideal for long-term stable operation.

This PLC, with built-in LINUX CPU, can collect data, monitor and control the plant, and issue alarms. Integrated data on wind power such as generated power, battery status, lightning events, weather information and substation abnormalities can be monitored and, in case of abnormality, the switchgear or circuit breaker can be quickly operated and alarms issued.





Energy Management System

The objective of the Renewable Energy Management System is to minimize disruption to renewable generation. To increase the inclusion of renewable energy in electrical power grids, its supply must be stabilized.



Battery Energy Storage System

To ensure a stable supply of power to the grid, a renewable energy farm may use batteries. Yokogawa's network-based control systems play an important role in smoothing out the supply of this power to the grid. A power monitoring & control system and a battery control system are both configured in the dual-redundant controllers.



Cybersecurity

- Centralized and standardized cybersecurity management
- Distribution of OS security patches and anti-virus signature files

IIoT Solutions

- Remote CCTV plant monitoring
- Operations management
- Weather data collection
 Wire (wind direction, wind speed, storm activity, etc.)
 - Wireless sensors
- Production Dashboard System (such as KPI management)



Yokogawa Wind Power Solutions

Wind Turbine Monitoring and Control

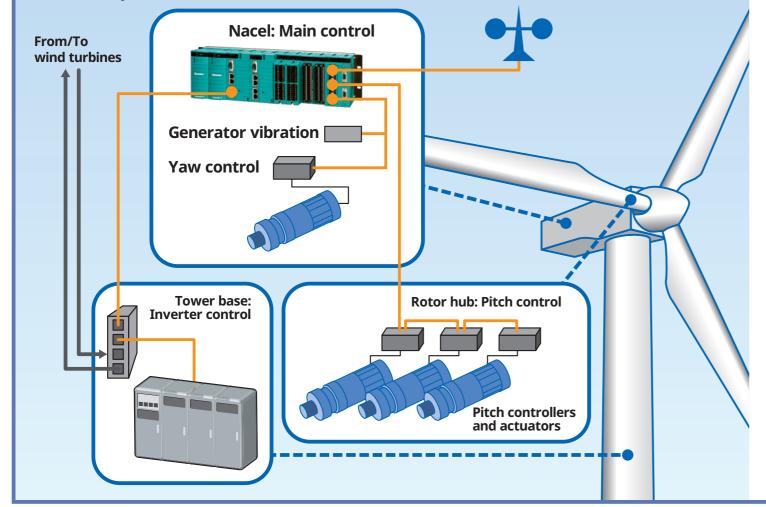
Wind Turbine Control

Yokogawa's network based controller "STARDOM" has a huge installed base throughout industry and across global markets. The dedicated and redundant CPU for wind turbine control complies with ANSI/ISA S71.04 corrosion resistance and thus ensures extremely reliable operation even in harsh environments.

When it functions as a main controller, STARDOM can be integrated with other systems such as pitch controllers, tower base controllers and inverter controllers thanks to its wide range of interface protocols. This flexible option allows the control system to be fully integrated and optimized.

Key Features

- Extremely reliable operation
- High areliability dual redundant CPU as an option
- Anti-corrosion coating compliant with ANSI/ISA S71.04 G3 standard
- Excellent local support throughout the world
- Quick delivery





Example display of wind turbine monitoring

Remote Monitoring of Wind Turbines

Yokogawa's SCADA "FAST/TOOLS" based monitoring system provides consolidated data of multiple turbines as well as relevant information such as environmental conditions and grid status. The system can function as a secondary SCADA and acquire integrated data from local control systems to provide their consolidated information in the remote monitoring room.

Available data includes:

- Power generation/operating status and record
- Ambient temperature, wind speed, wind direction
- Nacelle condition, including rotor speed, rotor vibration, tower vibration
- Detection, alarm issuance, and recording for lightning and fire
- Natural conditions e.g. wind speed, direction, number/time of lighting strikes

Montaing data
Automatic Acquired data
Anomal data
Windmill
Substation
Windmill
Substation
Windmill
Substation

Windmill
Substation

Windmill
Substation

Windmill
Substation

Windmill
Substation

Windmill
Substation

Windmill
Substation

Windmill
Substation

Windmill
Substation

Windmill
Substation

Some components are designed for use in offshore wind farms and their installation is rapidly growing.

Yokogawa Wind Power Solutions

Offshore Wind Turbine Solutions

Offshore wind turbines face a higher risk of accident compared to onshore ones.

Yokogawa is able to offer early-detection solutions so that countermeasure can be taken before the

accident escalates to a serious level.

Wave level sensing

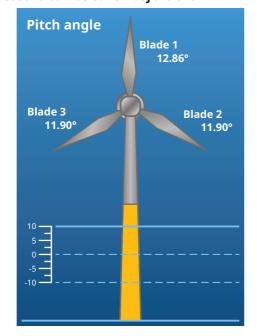
Abnormally high ocean waves can cause significant damage to wind turbine operations. Yokogawa's wind turbine control system comes with a fully integrated wind level sensor and ensures suitabl operations to avoid serious damage to the turbines.

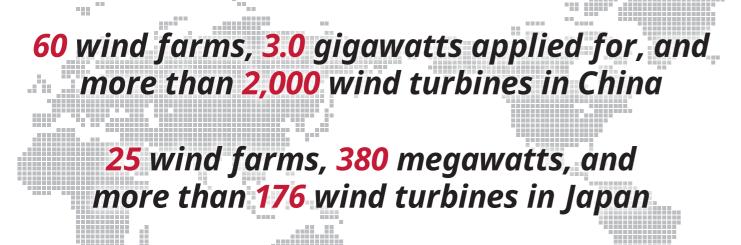
External monitoring by anti-corrosion CCTV

Wind turbines are often located near or in the sea, making it difficult for field cameras to survive in such harsh conditions. Yokogawa's CCTV FIELDEYE II is corrosion-resistant and offers 360° viewing. External monitoring enables detection of abnormalities.

Wide-area fire detection by Distributed Temperature Sensor (DTS)

Yokogawa's DTS, a fiber optic cable type of temperature sensor, can cover the whole area where there is a risk of fire such as power cable. It provides 24/7/365 monitoring along the entire length of the cable.



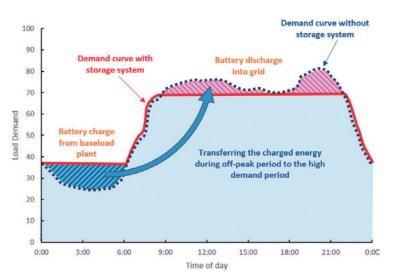


Energy Management System

The Energy Management System (EMS) provides integrated operation and revenue maximization for renewable energy generation facility operators, by providing energy balancing and scheduling between various forms of renewable energy (wind, solar), conventional generation (thermal, hydro), energy storage systems (batteries, pumped hydro, flywheels), and dispatch instructions from the market operator.

By integrating various data such as weather forecasts, power storage and electricity tariffs, the EMS provides automated predictions of power demand and calculates the optimum power generation and supply schedule, including the optimized use of battery energy storage.

While the EMS is intended to manage energy, it can also be integrated with Yokogawa's Computerized Maintenance Management System to avoid system failure caused by malfunction or deterioration of mechanical devices.



Battery Energy Storage System

To ensure the stable supply of power to the grid even when there is a dip in power generation, many renewable energy farms use a battery energy storage system (BESS) as a backup power supply.

Yokogawa's network-based control system play a key role in smoothing out the supply of this power to the grid.

The following key functions of BESS monitoring and control help you to achieve stable and profit-maximized operation.

Operation planning and monitoring:

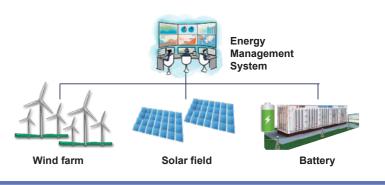
Using the power generation scheduling system, operators can access the weekly operation plan data they need to draw up an operation plan for the next day. At their stations, operators can view graphic displays showing the power sales target, power generation plan and battery charge-discharge plan.

Associated power monitoring:

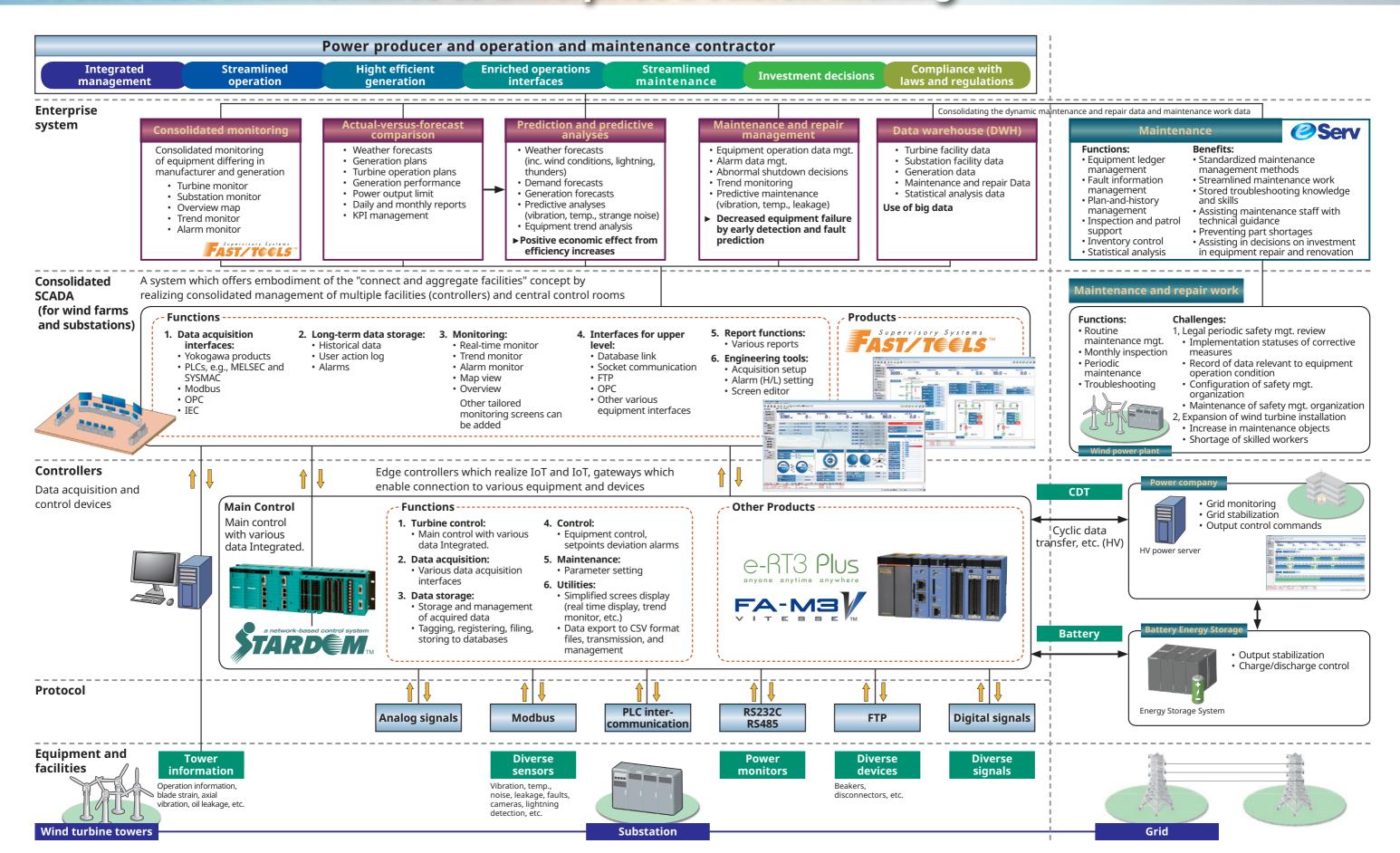
Operators can view data on total power output for the entire facility, battery charge status, and transformer operation status.

Battery monitoring:

The charge-discharge rate, charge status and operation status of each battery are displayed.



From Field Maintenance to Enterprise Decision-making



Yokogawa's SCADA Solution for Japan's Largest Wind Farm

Supporting the Future of Wind Farm Tsugaru





Wind Farm Tsugaru is owned and operated by Green Power Investment Corporation and commenced commercial operation on April 1, 2020 after two and a half years under construction. The area enjoys moderate temperatures of around 25°C in summer and –5°C even in the depths of winter, making it a relatively comfortable part of the Northeast region.

Most of the plant is built on agricultural land in line with a government environmental law. With 38 General Electric 3,200-kW turbines spread across the northern and southern blocks, its installed capacity of 121,600 kW is sufficient to power 90,000 typical households. At the start of operation it was the largest wind farm in Japan, and it is expected to reduce carbon dioxide emissions by 180,000 tons annually.

All of the electricity generated is supplied to the local electric utility, Tohoku Electric Power, via a grid interconnection switchyard at least 10 km away.

Yokogawa participated throughout the project as the system provider, from the beginning of construction to design, engineering, introduction, and test runs, and will support the plant's operation over the next two decades.

Comprehensive Solution for Wind Farms

Yokogawa's SCADA solution for wind farms ensures safe and secure remote operation at Wind Farm Tsugaru. It is an example of comprehensive services offered by Yokogawa, from system proposal to design, engineering, adoption, and support for test runs.

Proven FAST/TOOLS SCADA enables supervisory monitoring from remote offices. It communicates with the substations, switchyard, and wind turbines every second or faster and displays the readings and statuses on screen. In addition to real-time monitoring, FAST/TOOLS facilitates administrative tasks such as daily and monthly reporting.

Robust and reliable Yokogawa controllers for operation and monitoring from the remote operation and maintenance office monitors equipment statuses, process values, and alarm statuses in real time and works as RTUs to communicate with local power utility and turbine controllers.

The comprehensive solution includes network and cyber security design and configuration for assured and stress-free operation, including remote environments such as at overseas offices as well as all associated engineering and on-site services. In addition, a wealth of packaged software can realize streamlined and preventive maintenance.

Helping the Wind Power Industry to Grow



Yokogawa is actively working on maximizing the use of energy from renewable sources by utilizing reliable batteries. Yokogawa's solution helps streamline and optimize the operation of wind firms to reduce maintenance and equipment operating costs, extend equipment service life, predict failures, and so on.

We are co-innovating with companies in various fields and contributing to the development of renewable energy worldwide through our expertise in measurement, control and information, to help create a sustainable society.

Sustainability Policy

Long-term vision and commitment

With the adoption of the Paris Agreement at the 21st Framework Convention on Climate Change (COP21) and the Sustainable Development Goals at the United Nations Sustainable Development Summit, momentum is building in the global effort to achieve a sustainable society. In light of these developments, in August 2017 Yokogawa established sustainability goals (Three goals) for achieving sustainability. These aim to make the world a better place by means such as enabling the use of low-carbon energy sources and the recycling of materials. As described below, the Company is committed to transforming itself in several key ways to better position itself to achieve these goals.

Statement on Yokogawa's aspiration for sustainability

Yokogawa will work to achieve net-zero emissions, make a transition to a circular economy, and ensure the well-being of all by 2050, thus making the world a better place for future generations.

We will undergo the necessary transformation to achieve these goals by 1. becoming more adaptable and resilient, 2. evolving our businesses to engage in regenerative value creation, and 3. promoting co-innovation with our stakeholders.

Sustainability goals "Three goals"



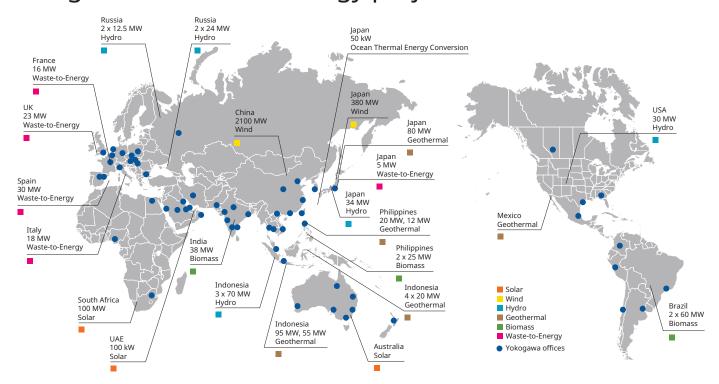
Three goals

Yokogawa will work to achieve net-zero emissions, make a transition to a circular economy, and ensure the well-being of all by 2050, thus making the world a better place for future generations.

Achieve net-zero emissions; stopping climate change

Climate change is an urgent issue that requires a global response. We aim for net-zero emissions, which means that the greenhouse gas concentrations in the atmosphere do not rise due to the balance of emissions and the absorption of greenhouse gases, which can be accomplished through the introduction of renewable energy and efficient use of energy. We are also working to reduce the impact of natural disasters and respond to biodiversity issues.

Yokogawa's renewable energy projects



OpreX[™] Yokogawa achieves operational excellence by providing products, services, and solutions based on the OpreX comprehensive brand that cover everything from business management to operations.

YOKOGAWA ELECTRIC CORPORATION **World Headquarters**

9-32, Nakacho 2-chome, Musashino-shi, Tokyo 180-8750, Japan http://www.yokogawa.com/

YOKOGAWA CORPORATION OF AMERICA

12530 West Airport Blvd, Sugar Land, Texas 77478, USA http://www.yokogawa.com/us/

YOKOGAWA EUROPE B.V.

Euroweg 2, 3825 HD Amersfoort, The Netherlands http://www.yokogawa.com/eu/

YOKOGAWA ENGINEERING ASIA PTE. LTD.

5 Bedok South Road, Singapore 469270, Singapore http://www.yokogawa.com/sg/

YOKOGAWA CHINA CO., LTD.

Room 1801, Tower B, THE PLACE, No.100 Zunyi Road, Changning District, Shanghai, China http://www.yokogawa.com/cn/

YOKOGAWA MIDDLE EAST & AFRICA B.S.C.(c)

P.O. Box 10070, Manama, Building 577, Road 2516, Busaiteen 225, Muharraq, Bahrain http://www.yokogawa.com/bh/

All brand or product names of Yokogawa Electric Corporation in this bulletin are trademarks or registered trademarks of Yokogawa Electric Corporation. All other company brand or product names in this bulletin are trademarks or registered trademarks of their respective holders.

Subject to change without notice.

All Rights Reserved. Copyright © 2018, Yokogawa Electric Corporation

Visit our website at: https://www.yokogawa.com/ industries/power/renewable-energy/



Represented by:

