

Yokogawa Renewable Solutions **HYDRO POWER**

YOKOGAWA HYDRO POWER SOLUTIONS



Hydro turbine control

Yokogawa, with its expertise and long experience in control and monitoring, plays a role of a hydropower plant control system provider. The service is not only for new power plants but is applicable to retrofitting projects such as replacement of the existing conventional control systems. Retrofitted, digitized systems will bring financial and safety benefits to customers' operation.



Enterprise Automation Solution

Safety and compliance are becoming increasingly important in industrial plants. 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.



Penstock condition monitoring

Aged hydro power plants nowadays are encountering the risk of damaging environment by leaks of ruptured penstocks. Yokogawa offers an innovative tool and real-time analysis to predict pipe ruptures and support customer's most optimized condition-based maintenance.



Yokogawa's system platforms combined with proven execution experience provide the highest quality and innovative solutions for secured and optimized process automation and management. Yokogawa's global customer centric focus together with strong local support reduces users' business risks and provides the lowest total cost of ownership. With a long history of progressive compatibility, Yokogawa is your dependable automation partner.

Generator stator condition monitoring

It costs the owners not so little to replace generator stator coils. The owners often just follow the replacement intervals advised by the manufacturer and may not be able to know whether or not the replacement is indeed necessary. Yokogawa DTSX fiber-optic temperature sensor will make it possible to monitor the temperature profile of each stator coil 24/7 and support your condition-based maintenance.

Energy Management System

Yokogawa's Energy Management System (EMS) can automatically calculate the power and water demand from several data sources such as the weather, season and time. When integrated with a control system, it will support automatic creation of power generation and supply schedules of best fit to minimize the cost.



*IIoT Solutions

- Remote CCTV plant monitoring
- Computerized maintenance management system
- Production dashboard system (such as KPI management)
- Operations management
- Wireless sensors



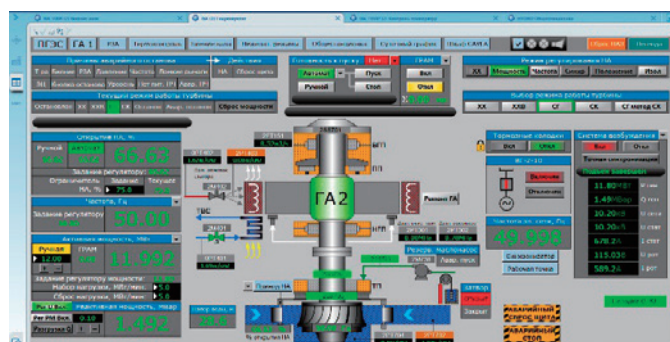
***IIoT : Industrial Internet of Things**

YOKOGAWA HYDRO POWER SOLUTIONS

Hydro power plant control and monitoring system

Yokogawa's control systems is suitable for hydropower plant control, and thanks to its reliability, the demand of retrofitting to aged plants with conventional system is increasing. The following features of Yokogawa's system will contribute to the power availability:

- **Unrivalled reliability and long-term stability of turbine control both in regular and emergency situations thanks to the utmost reliable CPU modules with "seven nines" availability**
- **Minimized maintenance operations and maximized service intervals**
- **Turbine governor control with turbine specific modules for critical control**
 - High speed (5 ms scan)
 - Turbine-specific I/O interfaces
 - All in one
- **Turbine protection**
- **Automatic turbine run-up**
- **State-of-the-art HMI with the latest technology**
- **Easy integration with asset management system**



Hydro turbine control & monitoring graphic

Applicable to turbines of all manufacturers

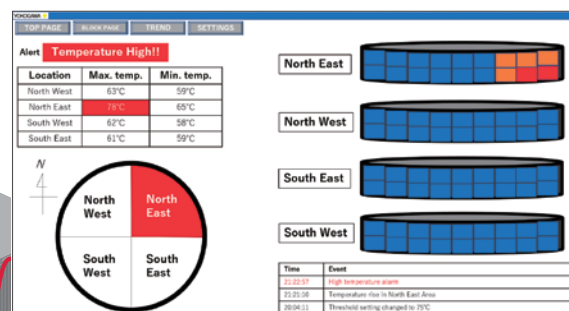
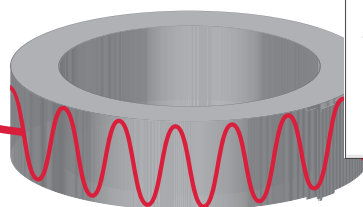
Generator stator coil condition monitoring

Innovative predictive maintenance *solution for generator safety*

Distributed Temperature Sensor



Optical fiber cable



Monitoring graphic

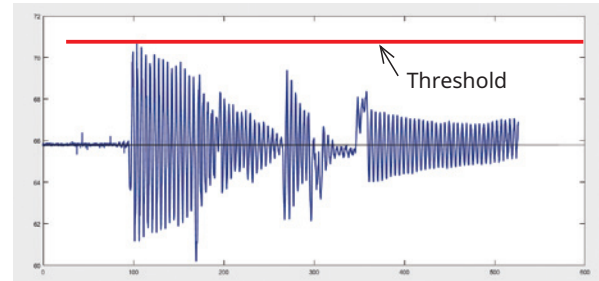
Fiber-optic Distributed Temperature Sensing (DTS) is an innovative solution compared to conventional measurement of each point with RTDs and thermocouples. Yokogawa DTSX sensor can continuously measure the average temperatures at every 1-meter intervals along a fiber optic cable. By installing the cable around the stator, the DTSX will provide a comprehensive view of temperature profiles of all stator coils and alerts the user when abnormality occurs. It thus enables stator coil temperature abnormalities to be detected and exactly located very quickly to help take countermeasures quickly.

Penstock condition monitoring

Innovative predictive maintenance *solution for hydropower safety*

Facility accidents at aged plants due to the deterioration, such as penstock and turbine casing damages, are reported. Recovery of these accidents require time and money.

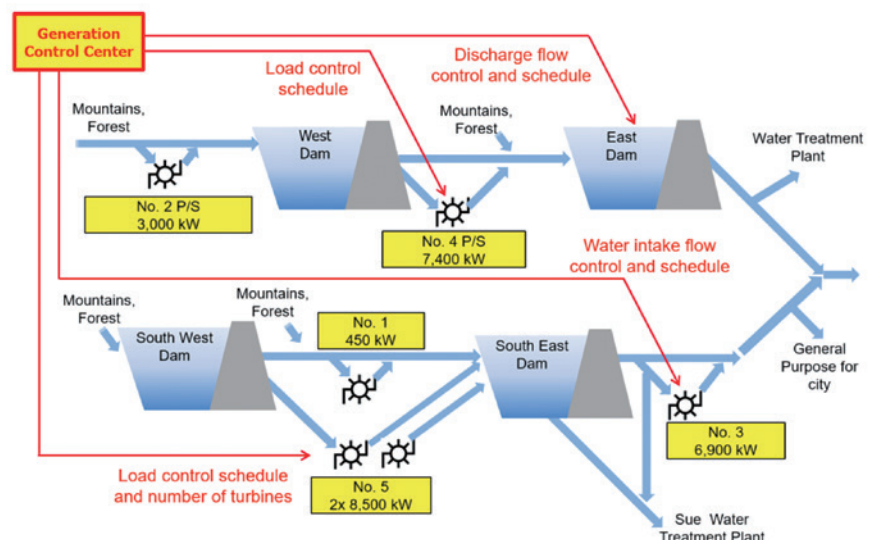
From the single tapping point, a monitoring system will continuously monitor and analyze the hydro oriented pressure signal for the purpose to predict risks of hydro acoustic phenomena including penstock breakage throughout all phases of plant operation from a start-up to shut-down. When the safety threshold is exceeded, the monitoring system regards it as a malfunction or instability of a system or component (such as the speed governor, valve automation and control system, ventilation valve, and relief devices) which may compromise the penstock safety, and generates an alarm to prompt an immediate countermeasure.



Energy management system

An energy management system (EMS) provides comprehensive management which covers total load control in the area, power generation schedule, river flow control, prediction and simulation. The EMS performs load control and prediction to figure out the suitable operation schedule to meet the power demand while maintaining the sufficient river water flow and storage in dams, based on extensive data including:

- Predicted river flow
- Target dam level
- Drinking water intake flow
- Dam discharge flow
- Target dam level
- Minimum river water flow
- Power station base operation
- Necessary flow for use
- Irrigation water pump operation
- Irrigation water pump flow
- Water flow for dam level target
- Planned water flow for use



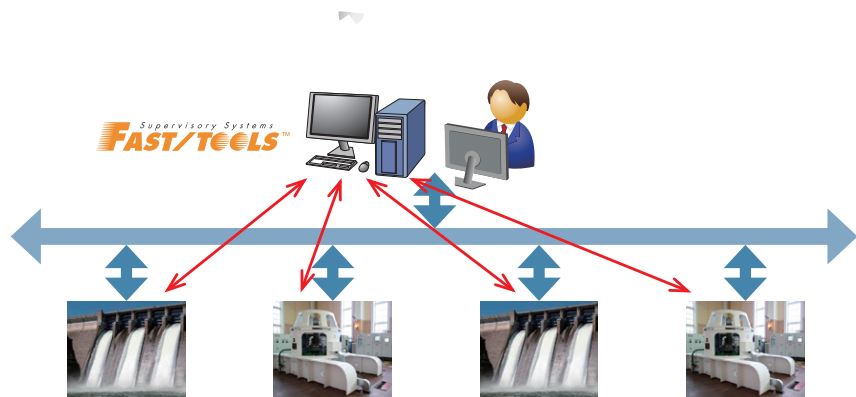
YOKOGAWA HYDRO POWER SOLUTIONS

Enterprise Automation Solution / Remote monitoring



FAST/TOOLS provide solutions for a wide range of control and supervisory applications where, for example one or more of the following requirements apply:

- Multiple Process Site environments
- Integration of third party systems
- Wide Area (Media independent) communication
- Robustness for intermitted communication
- Security against unauthorized access
- Disaster recovery and high availability architecture
- Alarm & Event management, Trending & Reporting.



IIoT Solutions

Yokogawa offers an IoT-enabled ISA100 compliant gateway, access point, media converter, management station and a full range of instrumentation. All Yokogawa ISA100 compliant products can be integrated into any ISA100 compliant network.

Distributed temperature sensing enhances site safety, asset monitoring and facility maintenance. Yokogawa's Field Eye CCTV solution enables monitoring of real-time images as well as camera operations such as panning, tilting, and zooming, through a Web browser.

Yokogawa's security experts have been actively participating in the development of international industrial standards from ISO, IEC and ISA such as IEC/ISA62443 (ISA99). Indeed, Yokogawa was one of the founding members of the ISA Security Compliance Institute.

Yokogawa has research and development centers in Singapore, Japan, India, and the U.S. where technologies for optimally applying security techniques to control systems are being developed. With long experience of integrating control systems, these centers develop security techniques and solutions optimized to each industry, application, and system configuration, helping customers to secure their control systems against evolving security risks..

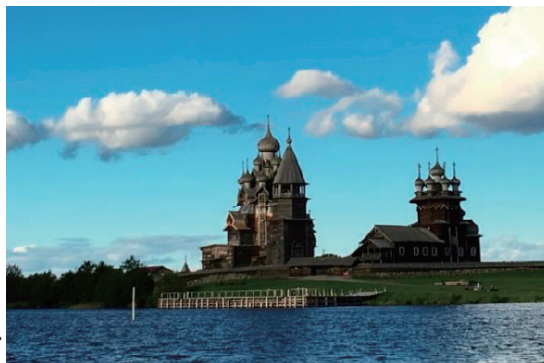


Success story in Russia

The Republic of Karelia is located in the northwest of the Russian Federation and has many hydro power plants making use of the abundant water resources. The Pal'eozersk hydro power plant was built in 1954 close to the Sun River which flows through Girvas city, with two 12.5 MW units. This is a cascade type of hydro power plant which uses the difference in height of the Sun River.

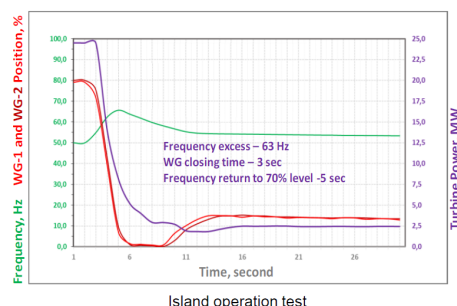
TGC-1, the owner of the plant is a regional power generation company affiliated with Gazprom, a biggest gas company in Russia.

Due to the obsolete equipment operated more than 50 years, TGC-1 replaced them to the newest and installed Yokogawa DCS CENTUM VP and the safety control system Prosafe-RS for modernization of the existing control, monitoring, and protection systems.



The challenges and solutions

As this area is remote from the central city area, performing load control is necessary for island operation in case of grid shutdown by natural disaster. The replacement of electric actuator and control system realized the stable load control less than 3 MW power generation and island operation in case of natural disaster while it made shutdown frequently before the replacement. Since its operational start in December 2015 after the replacement by Forus, there is neither error nor shutdown.



<Replacement from mechanical hydraulic control to CENTUM VP>

Existing mechanical hydraulic control was replaced with digital electric control, CENTUM VP. The new control system with new speed gear and sensors drastically improved speed/ load control.

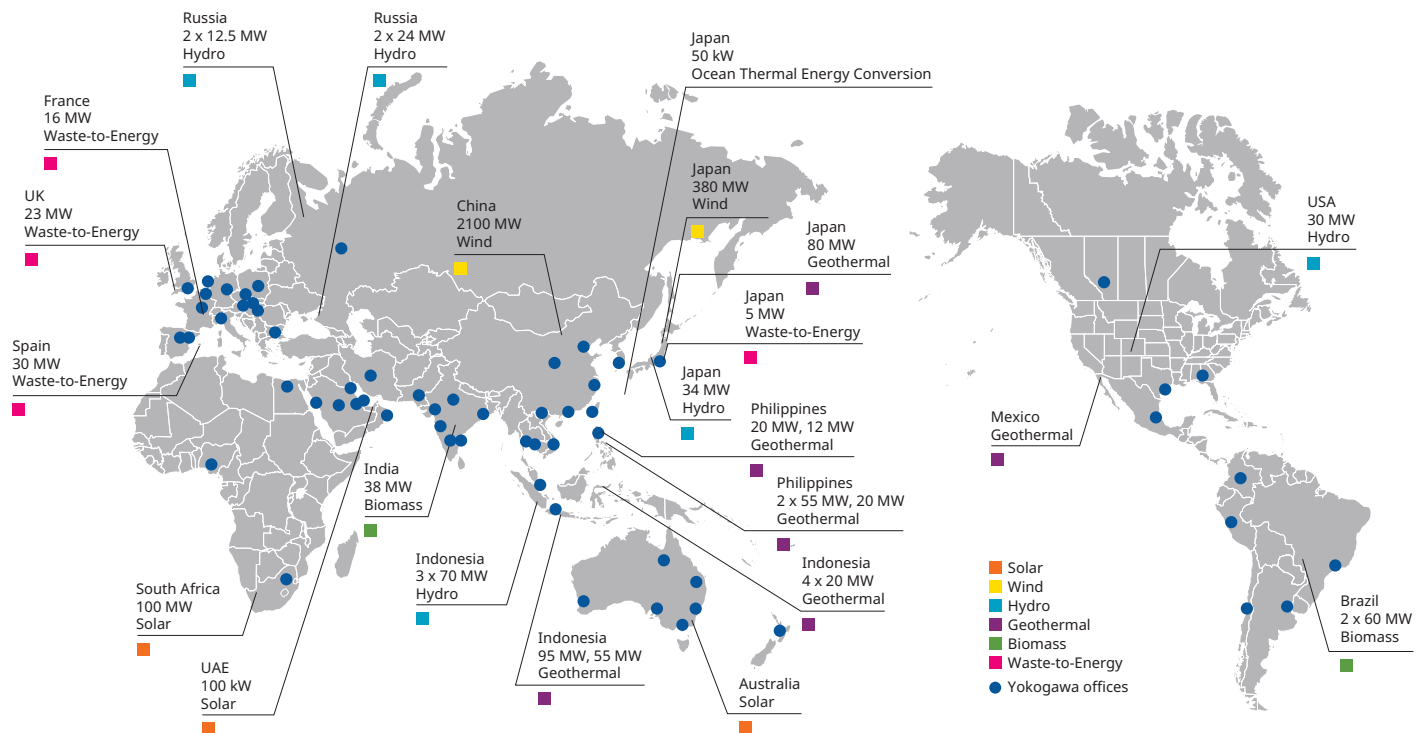
Full integration with excitation, electrical protection, vibration control, and more systems combined with such beneficial electric actuators delivers the following benefits:

Customer's Satisfaction

TGC-1 operators are satisfied with the result of the replacement. The HPP cascade general manager Evgeniy Lopatin commented, "Before the replacement, we were skeptical about whether Yokogawa could complete this project or not, but our fears proved to be unfounded. After system replacement, we found no malfunction. Also we have suffered no shutdown during operation even in island operation. We are very satisfied with the new system, and Forus's and Yokogawa's work. Various companies visit our hydro power plant to see it working thanks to such a successful project".



Yokogawa's renewable energy projects



Synaptic Business Automation underlies a process of co-innovation and collaboration with customers that leverages Yokogawa's domain knowledge and digital automation technologies to create sustainable value.

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.

3F TowerD Cartelo Crocodile Building,
No.568 West Tianshan Road, Shanghai 200335, 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/>

Trademarks

Co-innovating tomorrow, Synaptic Business Automation are trademarks or registered trademarks of Yokogawa Electric Corporation. 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/solutions/products-platforms/control-system/safety-instrumented-systems-sis/>



Represented by:

Printed in Japan, 810(KP) [Ed : 01/b]