Yokogawa in the Power Industry

Yokogawa’s VigilantPlant delivers visibility, predictability and agility for power generation – throughout the plant life cycle.
Envision a plant where people are watchful and attentive while your business responds to change quickly and efficiently. Now picture an operation that delivers non-stop power generation while confidently expanding your capabilities into the future. Imagine no further. This is the vision and promise behind VigilantPlant, the clear path to operational excellence.

Making critical plant information fully visible is just the beginning of the vigilant cycle.

Seeing clearly gives you the knowledge necessary to anticipate the changes required in your process. Knowing in advance brings you the speed and flexibility to optimize your plant in real time. And by acting with agility, you are able to adapt to the ups and downs of your business environment.

VigilantPlant excels at bringing out the best in your plant and your people – keeping them fully aware, well informed, and ready to face the next challenge.
You know a well run plant the moment you walk in

The plant’s alert approach to operations, maintenance, and information is obvious. Operators are calm and in control. Managers are well informed, but never overwhelmed with data. All facilities are under control, ready to unleash their full potential for occasional peak load. At the same time, potential problems are anticipated before they happen. All this in the life of a vigilant operation.

A New Plant Comes On-stream

The control room is quiet, with arrays of computer screens displaying trends and messages on the walls and operating desks. Gone are the chart recorders, printers, meters and push buttons of yesterday. Operating staff remain calm, monitoring operations, preparing the plant for routine testing and maintenance.

Other operating staff take time out from the control room for refresher training on the plant’s full replica training simulator. Here, the atmosphere is not quite as calm as the simulator. Here, the atmosphere is not quite as calm as in routine testing and maintenance, and under training for less common tasks such as plant start-up.

Being trained for a wide variety of emergencies, the operators are ready to handle unexpected events with confidence. Unscheduled shut-downs are minimized and rapid recoveries from unforeseen incidents are assured.

Daily Operations & Maintenance

During the night, while most of the community sleeps, the power plant remains in operation, ticking over at minimum output, meeting society’s needs for an uninterrupted electricity supply. The plant is prepared for the surge in electricity demand as the community awakes and commercial activities resume.

The CENTUM VP system coordinates operations throughout the plant, ensuring that boilers, steam turbines, and balance of plant (BOP) facilities function stress-free and at optimum efficiency while staying within safe operating limits.

The advanced alarm and monitoring system monitors all control system traffic, alerting operating staff to problems, while blocking out unnecessary messages. Most alarm messages relate to routine issues, such as the failure of an aging field instrument or a problem with the operation of a valve or damper.

As morning approaches, operating staff check the plant’s daily schedule and begin placing additional coal grinding mills into operation to increase the plant’s output and meet the morning demand.

During the day, the control system continually adjusts the plant output up and down to meet shifts in power demand. A sudden cold weather snap a hundred km away – or a failure in a plant elsewhere – may call for more power. In the competitive electricity market, a plant must be agile to quickly respond to market needs and capitalize on opportunities to increase profitability.

Recent heavy rain may result in deliveries of wet coal from the local mines. Operating staff respond by placing an extra milling plant in reserve, and then relax knowing that the Yokogawa control equipment includes fuel control strategies to cope with changes in fuel conditions.

Meanwhile, in the maintenance workshop, plant technicians responsible for 24/7 maintenance of all plant instruments and control systems use the PRM asset management software to monitor the performance of field devices such as transmitters, analysers and actuators.

The control system provides high-level operational and maintenance diagnostics, enabling immediate identification of plant faults, greatly accelerating response to problems.

Plant managers keep an eye on plant performance via secure remote access. Plant experts check and evaluate plant performance from the comfort of their office environment.

To a casual observer, this calm & efficient setting may seem rather boring. But this is the way a plant should run – allowing you to See Clearly, Know in Advance, and Act with Agility. It should run like a VigilantPlant.

Plant Revamp & Expansion

With today’s power plants remaining in operation for several decades, there comes a time when instrumentation and control systems must be renewed to maintain a competitive edge.

At the start of a replacement project, Yokogawa’s experienced engineering team carries out a plant and control system audit. The sustainable and flexible architecture of Yokogawa’s control system means that only the obsolete control units need to be changed over, allowing existing equipment to be retained to the maximum extent. Strategies for increasing plant safety, avoiding project cost over-runs, and increasing plant availability are put into place.

While the design and fabrication proceed, other process application specialists review the plant control strategies and incorporate new control concepts. This is thoroughly tested by simulation, almost always with a full replica simulator. Testing proceeds separately from the manufacture of control equipment, providing low risk engineering processes for projects with short outage times.

Once the plant outage begins, existing control equipment is quickly removed, without disturbing existing cabinets and cables. The new factory-assembled and tested control equipment is installed, and connections made to existing terminals and cables. Commissioning and testing of the new control equipment commences almost immediately.

As the outage concludes, operating staff “run up” the plant with the confidence that comes from having undergone extensive training on the plant simulator.

With the new control system, the power plant is set for many more years of safe, reliable and competitive operation.
The effectiveness and efficiency of power plant operations depend on the availability of key performance information about the plant and the process. Yokogawa delivers a single-architecture monitoring and control system that integrates information from all facets of a power plant and keeps the plant personnel well informed. The industry-leading availability, reliability, and long-term stability of the Yokogawa automation platforms ensure an operating environment where your people can have 20:20 vision of your entire operation.

Key Enablers:

- **Single architecture covering the entire plant**
  - CENTUM VP total power plant control system for turbine, boiler and balance of plant (BOP) controls
  - TÜV SIL3 certified ProSafe-RS integrated safety controller for the burner management system (BMS) and protection system
  - FOUNDATION™ fieldbus and HART interface for field instruments, analyzers, and valve positioners
  - PROFIBUS interface for electrical equipment and motor valves
  - IEC 60870-5 interface for substation equipment

- **High availability**
  - Field-proven controller with seven 9s (99.99999%) availability in unique pair-and-spare redundant architecture
  - Pair & spare fail-safe architecture is also available for the ProSafe-RS safety controller

- **Long term stability**
  - ±0.04% accuracy of the DPharp EJX digital transmitter even in the most critical applications (drum level, etc)
  - ±0.1% of upper range limit (URL) for 10 years with EJA/EJX transmitters
Optimizing operation & maintenance for unprecedented plant management efficiency

Once into commercial operation, competitive power plants pursue operational excellence by continually improving efficiency and preventing/minimizing abnormal situations. Yokogawa enables optimization solutions that empower plant personnel under both normal and abnormal conditions. Knowledge-based tools and consulting services enable continual productivity improvement, advanced alarm management, and integrated plant asset management. No longer just reacting to problems, your people and your assets are focused on meeting tomorrow’s challenges.

Key Enablers:

- **Alarm Management**
  - *Intelligent alarm management* automatically displays alarms requiring operator attention, informing operators whether alarm points are improving while suppressing irrelevant alarm messages.
  - *Exaplog event analysis package* analyzes the frequency of alarms and operator actions, visualizing statistical data and helping to find the root causes of alarm occurrence and areas for improvement.
  - *Event sequence analysis* with built-in Sequence of Events Manager (SEM) allows 1msec time resolution and 1msec accurate time synchronization system across all controllers.

- **Plant Asset Management**
  - *Integrated asset management* with PRM Plant Resource Manager enables effective maintenance of plant assets in a single unified database system across different protocols and multiple suppliers.

- **Plant Modeling & Simulation**
  - *Full-replica simulator* performs highly accurate modeling of actual plant behavior under any scenario for optimized operation and control.
  - *Performance calculation* is fully integrated with the Yokogawa DCS and uses predefined formulae to monitor and optimize performance.

- **Plant Information Management**
  - *Long-term data archiving and data transformation* with Exaquantum ensures enhanced, seamless information flow within and between plant systems and business applications.
During the relatively long life cycle of a power plant, there comes a time when the instrumentation and control systems must be renewed to maintain a competitive edge. Yokogawa supports power plants with expert services that maximize efficiency and minimize cost over the entire life cycle. From initial design, construction, and daily operation to revamp and reinstrumentation, Yokogawa stands by your power plant. This long-term partnership ensures bottleneck-free performance and ongoing optimization that bring speed and flexibility to your business.

> Plant life cycle services

Enabling agility of business with plant services throughout the plant life cycle

Key Enablers:

- **Sustainable control system architecture**
  - Our philosophy of continuous evolution, demonstrated over a 30 year period with CENTUM, ensures a smooth migration path and keeps your investment for I&C refurbishment to a minimum.

- **Efficient plant commissioning with plant simulator**
  - Offline commissioning on a high-fidelity simulator allows thorough validation of the DCS configuration before the software is loaded at the actual plant, keeping to a minimum the final tuning that must be done during plant commissioning.

- **Custom-made operator training**
  - Certified professional trainers deliver competency-based training using a plant simulator to create training scenarios that flexibly replicate normal, abnormal, and emergency operating conditions.

- **Condition-based system maintenance**
  - 24/7/365 remote monitoring combined with real-time diagnostic tools and services ensures system maintenance can be condition-based, not time-based, reducing maintenance spending.

- **Standard knowledge base**
  - Automated operation procedures created with Exapilot enable the know-how of experienced operators to be shared with less experienced staff.
  - Documentation of standard procedures for operation, maintenance, training, commissioning, audit, and reporting.

- **Plant auditing and consulting**
  - Plant-wide audits examine human resources, fuel, asset management, environment, production, plant operation, and information systems, identifying opportunities for improvement and cost reduction.
Yokogawa in the power industry

Field Instruments
- Pressure, temperature, flow, and level measurement
- Valve positioners and converters

Analytical Instruments
- Liquid analysis (pH/ORP, conductivity, dissolved oxygen)
- Gas analysis (NOx, SOx, CO, CO2, O2, hydrogen purity)

Safety Management Systems
- TÜV SIL3 certified integrated safety systems for burner management and emergency shutdown

Unit Control Systems
- Distributed control systems
- SCADA and network-based control systems

Data Acquisition and Control
- Paperless videographic recorders
- PC-based and stand-alone data acquisition equipment
- Single loop and highly scalable programmable logic controllers

Meters and Test Instruments
- Analog/digital meters, clamp-on power meters, power monitors, insulation testers, handy calibrators

Plant Optimization Software
- Performance analysis, operational efficiency improvement, and alarm management
- Asset management

Power Plant Services
- Commissioning, operator training, operation, maintenance, and simulation services
Wide application experience in the power industry

Yokogawa supports a wide range of applications, from conventional power to renewable energy.

Fossil fuel fired power plants
- Coal/oil/gas fired
- Combined cycle
- Simple cycle
- Co-generation
- Industrial boilers
- Independent water and power producers (IWPPs)

Combined cycle power plant

Industrial boiler plant/co-generation plant

Coal fired power plant

Renewable power plants
- Geothermal
- Biomass
- Waste to energy

Geothermal power plant

Waste to energy plant

Environment protection
- Flue gas desulphurization (FGD)
- Circulating fluidized bed (CFB) boilers

FGD plant

CFB boiler plant
**Total power plant control system**

**CENTUM VP provides an excellent platform for the comprehensive and coordinated control of power plants.**

**Human interface station/engineering station**

The human interface station (HIS) provides a unified and intuitive operating environment. Screens are ergonomically designed and arranged to reduce operator fatigue and discomfort. The engineering station provides powerful configuration tools and a virtual test function.

**Plant information management**

All types of plant information including process data, alarms, events and sequence of events (SOE) are handled by plant information management, enabling the analysis of plant operational performance.

**Plant resource management**

Plant resource management integrates and manages maintenance information from field instruments and monitors online conditions.

**Field Control Station (FCS)**

The FCS provides powerful control functions with a highly reliable dual redundant configuration that incorporates Yokogawa’s own pair-and-spare technology.

**Safety Control Station (SCS)**

The ProSafe-RS SCS is a TÜV SIL3 certified safety system that incorporates Yokogawa’s own pair-and-spare technology.

**Typical control scope of a coal fired power plant**
- Boiler control
- Burner management
- Turbomachinery control
- Balance of plant (BOP)

- Coal handling
- Water treatment
- Ash handling
- Flue gas desulfurization (FGD), etc.

**Total power plant control system**

**Control LAN (What if?)**

**Typical coal fired power plant**

- Turbomachinery
  - Steam turbine
  - Water treatment
- Boiler & BOP
  - Boiler
  - EP
  - FGD
  - Fuel
  - Ash pond
  - Waste water
- Coal yard
- Ash pond
- Fuel
- Water treatment
- Ash handling
- Flue gas desulfurization
In this revamping project, one important issue to be considered was the improvement of system maintainability. The customer wished to centrally manage through the DCS architecture many hundred HART-enabled and analogue devices from multiple vendors. Yokogawa’s PRM Plant Resource Manager integrats all field device information and device diagnostic information into a single database, allowing real-time, remote maintenance via DCS networks. When a plant problem occurs, associated instruments can be remotely checked and verified in just a few minutes, which minimizes routine maintenance work.

Efficient field asset management

In this revamping project, one important issue to be considered was the improvement of system maintainability. The customer wished to centrally manage through the DCS architecture many hundred HART-enabled and analogue devices from multiple vendors.

Yokogawa provided an integrated control solution comprised of a DCS, plant information management system, plant asset management system, full-replica training simulator, and field instruments together with strong local support.

The units have been returned to service ahead of schedule and have been operating very stably and efficiently.

Faster commissioning with plant simulator

The highly accurate simulation environment (>99% steady state; >95% dynamic state) enabled thorough validation of the control configuration on the simulator prior to the control system’s actual commissioning at the plant. A significant number of potential plant trips and incidents were identified and resolved before the initial plant startup.

Within the plant commissioning, the plant operators were well trained under a wide variety of normal, abnormal, and emergency operating conditions. This ensures a safe and smooth plant commissioning process.
The 4th Thermal Power Plant (Phase One)
4 x 420 t/hr, coal fired, plant revamping

A more stable and robust power supply
The re-instrumented boilers realized both higher stability and increased throughput, assuring a stable energy supply.

Reduction of malfunctions and accidents
Since the renovation, equipment malfunctions have dropped dramatically, eliminating costly plant downtimes.

“Seeing is believing”
Ts. Bayarbaatar, Head of the 4th Thermal Power Plant, Mongolia

“Seeing is believing. Whatever beautiful things sales people say, I will not believe until I see them at work. When we experienced the plant trip, I learned what makes Yokogawa different from others. I admire their sincerity and devotion toward customers.”

Complex revamp/expansion projects test the alertness, care, and skill of both the user and the supplier of automation. Yokogawa delivers practical engineering solutions with professional care, modernizing and expanding your plant with minimum disturbance to your business.

Installation & Commissioning
Good coordination between multiple suppliers and engineering teams is the key success factor in commissioning. Yokogawa ensures both human collaboration and technical integration throughout the project life cycle.

Operation & Optimization
Ongoing adaptation and optimization requires continued collaboration. Yokogawa keeps in close touch with your plant through 24/7 operation support and expert consultation services.

Maintenance and Upgrade
Be it diagnosis, root cause analysis, or predictive maintenance, practical solutions are in short supply. Yokogawa brings you the tools and services that help you take concrete actions to improve the effectiveness of your plant assets.

Design & Engineering
Early involvement and collaborative project execution lowers the overall risk of the project. Yokogawa strives to understand the goals of each project upfront and to secure a firm ground for ongoing teamwork. Throughout execution, Yokogawa secures strict quality gates based on proven procedures.

“Seeing is believing”
Front-End Engineering & Design (FEED)

Main Instrumentation Vendor (MIV) Services

Site Engineering
Integration Testing
Turn-Key Services
Commissioning Services

Optimization Consulting
24/7 Operation Support
Online Diagnosis Support
Operator Training

Asset Optimization
Life Cycle Solutions
Standard Knowledge Base

Standard Knowledge Base

Ongoing adaptation and optimization requires continued collaboration. Yokogawa keeps in close touch with your plant through 24/7 operation support and expert consultation services.

Maintenance and Upgrade
Be it diagnosis, root cause analysis, or predictive maintenance, practical solutions are in short supply. Yokogawa brings you the tools and services that help you take concrete actions to improve the effectiveness of your plant assets.

Design & Engineering
Early involvement and collaborative project execution lowers the overall risk of the project. Yokogawa strives to understand the goals of each project upfront and to secure a firm ground for ongoing teamwork. Throughout execution, Yokogawa secures strict quality gates based on proven procedures.

“Seeing is believing”
Front-End Engineering & Design (FEED)

Main Instrumentation Vendor (MIV) Services

Site Engineering
Integration Testing
Turn-Key Services
Commissioning Services

Optimization Consulting
24/7 Operation Support
Online Diagnosis Support
Operator Training

Asset Optimization
Life Cycle Solutions
Standard Knowledge Base

Ongoing adaptation and optimization requires continued collaboration. Yokogawa keeps in close touch with your plant through 24/7 operation support and expert consultation services.

Maintenance and Upgrade
Be it diagnosis, root cause analysis, or predictive maintenance, practical solutions are in short supply. Yokogawa brings you the tools and services that help you take concrete actions to improve the effectiveness of your plant assets.

Design & Engineering
Early involvement and collaborative project execution lowers the overall risk of the project. Yokogawa strives to understand the goals of each project upfront and to secure a firm ground for ongoing teamwork. Throughout execution, Yokogawa secures strict quality gates based on proven procedures.

“Seeing is believing”
Front-End Engineering & Design (FEED)

Main Instrumentation Vendor (MIV) Services

Site Engineering
Integration Testing
Turn-Key Services
Commissioning Services

Optimization Consulting
24/7 Operation Support
Online Diagnosis Support
Operator Training

Asset Optimization
Life Cycle Solutions
Standard Knowledge Base

Ongoing adaptation and optimization requires continued collaboration. Yokogawa keeps in close touch with your plant through 24/7 operation support and expert consultation services.

Maintenance and Upgrade
Be it diagnosis, root cause analysis, or predictive maintenance, practical solutions are in short supply. Yokogawa brings you the tools and services that help you take concrete actions to improve the effectiveness of your plant assets.

Design & Engineering
Early involvement and collaborative project execution lowers the overall risk of the project. Yokogawa strives to understand the goals of each project upfront and to secure a firm ground for ongoing teamwork. Throughout execution, Yokogawa secures strict quality gates based on proven procedures.

“Seeing is believing”
Front-End Engineering & Design (FEED)

Main Instrumentation Vendor (MIV) Services

Site Engineering
Integration Testing
Turn-Key Services
Commissioning Services

Optimization Consulting
24/7 Operation Support
Online Diagnosis Support
Operator Training

Asset Optimization
Life Cycle Solutions
Standard Knowledge Base

Ongoing adaptation and optimization requires continued collaboration. Yokogawa keeps in close touch with your plant through 24/7 operation support and expert consultation services.

Maintenance and Upgrade
Be it diagnosis, root cause analysis, or predictive maintenance, practical solutions are in short supply. Yokogawa brings you the tools and services that help you take concrete actions to improve the effectiveness of your plant assets.

Design & Engineering
Early involvement and collaborative project execution lowers the overall risk of the project. Yokogawa strives to understand the goals of each project upfront and to secure a firm ground for ongoing teamwork. Throughout execution, Yokogawa secures strict quality gates based on proven procedures.

“Seeing is believing”
Front-End Engineering & Design (FEED)

Main Instrumentation Vendor (MIV) Services

Site Engineering
Integration Testing
Turn-Key Services
Commissioning Services

Optimization Consulting
24/7 Operation Support
Online Diagnosis Support
Operator Training

Asset Optimization
Life Cycle Solutions
Standard Knowledge Base

Ongoing adaptation and optimization requires continued collaboration. Yokogawa keeps in close touch with your plant through 24/7 operation support and expert consultation services.
An industry leader on a clear path

In 2002, Eraring Energy began a revamp process to replace the original 1970s design hard-wired electronic control equipment and computer equipment at its Eraring Power Station, one of Australia’s largest. Inviting and evaluating proposals for the latest equipment from the major control systems suppliers, Eraring Energy chose Yokogawa.

“The ability to operate flexibly gives us a competitive advantage”

Jeff Hogan, Instrument and Control Team Manager of Eraring Energy

“Yokogawa took advantage of the flexibility of its equipment to suit the existing installation. Where possible, the new equipment slotted into existing cabinets, reusing existing field cables, terminations, cabinets, and connectors. New equipment was wired and tested in the factory. This avoided disturbing most existing cabling and greatly sped up installation and commissioning times.”

“The new control equipment makes fault finding a breeze, while the new graphic displays show us all the details we need.”

“The asset management system allows us to directly monitor and manage all smart field devices from our workshop.”

“The renovated units are now more flexible and responsive than before, giving the station additional advantages in a highly competitive electricity market. The refitted control room is state-of-the-art and provides a quiet and stress free operating environment for our staff.”

Jeff Hogan, Instrument and Control Team Manager of Eraring Energy

“Expectations exceeded, our plant was back in operation ahead of schedule”

Michael Mortiss, Project Manager of Eraring Energy

“Yokogawa has exceeded our expectations, bringing each revamped unit back into reliable service ahead of schedule. Utilizing a full replica simulator, our engineering team and Yokogawa fully tested the new logic and control configurations before they were loaded on the actual plant. This significantly reduced the time needed for site commissioning, and avoided plant trips during commissioning. Being thoroughly trained on the new screen-based control system training simulator, our operators were well prepared for the new control scheme in time for plant commissioning. This assisted in ensuring an uneventful, smooth return to service.”

Michael Mortiss, Project Manager of Eraring Energy

“Supported by the high-level operational and maintenance diagnostics, together with strong local support from Yokogawa, we are sure that Eraring Power Station will secure high plant availability for a further 20 years.”

Choose Yokogawa as your partner for operational excellence. Let us be vigilant about your business!

Yokogawa’s flexible approach to design and implementation of large power plant revamp projects, team of experienced power plant engineers, and commitment to meeting all important project outage schedules were further reasons for selecting Yokogawa.”

“We had already purchased other Yokogawa equipment such as transmitters and paperless chart recorders for our plant, and had received excellent service and on-going support.”

Michael Mortiss, Project Manager of Eraring Energy

“While there are several very capable control systems vendors, Yokogawa provided the most completely integrated solution of plant control system, training simulator, plant asset management system, and plant information and management systems.

“For flexibility, experience and commitment, we selected Yokogawa”

Michael Mortiss, Project Manager of Eraring Energy

“Our decision to carry out the revamping project was based on the need to maintain a competitive advantage in the Australian deregulated electricity market. Maximizing plant availability for at least another 20 years, timely returns to service of each unit, and efficiency gains were also significant project drivers.”

“Expectations exceeded, our plant was back in operation ahead of schedule”

Michael Mortiss, Project Manager of Eraring Energy