YOKOGAWA

Co-innovating tomorrow™

Gas and Combined Cycle Power Plant Solutions

Field Instruments, Analyzers, and Project Execution Services for the North American Power Industry

BU-P-20250526-01

The Pursuit of Smarter, Cleaner Energy
with Yokogawa's Proven Solutions

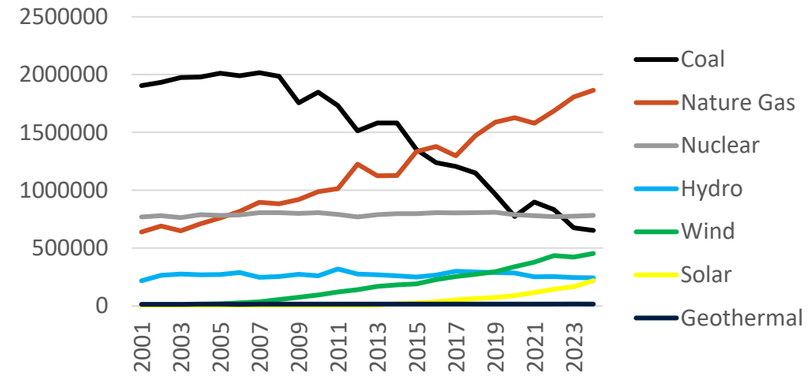
Today's power producers face increasing complexity—balancing efficiency, emissions, grid stability, and profitability in a rapidly evolving energy landscape. Success depends on solutions that combine proven reliability with forward-looking innovation. Yokogawa has been a trusted partner to the global power industry for decades, delivering field-proven instruments, analyzers, control systems, and digital solutions that ensure operational excellence from startup to steady state. Our mission is simple: to help operators, engineers, and plant leaders achieve stable, safe, and sustainable performance every day.

As power producers navigate the dual pressures of demand growth and maintaining lower rates, achieving safe, stable, and flexible operations has never been more critical. From natural gas and combined cycle to renewables and thermal assets, every part of the generation, distribution, and delivery ecosystem must work in unison—with higher efficiency, tighter control, and greater resilience.

That's where Yokogawa comes in.

Backed by decades of domain experience and a deep portfolio of best-in-class measurement, control, and data solutions, Yokogawa is helping power producers across North America modernize their operations without compromising safety, reliability, or compliance. Whether you're optimizing a turbine, reducing water losses, or preparing for a more distributed grid, we deliver precise visibility and responsive control **where it matters most**.

U.S. Power Generation by Source (000's mWh)



Data Source: U.S. Department of Energy, Energy Information Administration (EIA).

Reliable, intelligent solutions that keep the lights on and your costs down



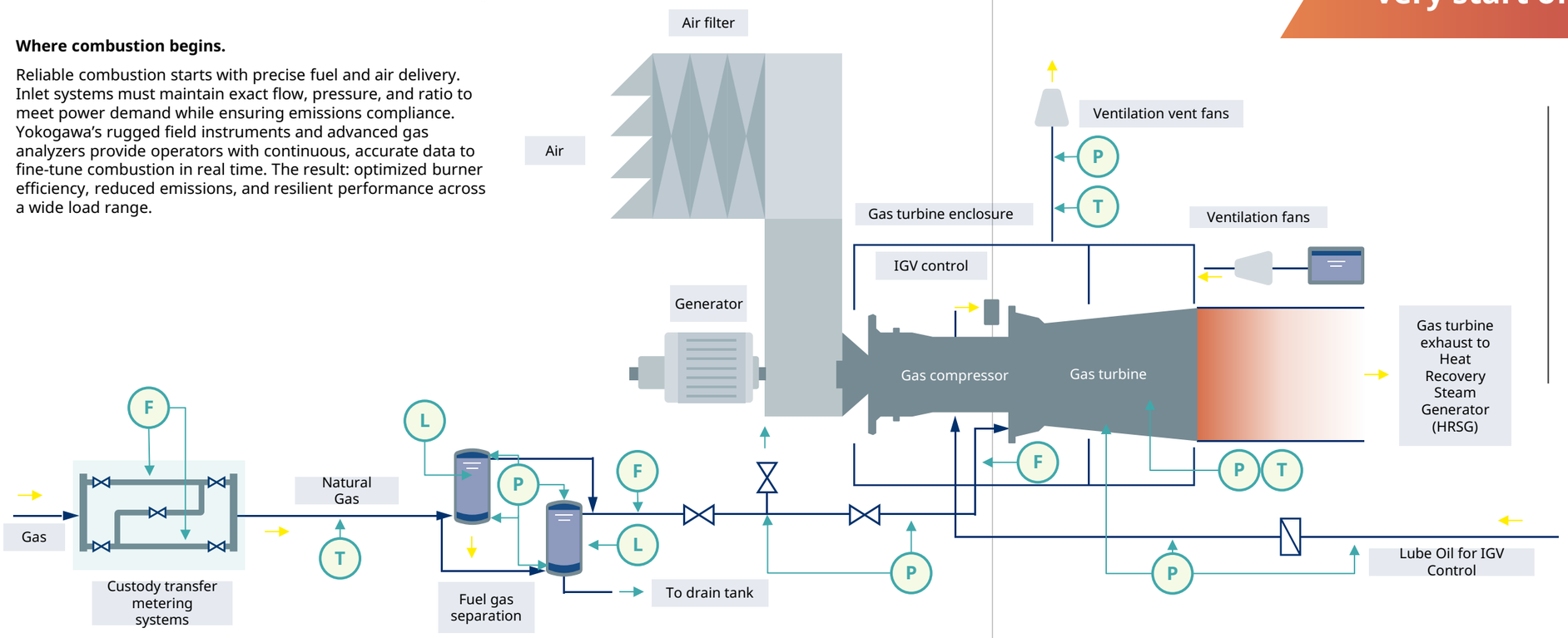



Securing the Foundation of Stable Combustion

Fuel Inlet & Air Inlet
critical inputs to combustion stability.

Where combustion begins.

Reliable combustion starts with precise fuel and air delivery. Inlet systems must maintain exact flow, pressure, and ratio to meet power demand while ensuring emissions compliance. Yokogawa's rugged field instruments and advanced gas analyzers provide operators with continuous, accurate data to fine-tune combustion in real time. The result: optimized burner efficiency, reduced emissions, and resilient performance across a wide load range.



CUSTODY TRANSFER

■ **Natural gas fuel inlet**

- In combined cycle power plants, accurate fuel measurement is crucial due to the high volume and cost of fuel involved
- Yokogawa's Coriolis meter measures mass flow directly without the requirement for separate pressure and temperature compensation
- NTEP Custody Transfer Approval standard

GAS INLET

■ **Gas Turbine Natural Gas Inlet**

- In high-demand scenarios (e.g., cold winters or natural gas price spikes), petroleum-fired generation is often used as a backup to meet load demands
- Accurate fuel flow measurement is essential for calculating power generation efficiency by comparing fuel input to megawatts output—a process known as the plant settlement system
- Yokogawa's ROTAMASS TI Coriolis flowmeter offers mass, temperature, and density measurement in a single unit, with a unique "box-in-box" design to isolate vibrations and status-based totalization capabilities for multiple fuels.
- Industry's thickest tubes – no requirement for pressure compensation

Ensure precision and reliability at the very start of combustion

GAS TURBINE

■ **Protection System**

- Turbine Protection Systems monitor for abnormal conditions such as, Overpressure, Over temperature, Loss of cooling, and Lube oil pressure loss
- These systems require high accuracy and reliability with the system tied to Safety Instrumented System requiring SIL certification
- EJX/EJA series maintain long term stability of 15 years
- EJX/EJA and YTA transmitters are SIL2 certified with SIL3 capability

AIR INLET MONITORING

■ **Natural gas fuel inlet system**

- Track ambient inlet temperature for heat-rate calculations with temperature transmitters.
- Detect clogging that robs compressor efficiency and raises OPEX with filter ΔP.
- Confirm differential has been restored after filter change-out with pressure post-filter monitoring.
- Optional velocity thermocouple to monitor fast inlet-air swings during fogging or chillers.

HYDROGEN BLANKETING

■ **Gas Turbine Gas Blanketing**

- Hydrogen is widely used to cool turbine generators due to its superior thermal conductivity, but its high flammability and small molecular size make leak detection critical for plant safety
- Yokogawa's GD40 detector features a unique multi-mode oscillating detector that enables direct measurement of density without relying on thermal conductivity for improved accuracy unaffected by temperature changes for increased efficiency and higher immunity to dust/oil effects decreasing maintenance expenses.

Steam Turbine
maximizing output from every BTU.

Maximize every megawatt.

The steam turbine is the workhorse that transforms thermal energy into mechanical power, driving the generator to boost overall plant output. By expanding high-pressure, superheated steam across multiple stages—high, intermediate, and low—the turbine extracts energy efficiently while protecting equipment life. With reheating stages to preserve steam quality and advanced monitoring to reduce moisture carryover, operators can achieve higher performance, longer uptime, and safer operation. As part of the combined cycle, the steam turbine elevates total efficiency well above simple cycle plants, delivering reliable, cost-effective energy to the grid. By harnessing the waste heat from the gas turbine exhaust, the steam turbine significantly increases the plant's total output and thermal efficiency, often pushing combined cycle efficiencies above 60%.

STEAM TURBINE

Additional Pressure and Temperature Measurements

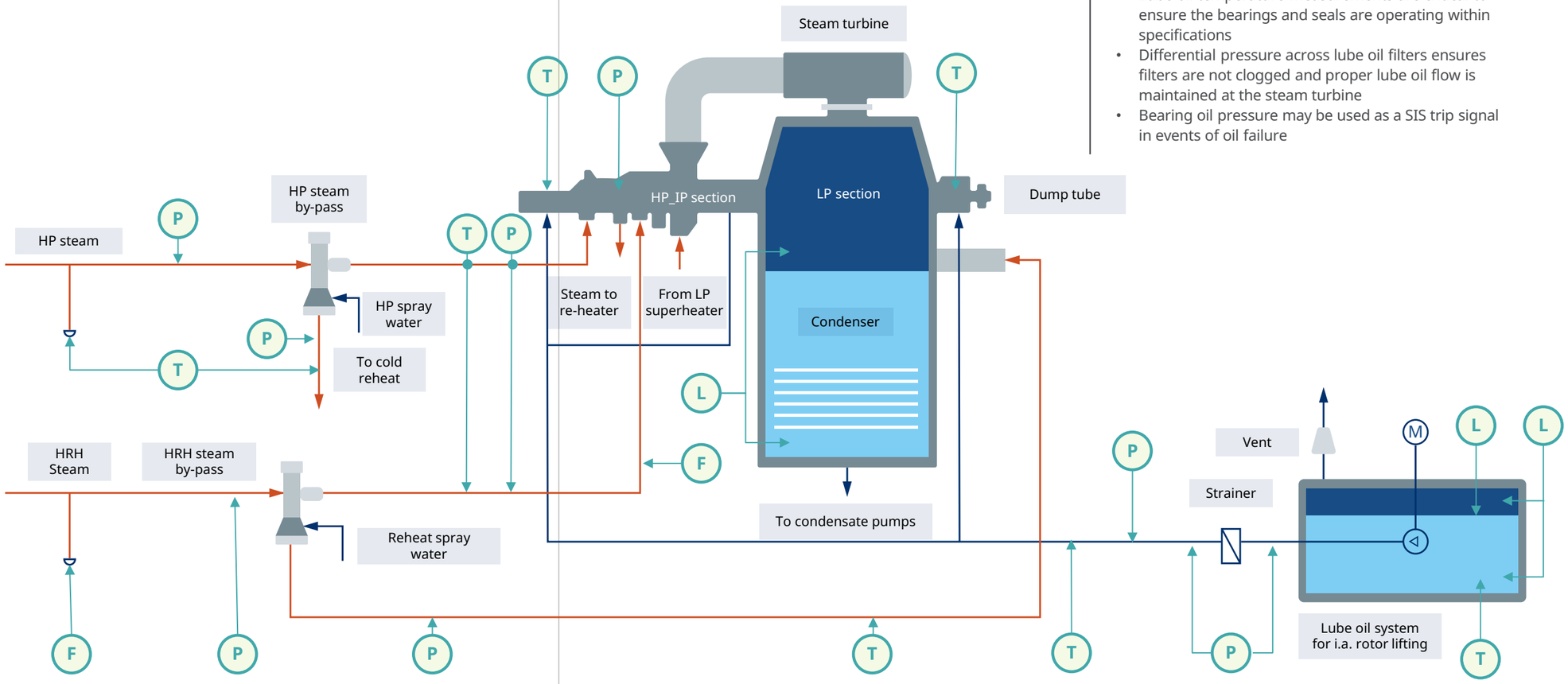
- Main steam pressure and temperature ensures correct steam conditions for efficient operation
- Reheat steam pressure and temperature is used to monitor reheat performance for the overall steam cycle efficiency
- Condenser pressure and temperature is used to indicate overall condenser health, turbine backpressure, and overall condenser efficiency

STEAM TURBINE

Steam Flowrate

- Yokogawa's VY Series vortex meters handle steam up to 450°C and ASME Class 1500 pressure making them ideal for saturated and superheated steam systems
- Integrated multivariable options eliminate the need for separate temperature sensors by providing direct mass flow measurements ideal for energy-efficient steam management movement

Optimize turbine efficiency and longevity with Yokogawa



STEAM TURBINE

Lubrication and Hydraulic Systems

- Lube oil pressure is critical to ensuring bearings are properly lubricated
- Lube oil temperature measurements are critical to ensure the bearings and seals are operating within specifications
- Differential pressure across lube oil filters ensures filters are not clogged and proper lube oil flow is maintained at the steam turbine
- Bearing oil pressure may be used as a SIS trip signal in events of oil failure

Do Not Let Heat Go to Waste

Heat Recovery Steam Generator (HRSG)
the bridge between turbines.

Unlock efficiency through waste heat recovery.

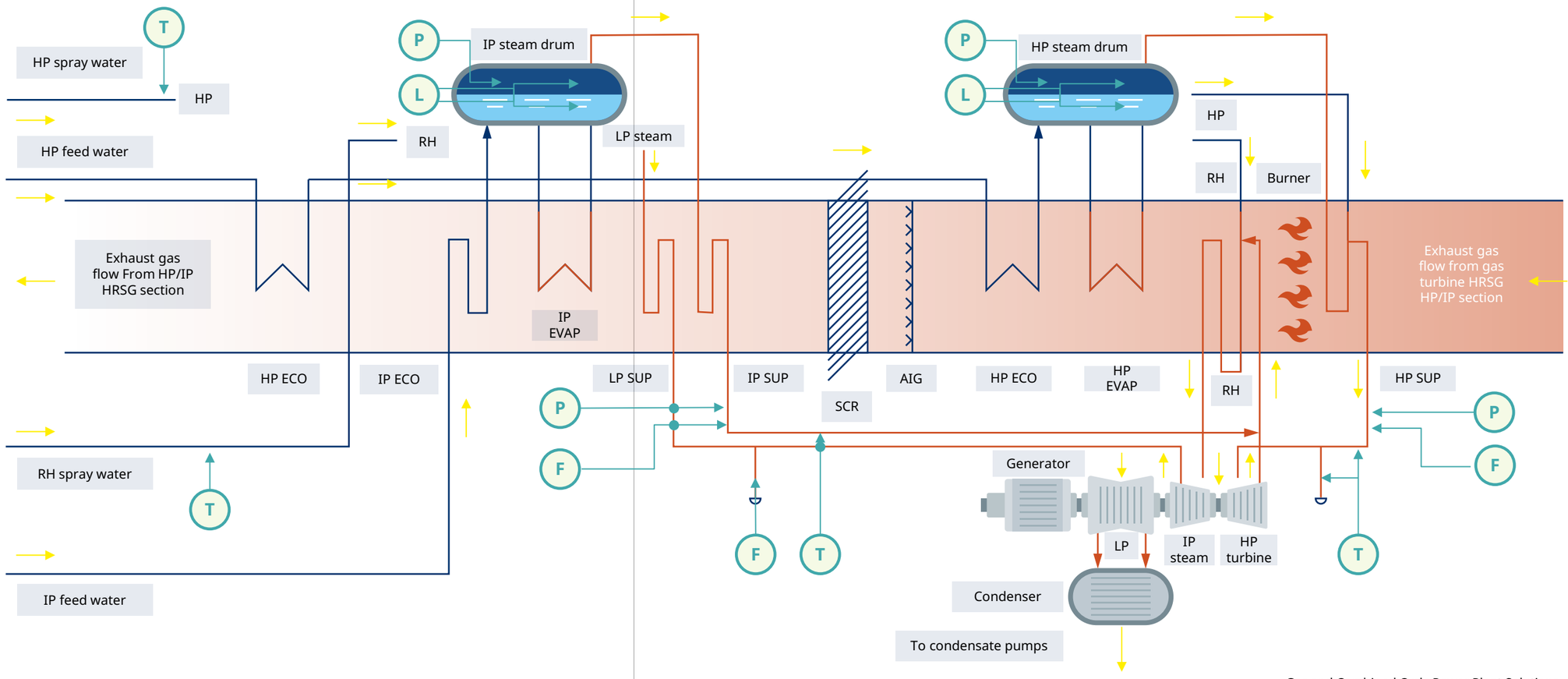
The HRSG transforms hot gas turbine exhaust into useful steam, acting as the vital link between gas and steam turbines. With multiple pressure stages, superheaters, reheaters, and economizers, the HRSG ensures optimal energy transfer while supporting flexible plant operation. This intelligent recovery of waste heat enables combined cycle plants to reach world-class efficiency and sustainability targets. Yokogawa solutions provide precise measurement and control across HRSG sections, ensuring stable steam conditions, safe operation, and higher availability..

Drive plant efficiency with precise HRSG monitoring and control

STEAM DRUM

■ **Steam Drum Level Control**

- It ensures makeup water is added to maintain a stable drum level as steam and blowdown exit, matching water input to steam output to maintain system balance
- The system must hold the drum level at a set point while adapting to changes in steam demand and drum pressure
- The YS1700 Dual Loop Programmable Controller offers an affordable solution for implementing various boiler feedwater control strategies with advanced math, characterization, and dual PID capabilities



STEAM DRUM

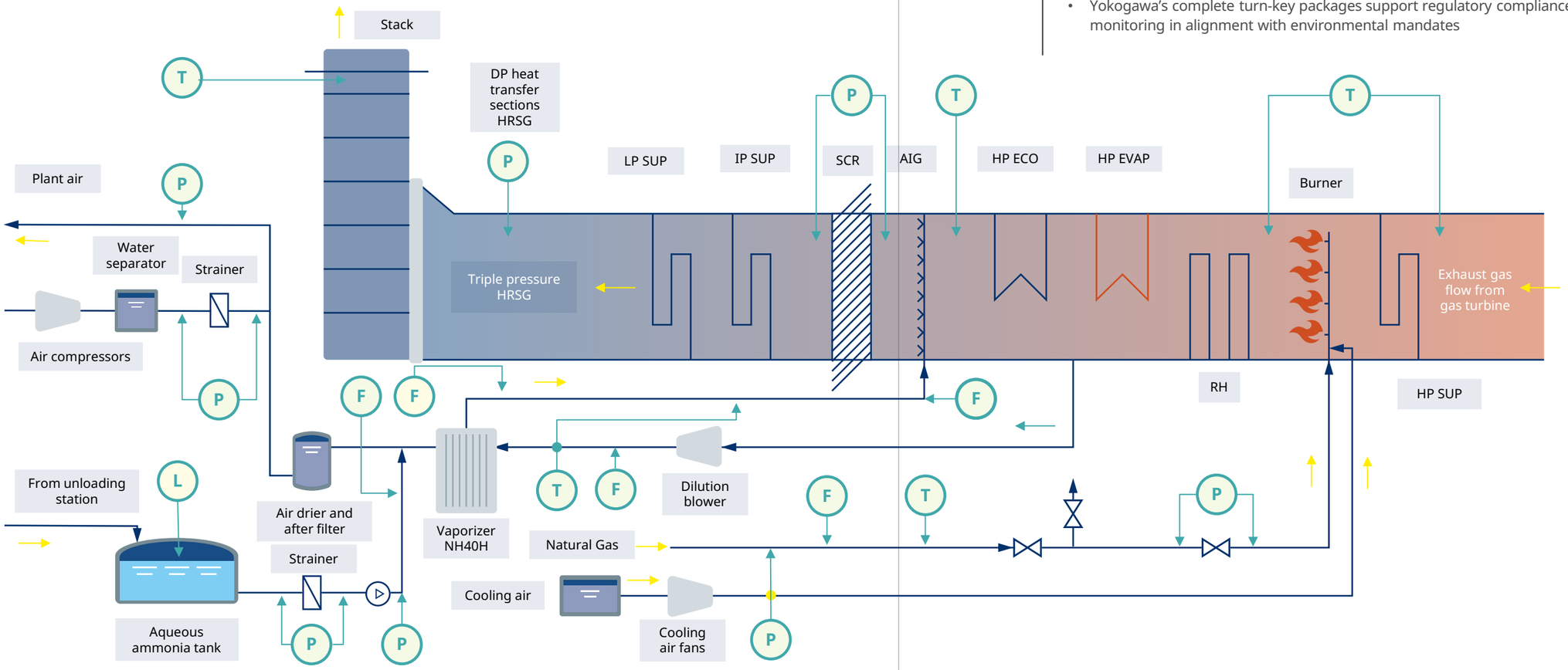
■ **Steam Drum Level Control**

- Accurate drum level measurement is critical, especially under large static pressure changes
- Fluctuating conditions such as temperature, overpressure, and static pressure can compromise measurement stability and reliability
- EJX/EJA series silicon resonant sensor ensures long-term measurement stability with overpressure protection while still maintaining high response time of 95ms

Heat Recovery Steam Generator Exhaust
ensuring compliance with confidence.

Control emissions without sacrificing efficiency.

After delivering its heat to the steam cycle, HRSG exhaust must be safely managed and kept within regulatory limits. Integrated Selective Catalytic Reduction (SCR) systems inject ammonia or urea into the flue gas to reduce NO_x emissions, converting pollutants into harmless nitrogen and water vapor. By operating within the optimal temperature range, SCR technology minimizes environmental impact while maintaining low backpressure on the turbine. Yokogawa's analyzers and controls help plants meet stringent standards, ensuring continuous compliance and reliable performance in one of the most closely monitored steps of the process.



Achieve emissions compliance and operational reliability with Yokogawa

EXHAUST

■ **Emissions Monitoring System for Exhaust**

- CEMS (Continuous Emissions Monitoring Systems) provide reliable and cost-effective solutions for measuring key gas components such as NOx, SO_2, CO_2, CO, and O_2 in exhaust gas streams
- Yokogawa's complete turn-key packages support regulatory compliance by enabling accurate, continuous monitoring in alignment with environmental mandates

EXHAUST

■ **Gas Pressure and Flow**

- The stack pressure measurement is used to ensure the correct draft is established in the stack and prevent excess backpressure to the gas turbine
- A differential pressure measurement across the HRSG stack is used as a key indicator of fouling, debris buildup, or potential tube damage
- In some systems a flue gas direct flow measurement is made for overall mass balance calculations for emissions

Discover more:

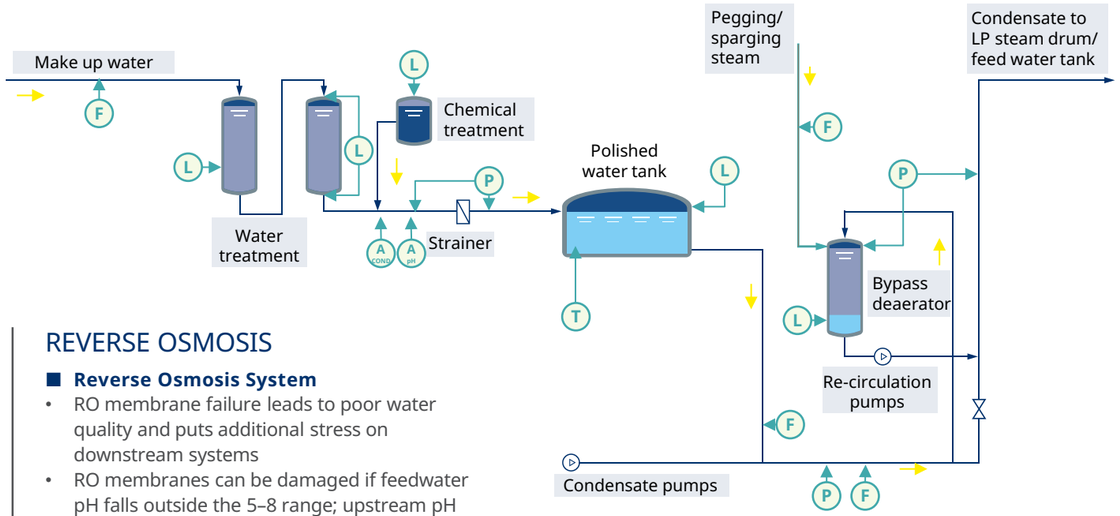
Visit our website at:
Environmental Measurement Solutions

Powering Performance From The Ground Up

Balance of Plant
your control center's strategic heart.

Operate with confidence.

From fuel systems and cooling loops to electrical auxiliaries and grid interfaces, the Balance of Plant encompasses the essential systems that support safe, stable, and efficient operation. Yokogawa's instrumentation and control devices empower operators with real-time visibility, precise automation, and seamless coordination across all subsystems—ensuring your plant stays responsive, resilient, and profitable, even in dynamic grid and market conditions.



REVERSE OSMOSIS

■ Reverse Osmosis System

- RO membrane failure leads to poor water quality and puts additional stress on downstream systems
- RO membranes can be damaged if feedwater pH falls outside the 5–8 range; upstream pH sensors enable control of chemical dosing to keep pH within safe limits
- Conductivity sensors at the RO unit's inlet and outlet assess the system's effectiveness in removing total dissolved solids.

DEMINERALIZER

■ Feedwater Demineralizer Measurement

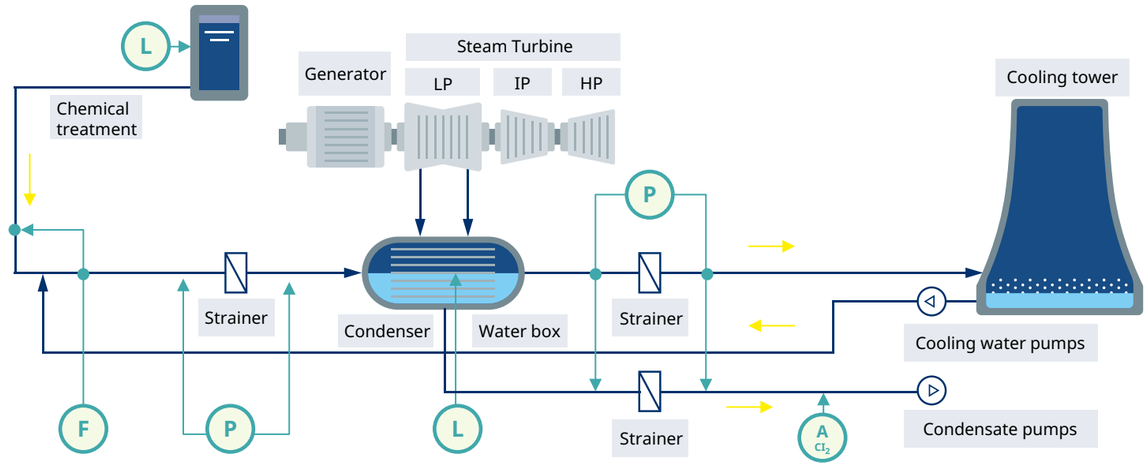
- Deionization (demineralization) process is used to remove dissolved ionic impurities from water to produce high-purity water
- Conductivity is monitored on the inlet and outlet of the bed "across the bed" monitoring to detect ion exchange exhaustion to alert when regeneration is necessary
- Accurate compensation is essential for reliable conductivity readings

FEEDWATER

■ Ultrapure Feedwater Measurement

- Pure water's low conductivity and minimal buffering capacity lead to drifting, non-reproducible pH readings, poor electrode response, high electrical noise susceptibility, and inaccurate temperature compensation
- High purity water causes unstable reference junction potentials and poor hydrogen ion detection by glass electrodes, resulting in erratic readings and slow response times, especially under low flow conditions.
- Yokogawa's all-in-one FU24 sensor features a patented internal bellow that replicates the same performance in UPW as the traditional separate type sensor system

Strength your foundation and extend the life of your assets



PUMP EFFICIENCY

■ Feedwater, Condensate, and Pump Efficiency

- Controlling feedwater flow by adjusting pump speed—using variable-speed drives or steam turbines—is preferred over control valves, as it reduces cavitation-related valve wear, minimizes replacement costs, and improves energy efficiency, especially in cogeneration setups with excess steam.
- Maintaining a constant pressure differential between the boiler drum and feedwater pump discharge improves boiler efficiency and responsiveness to changing electricity demands, requiring precise pressure measurements.

COOLING TOWER

■ Cooling Tower ORP Water Measurement

- Microbial slime—produced by bacteria, fungi, or algae—is a common problem in various aqueous systems such as cooling water. These organisms can lead to pressure loss, corrosion, reduced efficiency, system damage, and increased maintenance and downtime
- To combat microbial growth, biocides and antimicrobials are widely used
- Monitoring the ORP (Oxidation Reduction Potential)/redox is very useful in its ability to correlate millivolt readings to sanitization strength of the water .

Beyond Technology – Uniting Expert Instrumentation with Full-Service Solutions

Solutions for Complex Projects
let Yokogawa be your partner for progress.

The current approach of relying on multiple suppliers for process instrumentation field devices is inherently complex. Managing multiple bid evaluations, communicating with numerous contacts, and coordinating diverse processes and procedures increases effort, leading to inefficiency and heightened project risks.

- By partnering with Yokogawa, you gain a comprehensive solution for all field instrumentation needs, from flow measurement to transmitters to gauges and accessories.
- The best technologies for your project will be sourced from qualified suppliers (even if not manufactured by Yokogawa).
- Yokogawa also provides complete lifecycle services, from FEED to Operation, ensuring seamless support for all products within the project scope.
- In process instrumentation, seamless integration of products, solutions, and services is crucial. Yokogawa is a reliable instrumentation supplier that assumes responsibility for all deliverables, significantly minimizing integration risks.
- Through our strategic alliances and open integration partners, we minimize risks, reduce costs, enhance efficiency, and optimize plant performance.

What is MIV?

A Main Instrument Vendor (MIV) is a partner managing all instrumentation in a project, from design and procurement to installation and support.

Engaging an MIV early ensures standardized instruments, seamless integration, reduced complexity, and expert guidance throughout the project lifecycle, enhancing efficiency and success

With local support teams across North America and a global network of experts in energy and automation, Yokogawa empowers your plant to thrive today—and adapt for tomorrow. **Together, we can build a more intelligent, sustainable, and resilient energy future.**

Discover more:

Visit our website at:
[Main Instrument Vendor]

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Power Industry Solutions Guide

CCPP Edition

			GAS TURBINE					STEAM TURBINE					HSRG					BALANCE OF PLANT										
	Device Model	Measuring Principle	Natural Gas Inlet (Custody Transfer)	Fuel Gas Separation	Air Inlet (Filter)	Turbine Enclosure	Lubrication System	Steam Inlet/Outlet, Bypasss, Reheat Streams	Level Measurement of Condenser	Turbine Enclosure	Feedwater Pump	Lubrication System	Low, Intermediate, and High Pressure Steam Inlet/Outlet	Steam Drum	Steam Drum Blowdown	Exhaust Gas Treatment: SCR	CEMS Measurement	Post Reverse Osmosis	Make-up water	Demineralization (Ion Exchanger) outlet	Chemical Treatment Tank	Polished Water Tank	Condenser	Water to Cooling Tower	Polished Condensate	Deaerator
CONTROLLERS																											
	YS1000 Series	Single loop controller - dosing control												■		■											
DATA AQUISITION																											
	GX10 or GX20 or GM10	Paperless Data Recorder														■											
	GA10	Data logging software (PC)														■											
FLOW																											
	RAMC, RAKD, RAGN	Rotameter																		■	■		■	■		■	
	AXW Series	Magnetic Flowmeter AXW														■			■								
	ROTAMASS TI Series	Coriolis Mass Flow	■	■												■											
	VY Series	Vortex Meter						■					■	■	■								■				
	Multivariable	Orifice Plate						■					■		■									■	■		
LIQUID ANALYSIS																											
	FLXA402	Transmitter / analyzer												■						■	■			■		■	
	FU20	pH potentiometric																		■	■						
	FU20	ORP potentiometric												■													
	SC42/SC4A	Conductivity - inductive																		■							
	DO71	Dissolved oxygen - optical																								■	
	FC800D	Free Chlorine																						■			
GAS ANALYSIS																											
	GD40/GD402	Gas Density				■				■																	
	ZR202/22	CEMS															■										
	IR800G	CEMS															■										
	ASI	CEMS															■										
LEVEL																											
	EJA530E/EJA110E	DP Level		■					■					■		■					■	■	■				■
PRESSURE																											
	EJA510E/EJA530E	Absolute and relative pressure		■	■	■	■	■		■	■	■		■	■	■				■							■
	EJA110E	Differential pressure		■	■											■				■							
TEMPERATURE																											
	YTA610/710	RTD temperature		■	■	■	■	■		■	■	■		■	■	■							■	■	■		
IIoT ASSET MONITORING																											
	XS770A	Sushi Vibration Sensor									■																

Planning to start your next application?

Get a free consultation and estimate from industry experts **yca-salessupport@yokogawa.com**

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