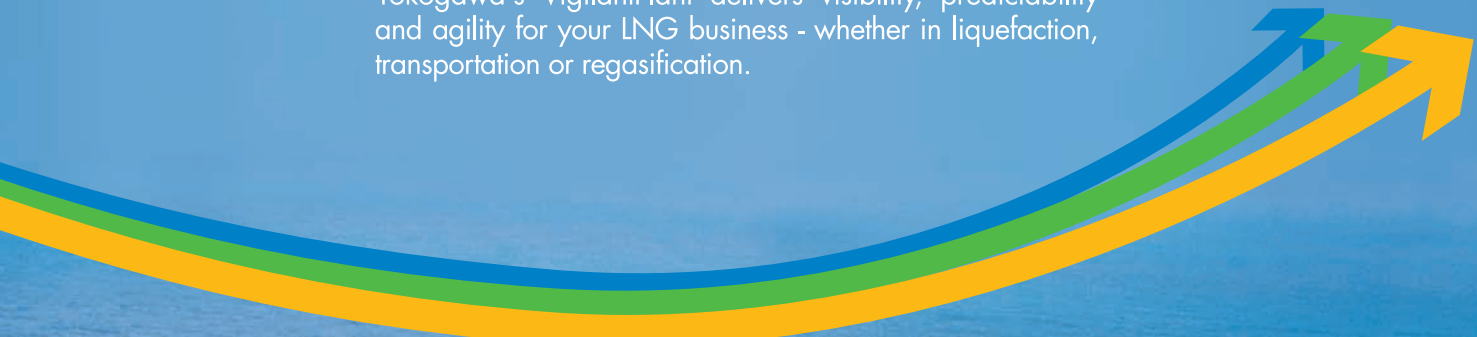


# Yokogawa in the LNG supply chain

Yokogawa's VigilantPlant delivers visibility, predictability and agility for your LNG business - whether in liquefaction, transportation or regasification.



Bulletin 53U01A01-01E



# vigilantplant.®

## The clear path to operational excellence

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 production 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.

*The Tokyo Gas Sodegaura LNG terminal is one of the world's largest.*

*(Total storage capacity 2.66 million m<sup>3</sup>, Total vaporization capacity 28 million tpy)*

*Operations at its two remote berths are fully integrated and automated with a Yokogawa integrated control system.*

*Both can be controlled by a minimal number of operators at a Yokogawa-designed central control room (CCR).*

*The CCR design emphasizes sound ergonomics to reduce operator errors and facilitate the smooth running and control of processes.*



### ACT WITH AGILITY

#### Preempt bottlenecks

Reduce delays, lost opportunities, knowledge silos

Minimize reactive measures, unexpected downtime, quality variations

### Avoid surprises

### KNOW IN ADVANCE



### SEE CLEARLY

#### Reduce blind spots

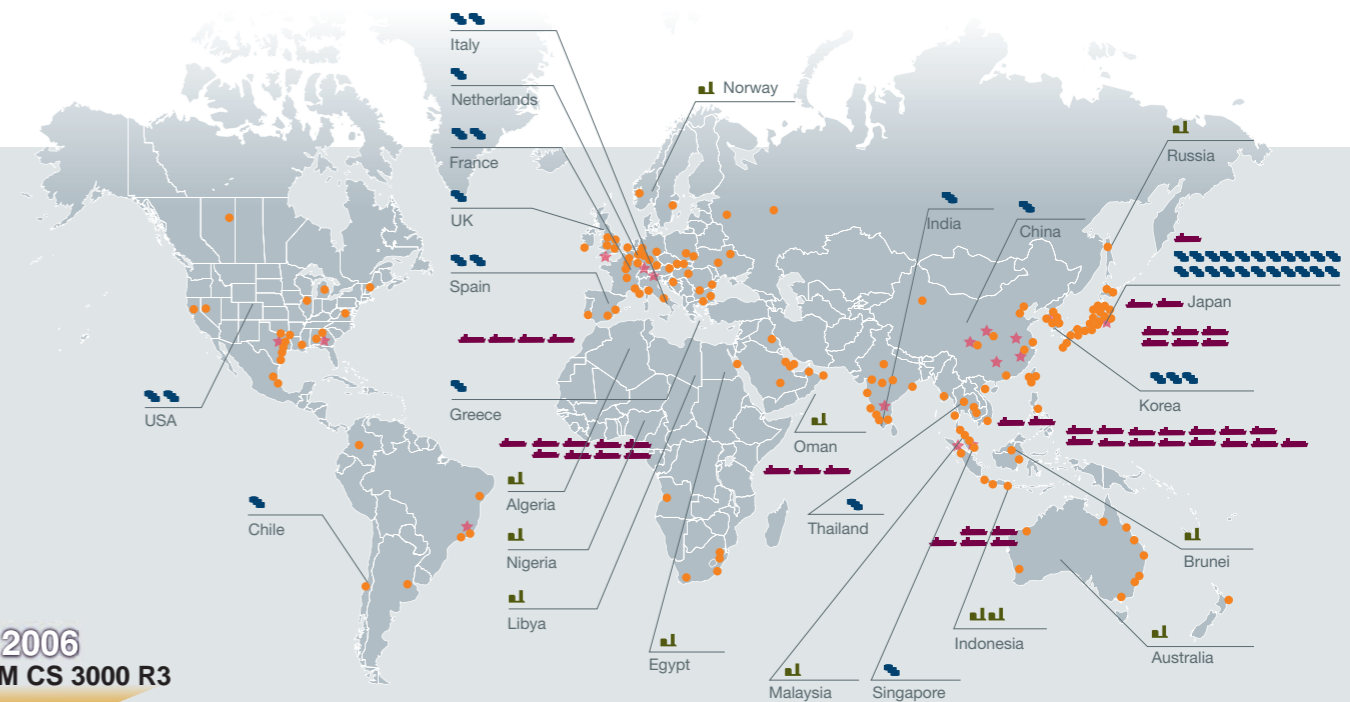
Avoid guesswork, instability, sub-optimization



# Yokogawa is the LNG automation leader.

Yokogawa's commitment to innovation in LNG projects worldwide dates back to the 1970s. With long experience and a comprehensive portfolio of solutions, Yokogawa has what it takes to achieve operational excellence in the LNG supply chain.

-  36% of Liquefaction Plants with Yokogawa APC
-  25% of Liquefaction Plants with Yokogawa DCS
-  47 LNG Carriers with Yokogawa DCS
-  41 Regasification Terminals with Yokogawa DCS
-  Yokogawa Service Office



## Over 30 years' LNG experience

**“We can replace control system without interrupting city gas production.”**

Yokogawa has more than 30 years of experience in executing LNG projects, and has acquired significant engineering know-how. We know how to replace control systems without interrupting city gas production. We can ensure a seamless migration path and supply a full range of implementation services.

**“Once you bring a tank down to the right temperature, it stays there.”**

The temperature inside an LNG tank is kept at a constant -162°C. If there is a long interruption in gas production and enough LNG is lost as boil-off gas (BOG), the temperature inside the tank will begin to rise, this will eventually “hot-up” to the ambient temperature and the tank will have to undergo an expensive, time-consuming initialization process to cool it down again to -162°C. Tanks remain in use for 50-60 years. On the other hand, control systems have a relatively much shorter lifecycle. Assuming a lifecycle of 20 years, the control system will need to be replaced at least twice. We have a great deal of experience doing hot cutover replacement of DCSs. Once we bring a tank down to the right temperature, it stays there.



Upgrade



Tokyo Gas  
Sodegaura

Hot cutover



## Over 80 projects worldwide

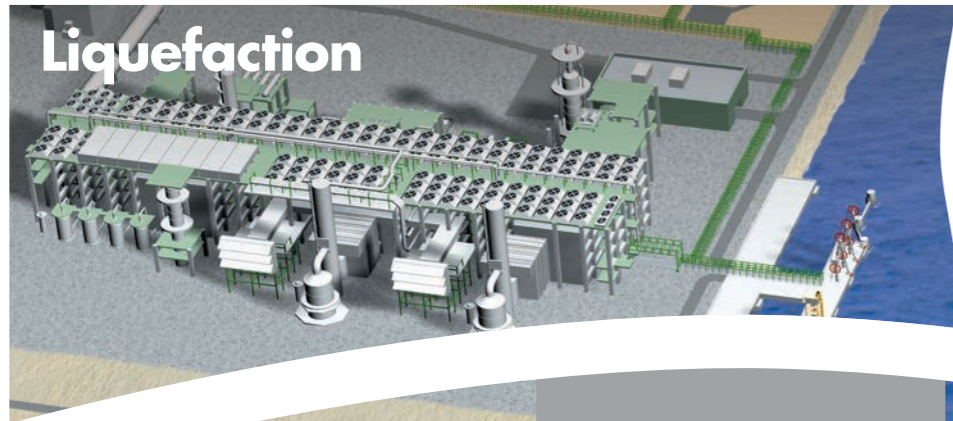
We are a world class automation leader and companies all over the world turn to us for our solutions. With our global experience in LNG, we can help you increase revenue, reduce cost, and improve safety. Yokogawa's VigilantPlant solutions bring you long-term success.

## Services for a lifetime of plant efficiency

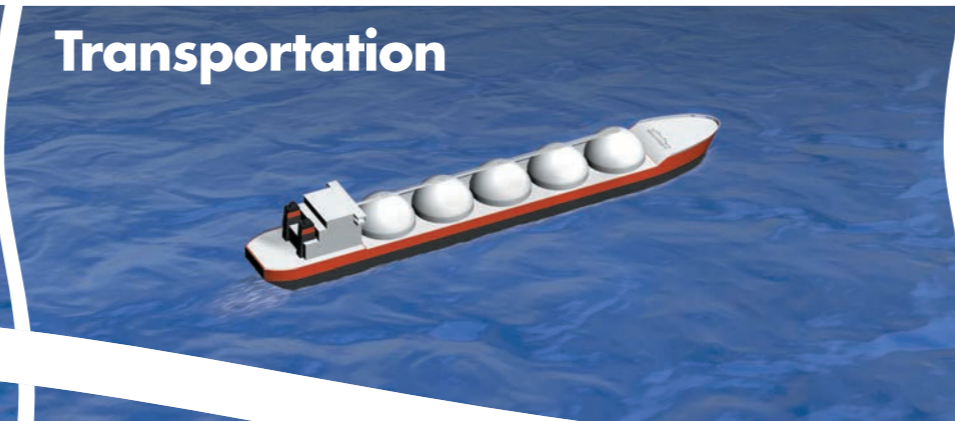
We are experts at finding the right solutions to keep your plant running at optimum efficiency. The more we get to know you and your operations, the better the solutions we can provide to maintain and improve your plant over the long term. Our services ensure your plant operates efficiently over its entire lifecycle. We deliver solutions for your plant's design, installation, operation, maintenance, and revamping needs.



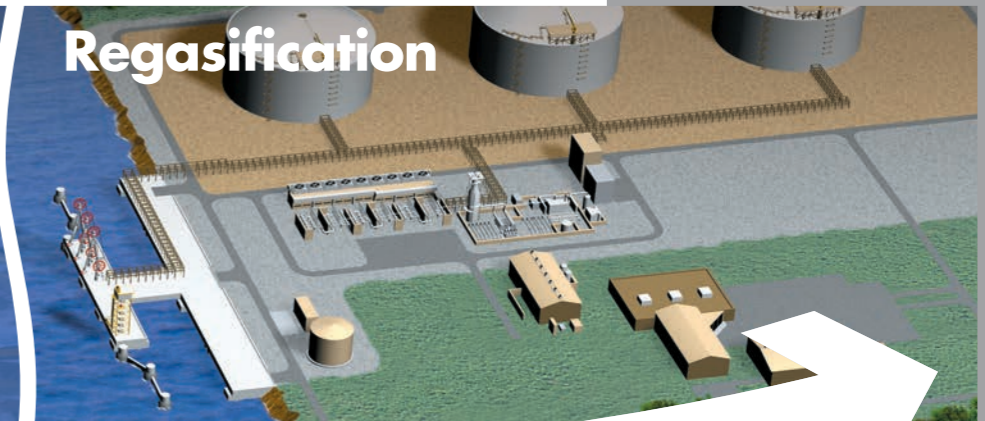
# Real Stories in the LNG Supply Chain



**Liquefaction**



**Transportation**



**Regasification**

## Project Reference Indonesia

Yokogawa has successfully completed the Trains A-D DCS Retrofit & Instrumentation Upgrade Project at PT Badak NGL in 2002. The objective of this project was to upgrade from conventional analog control instruments to the Distributed Control System (DCS) and supply of subsystems, for four (4) LNG process trains, associated utilities and offsite, which aims for life extension and reliability enhancements. The cut-over from the existing to the new was conducted by the combination of hot-cut-over and cold-cut-over. As for the DCS, the cut-over of 14,810 I/O points was completed in just 13 months. As a result of the project, the plant operation efficiency improved providing energy conservation, and improvement of the operability due to the new technology.

## 25% of liquefaction plants are controlled by Yokogawa DCS

To keep up with the ever increasing demand for LNG, forward-looking LNG liquefaction plants are investing in capacity expansion through modernization and upgrade of their physical plant assets. The challenge is to execute such revamp and expansion projects with minimum disruption to the ongoing LNG production, upholding the long-term gas supply contracts these plants typically have. Increasingly, LNG liquefaction plants are partnering with Yokogawa to gain access to its hands-on expertise and extensive global service network.



## Project Reference Malaysia

Yokogawa is now executing the Tenaga Fleet DCS Project for Malaysia International Shipping Corp Bhd. for their five LNG carriers. The objective of the project is to upgrade the existing conventional control instruments to the Distributed Control System (DCS), which aims for the life extension and the efficiency improvements of the cargo controls and the machinery controls including Automatic Boiler Combustion (ABC) and Burner Management System (BMS). Yokogawa also supplies field instruments and other

## 47 LNG carriers worldwide are powered by Yokogawa

Continuous improvement of carrier performance is another key path to operational excellence in LNG transportation. Proactive life-cycle management with an optimum mix of maintenance and retrofitting ensures efficient carrier performance. More and more, leading transportation companies are partnering with Yokogawa to benefit from its global capabilities and resources for the delivery of life-cycle services.

subsystems related to the control. Although the delivery of the system for the first ship was only 8 months from order intake with 3 months refurbishment work at the dockyard, the first ship has successfully been completed on schedule. As a result of the project, not only improvement of the operability has been realized due to the new technology, but also efficient boiler operation and fuel consumption both during 100% FO burning and dual firing have been improved.

## Project Reference Japan

Yokogawa is now executing the system upgrading project at Senboku LNG Terminal 1 of Osaka Gas. The project objective is to achieve the integration of the entire operation, by migrating the old generation DCS to the new DCS for the regasification plant as well as by accommodating control functions of other related plants. The cut-over work is conducted online while the plant continues regasification. Unique but proven methods such as utilizing the existing DCS cubicles helps meet the customer's requirement to assure continuous safe plant operation during the migration period. Yokogawa's rich experiences in such migration projects in the LNG regasification terminals was the key criteria to select Yokogawa. The integration of the various control and monitoring systems into one system will contribute to the improvement of the operability, and the increased system capacity will enable control function improvements and will give opportunities for future expansion.

## 41 regasification terminals are controlled by Yokogawa DCS

A forerunner in LNG automation, Yokogawa first introduced computerized control systems for regasification plants in the 1970s and has earned the trust of customers worldwide. Progressive terminal companies are partnering with Yokogawa for seamless migration solutions that ensure their long-term success.





# Yokogawa Benefits to LNG

## How Yokogawa Impacts Your LNG Business

Long-Term Business Success

Revenue

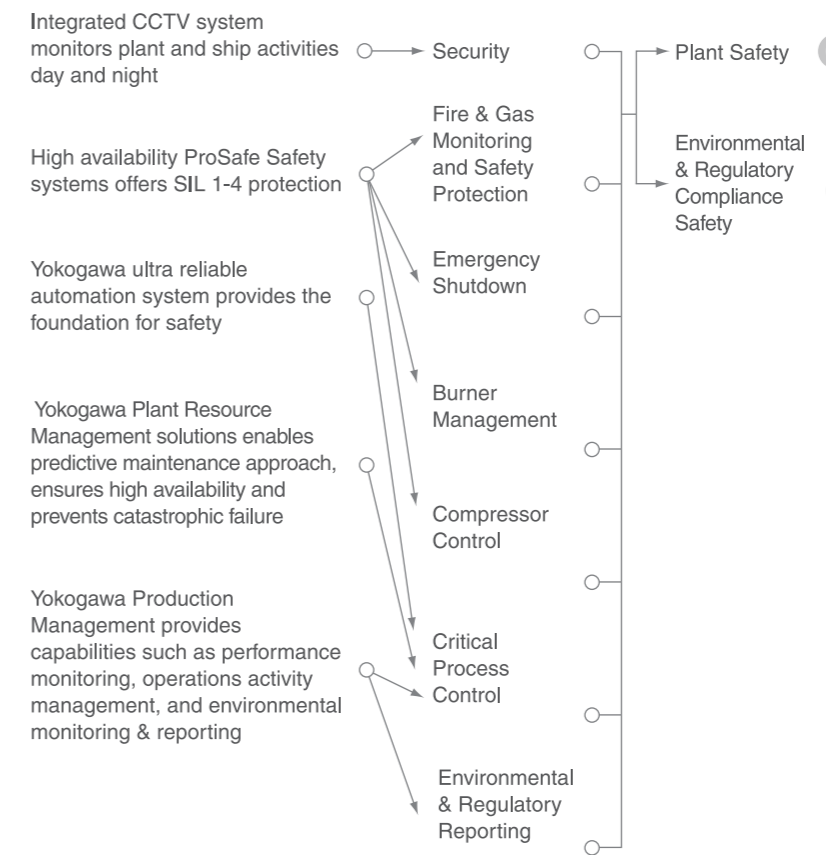
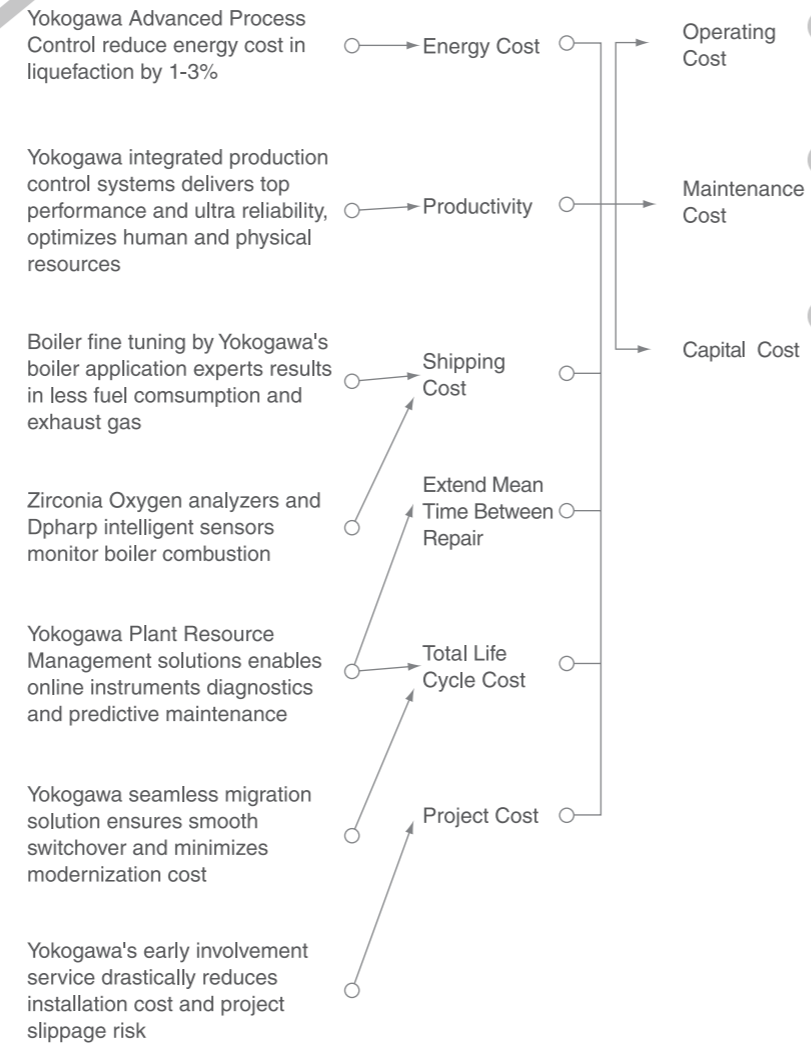
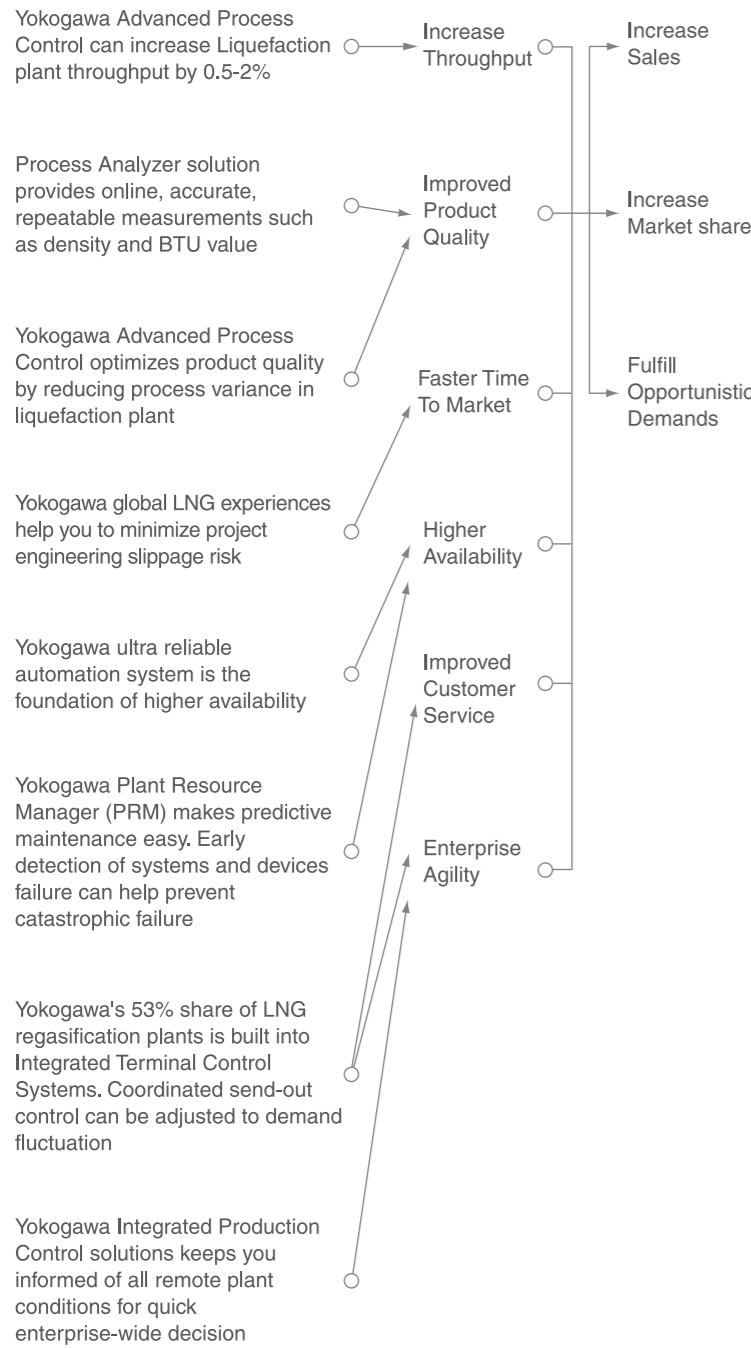
Cost

Safety

Increase Revenue

Reduce Cost

Improve Safety

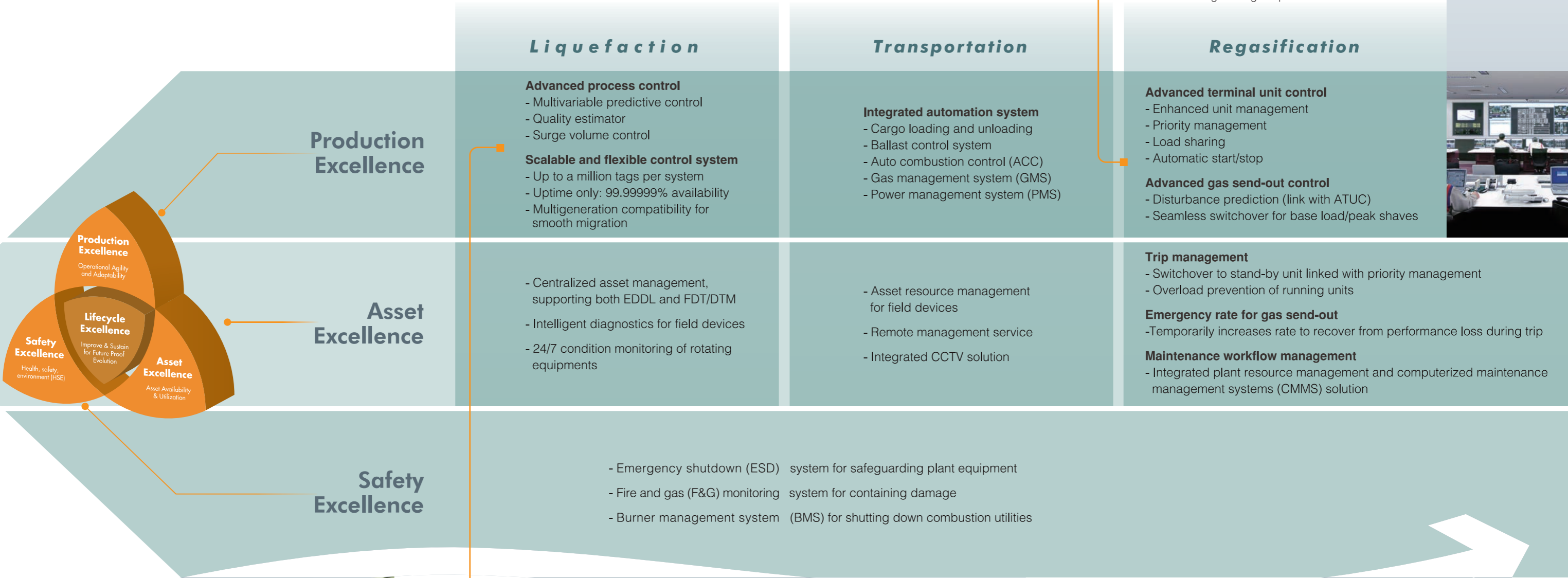


# Yokogawa's wide-ranging applications experience

Based on a long and very well established track record in the LNG field, Yokogawa's experts possess a wealth of high-level control knowledge. Planning as far as 50 years ahead, Yokogawa can propose cutting-edge LNG control solutions.

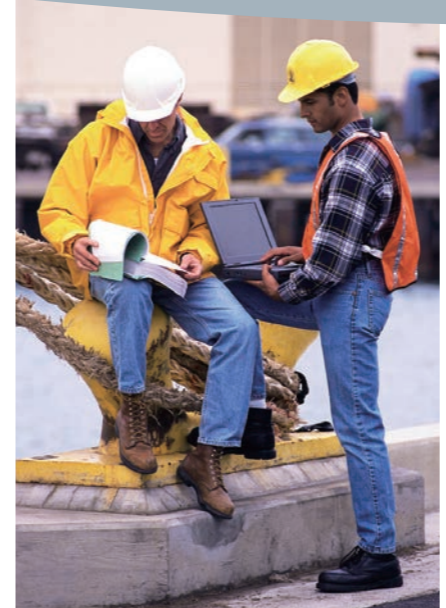
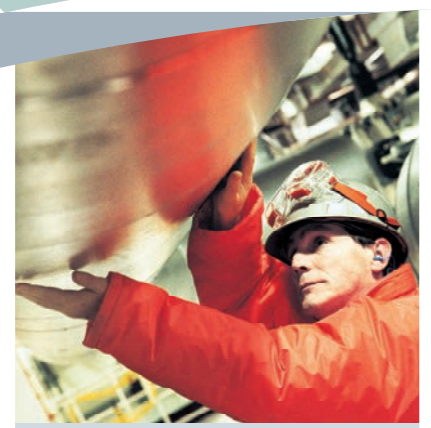
## Advanced terminal unit control and advanced gas send-out control

Field-proven enhanced unit management (EUM) simplifies operator decision making during the startup and shutdown of major plant assets, thus preventing inconsistent operational conditions. Through EUM concepts such as optimized load sharing, our customers can increase the operational efficiency and lifespan of major plant equipment. Advanced terminal unit control (ATUC) greatly improves the stability of gas send-out by anticipating disturbances such as the switching off of a pump by an operator. Simple continuous feedback control can also respond to the disturbance but time is needed to recover and loss always occurs. Only Yokogawa offers ATUC. A VigilantPlant library of ATUC and other engineering templates are also available.



## Advanced process control

LNG plants have to meet annual production targets whilst responding to fluctuating demand for LNG, maximizing production when demand is at a peak and maximizing energy efficiency during periods of lean demand. In addition, fluctuating product prices are driving plant managers to maximize production of either LPG or LNG. Such frequent changes in operating strategies can be easily managed with advanced process control (APC). Loose control of LPG and LNG specifications can result in either off-specification or product giveaway. The penalties for off-specification products can be severe. Consequently, most plants operate above the minimum specifications. APC stabilizes a plant and enables it to be operated closer to the minimum specifications. The application of APC can be of significant benefit for LNG plants. Projects have shown an attractive return on investment, a remarkable improvement in the stability of plant operation, and a very significant reduction in manual interventions.



## Floating LNG (FLNG) & floating storage regasification unit (FSRU)

Years of study have shown that large floating production, storage, and off-loading (FPSO) vessels are increasingly feasible solutions for LNG projects. Even though offshore and onshore natural gas liquefaction and regasification plants have different requirements, both must rely on proven liquefaction and regasification processes. Ballast and cargo loading/unloading control are also very similar on LNG carriers. Based on its rich LNG liquefaction, regasification, and carrier experience and its expertise in various kinds of floating production systems, Yokogawa is confident in its ability to provide a full range of production management, asset management, safety management, power management, and compressor control solutions for FLNG and FSRU projects.



# Yokogawa's key enablers for LNG supply chain

Yokogawa VigilantPlant solutions help you to Measure, Control, and Optimize your processes, ensuring plant-wide integration.

## Liquefaction

## Transportation

## Regasification

Operator training system



**OmegaLand**

OmegaLand provides a virtual plant simulation environment for training operator of integrated DCSs and safety systems.

Plant information management system



**Exaquantum**

Exaquantum functions as a data historian and an interface to the terminal access system which serves as a bridge between the process control system and the corporate information system.

Advanced process control

- Multivariable predictive control **Exasmoc**
- Quality estimator **Exarqe**
- Surge volume control **Exacoast**

Plant asset management



**PRM**  
Plant Resource Manager

PRM provides a consolidated supervisory window for viewing critical machinery assets and field devices.

Optimize

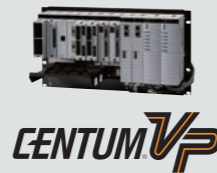
## Wide-ranging applications experience

With its long experience in this field and comprehensive portfolio of solutions, Yokogawa has what it takes to achieve operational excellence in the LNG supply chain.

Control

Flow computer

STARDOM performs AGA-compliant calculation of standard gas volume.



Integrated control and safety system (ICSS)

The single ICSS database simplifies engineering. With graphics, alarm windows, and system status screens all having the same look and feel, operation is also easier.



Flow computer

STARDOM performs AGA-compliant calculation of standard gas volume.



Measure

Gas chromatographs  
**GC8000**



The GC8000 measures composition and has a built-in function for calculating BTU.

Zirconia oxygen analyzers  
**EXAXI**



Zirconia analyzers measure O<sub>2</sub> concentrations in boiler exhaust gas to ensure compliance with SO<sub>x</sub> emission standards.

Gas chromatographs  
**GC8000**



The GC8000 measures composition and has a built-in function for calculating Wobbe Index.

**VTA Series**  
Temperature transmitters



**DPHarp**  
Pressure transmitters



Transmitters & Flowmeters

**digitalYEWFLO**  
Vortex flowmeter



**ROTAMASS**  
Coriolis mass flowmeter



# Services for a lifetime of plant efficiency

## 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.

- | Front-End Engineering & Design (FEED)
- | Main Instrumentation Vendor (MIV) Services



*"Commitment to working as a team"*

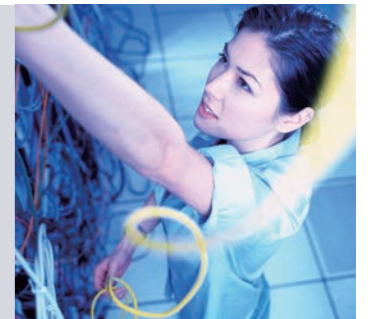
**Jim Rawlings, ICS Specialist**  
Burullus Gas Co., Egypt

"Yokogawa's commitment to working as a team resulted in an understanding of the project aims and objectives from the outset."

## 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.

- | Site Engineering
- | Site Acceptance Test (SAT)
- | Integration Tests
- | Turn-Key Services



*"Dependable experts are just one call away"*

**Mr. Bennie Coetzer, Process Control Engineer Polypropylene,**  
Dow Plastics Southern Africa

"Yokogawa system reliability is excellent, we are very satisfied with the exceptional quality. Even better is Yokogawa services. Dependable experts are just one call away."

## 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.

- | Optimization Consulting
- | 24/7 Operations Support
- | Online Diagnosis Support



## Revamp and Expansion

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.

- | Online Expansion
- | Hot Cutover



*"Indeed a vigilant company"*

**Tom Nobes, Senior CEI Engineer**  
British Nuclear Group, United Kingdom

"A great benefit is that we can count on high-quality services delivered by qualified professionals, who help us solve our instrumentation problems, not just sell us equipments."

## 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.

- | Asset Optimization
- | Lifecycle Solution
- | Online Upgrade
- | Support



*"Stabilize operation, maximize throughput"*

**Jeeranee Theeranuwat, Assistant Vice President,**  
The Aromatics (Thailand) Public Company Limited

"Our APC uptime last year was 99.8%. We look forward to more technology/service from Yokogawa."





The clear path to operational excellence

## "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 the LNG supply chain.

VigilantPlant excels at bringing out the best in your plant and your people – keeping the fully aware, well informed, and ready to face the next challenge.



The clear path to operational excellence



VigilantPlant is Yokogawa's automation concept for safe, reliable, and profitable plant operations. VigilantPlant aims to enable an ongoing state of Operational Excellence where plant personnel are watchful and attentive, well-informed, and ready to take actions that optimize plant and business performance.

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