



OpreX™ Control and Safety System

High-Integrity Pressure Protection System

Total solutions for HIPPS requirements



A High Integrity Protection System - or HIPPS - is a specially designed safety system that acts as the last line of defense in high risk and critical situations.

Fully autonomous, the HIPPS continuously monitors safety parameters to safeguard the process, the plant equipment, and the wider environment. If gas pressure becomes too high, the HIPPS automatically closes safety valves to bring the system to a safe state.

A HIPPS continuously monitors process parameters, logically combining measured values to determine whether process intervention is required.

In order to ensure that the HIPPS will intervene if - and only if - the safety of the related system is no longer guaranteed, the system must operate to an extremely high Safety Integrity Level or SIL.



The known availability and reliability provided by the HIPPS gives the whole of the plant the confidence of knowing that it is protected during both normal and extreme process operations. The HIPPS will act, automatically, to prevent damage, casualties, penalties, and extended production shutdowns.

Well Head Control Solutions

High-Integrity Pressure Protection System (HIPPS)

YOKOGAWA 
Co-Innovating tomorrow™

A High Integrity Protection System - or HIPPS - is a specially designed safety system that acts as the last line of defense in high risk and critical situations. Fully autonomous, the HIPPS continuously monitors safety parameters to safeguard personnel, the process, plant equipment, and the wider environment. To guarantee the proper functioning of these systems, the Safety Integrity Level of a HIPPS can be certified for applications up to SIL 4. This is the highest SIL level and guarantees an extremely reliable and highly available protection system at one of the most critical plant locations.

Typically, a HIPPS will monitor pressure and temperature parameters. Based on the actual value of these parameters, decisions are made to stop the process or — in extreme situations — initiate a total shutdown.

Installing a HIPPS may well avoid the need to emit large amounts of carbon dioxide, hydrocarbons and other toxic gases to the atmosphere by blow-off or flare - actions which may now incur penalties, under government regulations and restrictions.

A HIPPS provides a low-cost solution for a high level of protection:

- No release of large volumes of toxic gas
- No - or less - use of the flare installation
- Less - or no - damage to equipment
- No extended shutdown due to damage
- No casualties and less personal risk

A total Solution for HIPPS requirement...



...the most reliable design

The NAM-GLT field in The Netherlands produces around 30 billion m3 of gas a year. The design, construction and ongoing maintenance of all 29 gas production locations in this vast installation are the responsibility of Stork-GLT.

Reliability and maintainability is paramount, and is reflected in many aspects of the instrumentation and control design. Features include advanced redundancy techniques, remote diagnostics, a data warehouse and a plant information management system. Plus, a HIPPS system from the Yokogawa SCE ProSafe-SLS family — installed in all 29 production locations.

High-Integrity Pressure Protection System (HIPPS)

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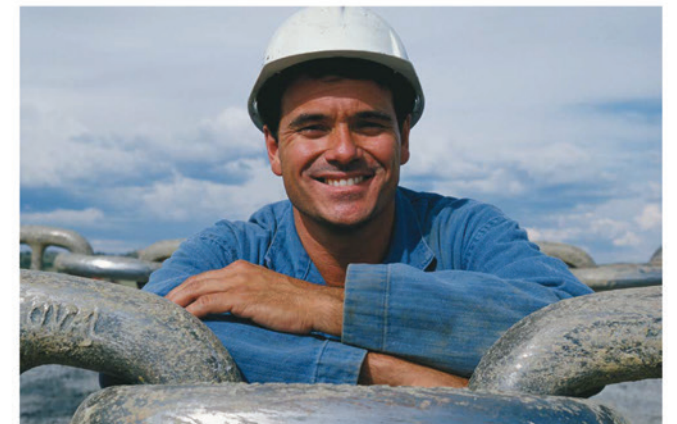
A chain is only as strong as the weakest link

That's never truer than in safety application, and that's why a SIL applies to the entire loop, not just sections of it. For HIPPS applications, this means that the entire safety system is part of the SIL approval: from transmitters, through the logic solver, to the safety valves.

The design and certification of a safety chain is a job for specialists. Nobody wants to pay for an oversized chain, or a false sense of security, and Yokogawa draws on many years of experience to deliver robust and proven solutions for total safety applications.

A total safety system will incorporate all these elements:

- HIPPS, the simplified loop
- Manifolds
- Transmitters
- The logic solver
- Solenoids and HIPPS Valves
- Communication and event registration
- Plant Resource Manager (PRM)
- Partial stroke testing



One responsibility

Yokogawa offers the complete solution, to meet your HIPPS requirements. Our experienced safety expert team can assist you in defining the specifications by writing the Front End Engineering and Design (FEED) specification, for example. Our High Integrity Safety System combines best of breed, quality products in a very price competitive solution.

The heart of the HIPPS system, the logic solver, is provided by our inherently fail-safe ProSafe-SLS. (And our 40-plus years of experience means that ProSafe-SLS performs at a much higher level than theoretical calculated values.)

A HIPPS solution demands a 'one responsibility' approach covering all the requirements, to achieve a balanced solution within the constraints of safety and functionality.

HIPPS - the simplified loop

The nearby schematic shows the most important elements and interconnections in the architecture of a typical HIPPS system. The whole system is designed to meet the required SIL and the Process Safety Time of a specific application. To meet this protection level for the entire safety loop, the parameters for the various safety components must be evaluated, allowing the SIL of the HIPPS system to be defined as SIL2, SIL3, or even SIL4.

A typical HIPPS will require a SIL3 level. The contributions to the SIL to the three safety sections - transmitters, logic solver and valves — are 15%, 10% and 75%.

Up to SIL2 levels, a standard PLC system might satisfy the application. However, in order to provide the operation integrity needed for SIL3 or SIL4 a ProSafe-SLS system is the most appropriate logic solver.

Manifolds

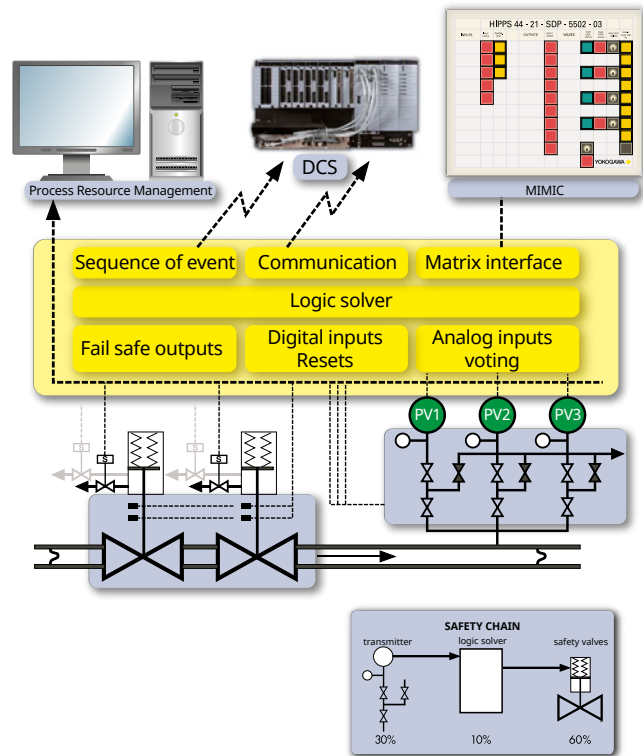
A manifold, in this context, is a mechanical structure that enables proof testing during operation. In this safety application, a manifold is used to provide a double-block-and-bleed interlock function, and to mount multiple transmitters for redundancy. (In this typical HIPPS system, a 2 out of 3 voting solution — or 2oo3 — is established.)

To prevent the disconnection of more than one transmitter at a time, mechanical interlocking between transmitters is employed. This interlocking device is equipped with integral limit switches to monitor the position of the interlock. This allows test pressure to be applied to one particular transmitter, for maintenance purposes. Clearly, all the devices employed must be certified to meet the required SIL.

Transmitters

Transmitters convert a measured value, such as pressure or temperature, to an analogue electrical value (4-20mA). The HIPPS monitors these measurements.

The transmitter has to meet (as a minimum) all requirements for a single instrument in a SIL2 loop. In the case of a SIL3 loop, at least two transmitters



will be used, to meet fault tolerance requirements. For any transmitter configuration, specific information is required, such as the Probability of Failure on Demand (PFD) and the Safe Failure Fraction (SFF).

A transmitter can be defined as a Type B component (which is a 'complex' system with a microcontroller or programmable logic). This kind of transmitter may have accumulated millions of hours of field usage over many years, but due to the single fault tolerance demanded for SIL3, the system will require a 2oo3 configuration.

Logic Solver

A logic solver is an electric safety system that combines digital and analogue signals to monitor the status of the HIPPS inputs and determine if a safety valve has to be closed.

The logic solver normally operates fully autonomously. After many years of experience, particularly in hard wired safety systems, Yokogawa can guarantee a smart, efficient and safe design. Each HIPPS is delivered with a dedicated certificate, incorporating the safety and availability figures for that particular system.

It all adds up to very simple functionality: if the pressure is too high, the valve will close to bring the system to a safe state.

Solenoids and HIPPS Valves

A solenoid is normally used to control HIPPS valves. These solenoids are electric valves, which energize the HIPPS hydraulically, pneumatically, or by process gas. HIPPS valves feature spring return mechanisms, and close if the solenoid de-energizes. The execution time of the entire system must be less than the process safety time, in order to prevent damage to equipment and additional risks.

Partial stroke testing

Every test done on a HIPPS will have to prove at least two criteria: its ability to close, and confirmation of closing within the specified time. Although partial stroke testing can be useful for maintenance purposes, using it to increase the safety performance of a HIPPS should be considered carefully. Also, it should be noted that a partial stroke test can not replace a full stroke test.



Communication

HIPPS solutions are always part of a total instrumentation system. Good communications - especially good information for the operator - is essential to modern plant control, so the total HIPPS solution supports this requirement. A sequence of events is maintained, allowing staff to determine whether the HIPPS is operating as intended and reducing the requirements for special testing. Due to the hardwired functionality, cyber security measures like firewalls etc are not required.

Plant Resource Manager

PRM or Asset Management is a dynamic software tool that supports the daily business activities of maintenance personnel. The Plant Resource Manager Package for the digital network era of fieldbus efficiently handles field device management and maintenance work for the FOUNDATION fieldbus and HART devices, which helps reduce Total Cost of Ownership in the plant. Incorporating the transmitters and, if present for example for partial stroke testing or valve signatures, valve positioners can be a valuable addition to the HIPPS functionality and especially maintainability.

Pressure protection method

The typical pressure at the well exit of 600# ANSI can easily increase up to 2500# ANSI. In the context of the exploration of a high capacity well connected with a large pipe, this kind of fluctuation is extremely dangerous.

To protect the process against such pressure fluctuations, a common strategy is to install a cascade of independent layers of protections. This cascade can consist of:

- A pressure control system to maintain the process within its normal operating limits.
- A HIPPS that will act on high pressure immediately, if the control system fails.
- A pressure relief valve to direct the overpressure to a vent or flare system.

Where high capacity wells and large pipe diameters are concerned, the use of relief valves and flare installations to match the full capacity of the well is not desirable. A HIPPS provides a better alternative, for ensuring the required level of safety. In those applications only a small relief valve need be installed, for manual depressurization during maintenance.

The implementation of a HIPPS system will result in considerable cost savings from, for example:

- A reduced design pressure level for the process piping, vessels and so on
- No requirement for flaring - which means fewer government penalties.



ProSafe-SLS logic solver in a HIPPS loop

The logic solver is one of the three basic safety elements in a HIPPS loop. It is here that field information is logically combined, to determine if a protection action has to be executed.

The SLS technology used in the ProSafe-SLS system is a proven technology that combines a high Safety Integrity Level with a very high level of availability. These specifications, plus the fact that the ProSafe-SLS system is an inherently safe system, means that all possible internal faults or defects will lead to a safe operation - making ProSafe-SLS the logic solver of choice for many HIPPS systems, in many configurations.

Safety

It has been proven that the highest Safety Integrity Level SIL4 can be achieved by using redundant transmitters, redundant safety valves and a single ProSafe-SLS system as logic solver. The SIL levels are specified in the IEC 61508 standard, the industrial safety standard.

Testability

The ProSafe-SLS system is an inherent self-testing safety system; external equipment such as transmitters and valves must be tested periodically in a semi-automated manner.

Availability

A single ProSafe-SLS systems already provides high availability: applying redundancy for fault tolerance in the ProSafe-SLS will only contribute significantly to higher availability if multiple sensors and valves are also used.

Interface capabilities

A communication system is available, to allow operators to check the status of the ProSafe-SLS system. The ProSafe-COM system communicates with external equipment - non safety applications, like a DCS system, a Human Machine Interface (HMI) or an event recorder - via the Modbus protocol. Information is transferred with a time tag accurate to within 1 millisecond of each event.

The Human Machine Interface

The HMI shows the status of the HIPPS and all field devices. This can be visualized in various ways, from a conventional MIMIC screen up to a SCADA application. Various other applications can be added, such as an event-data history of an override section and a testing sequence system, to ensure that the HMI provides a fully integrated view of the safety system, where all actions are traceable.

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.

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.

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

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."

"Dependable experts are just one call away"

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

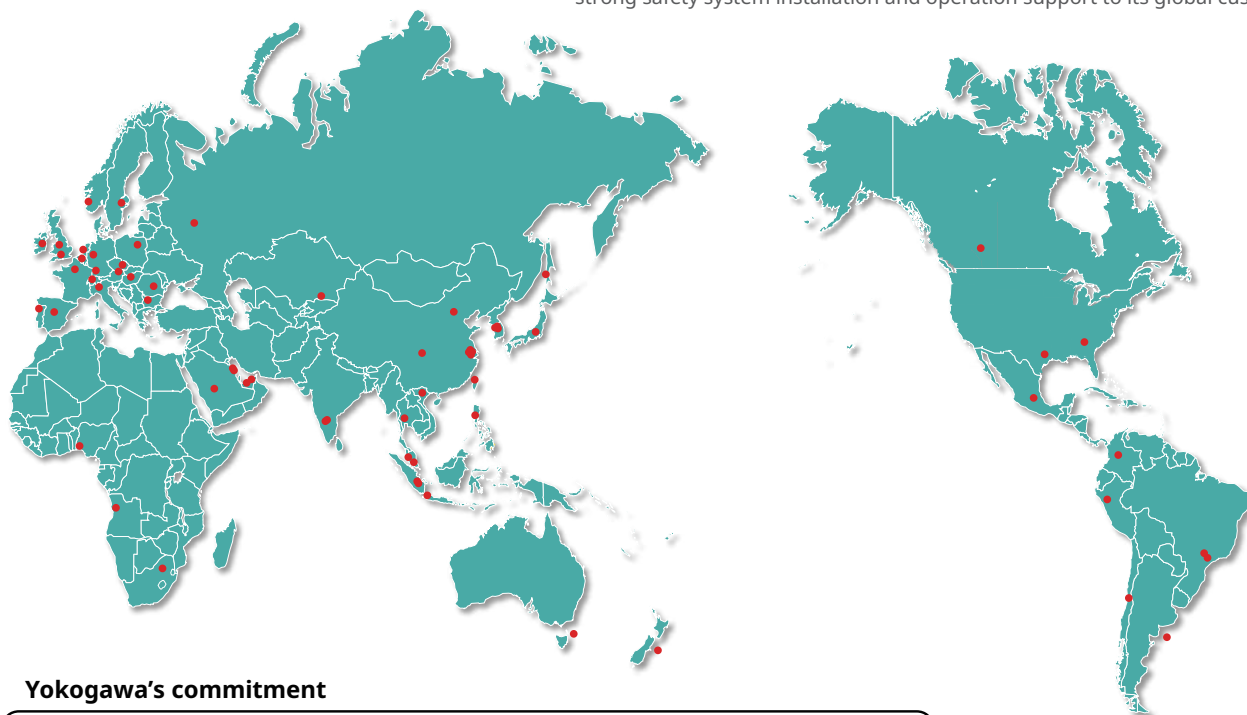
"Yokogawa system reliability is excellent, we are very satisfied with the exceptional quality. Even better is Yokogawa services. Dependable experts are just one call away."

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.

The Best Lifecycle Support

Not only have our products been certified according to international safety standards, they are backed by the safety expertise of Yokogawa Group engineers at certified offices and facilities worldwide. With this organization, Yokogawa provides strong safety system installation and operation support to its global customer base.



Yokogawa's commitment

Yokogawa's system platforms combined with proven execution experience provide the highest quality and innovative solutions for secure 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.

YOKOGAWA ELECTRIC CORPORATION

World Headquarters

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

YOKOGAWA CORPORATION OF AMERICA

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

YOKOGAWA EUROPE B.V.

Euroweg 2, 3825 HD Amersfoort, The Netherlands
<https://www.yokogawa.com/eu/>

YOKOGAWA ENGINEERING ASIA PTE. LTD.

5 Bedok South Road, Singapore 469270, Singapore
<https://www.yokogawa.com/sg/>

YOKOGAWA CHINA CO., LTD.

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

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

P.O. Box 10070, Unit A7, Building 1320, Road 1516, Block 115, BIIP, Al-Hidd, Kingdom of Bahrain
<https://www.yokogawa.com/bh/>

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