MITSUBISHI POWER

DIASYS Netmation 4S

DCS:Distributed Control System

TOMONI™

MOVE THE WORLD FORW>RD MITSUBISHI HEAVY INDUSTRIES GROUP

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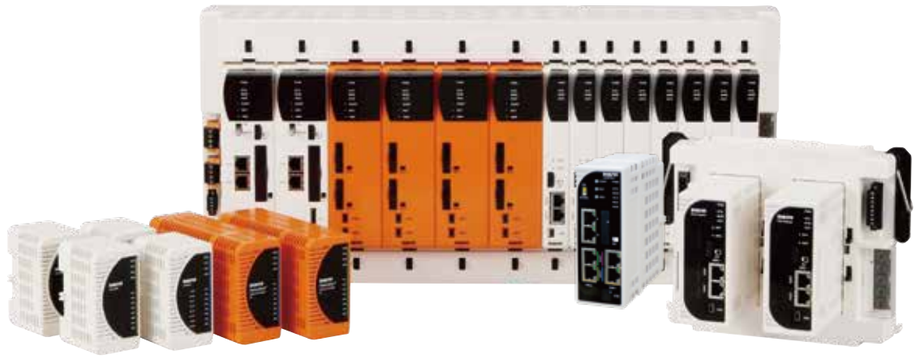
Mitsubishi Power is a power solutions brand
of Mitsubishi Heavy Industries.

METP-04CS02E1-A-0, (0.5.0)21-10,ZTP

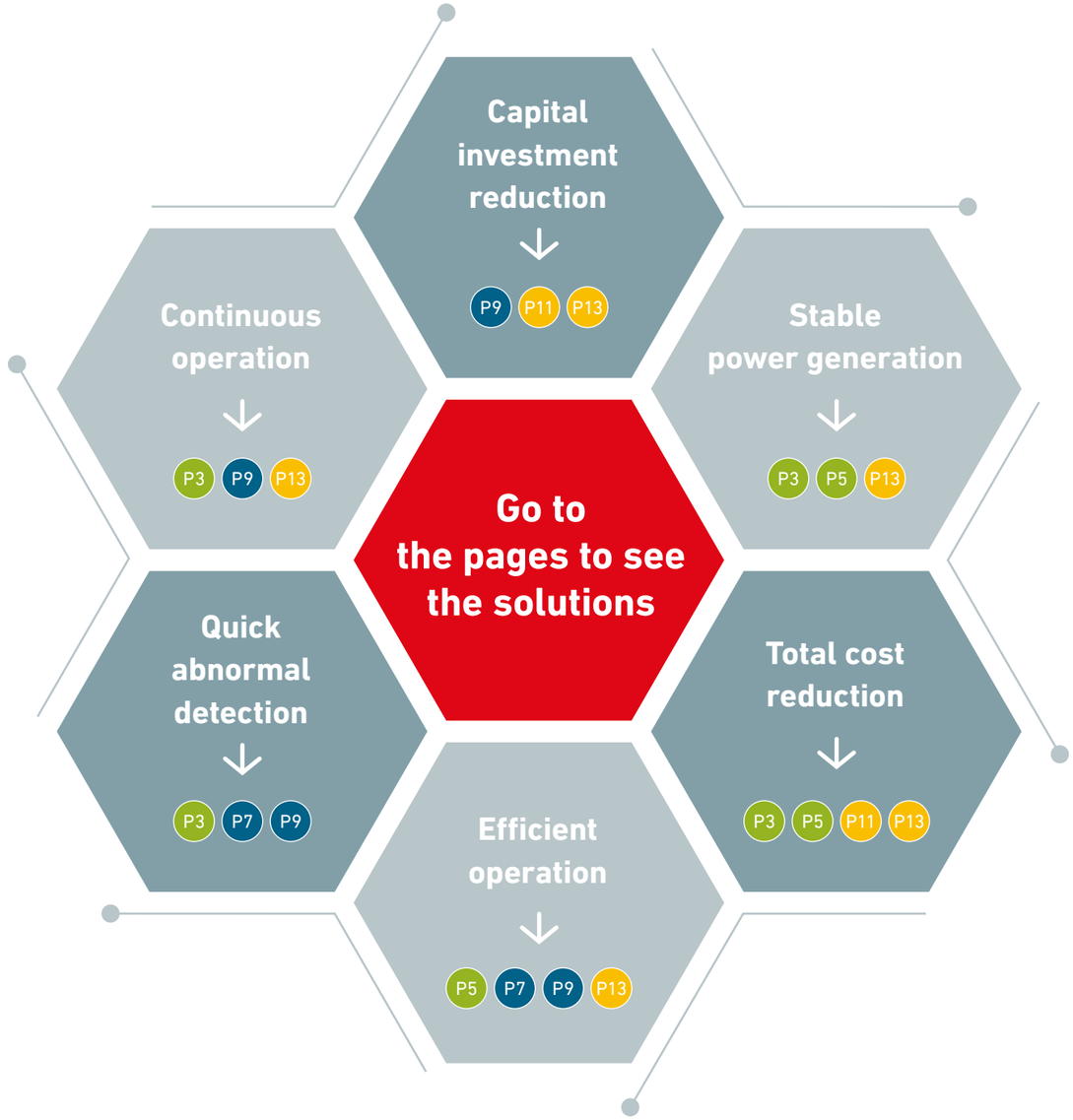
DIASYS Netmation 4S will help customer to fulfill various wants for plant control.

DIASYS Netmation 4S®

"4S" of DIASYS Netmation 4S means the following four "S"s; Safety Smartness Scalability Stability



DIASYS (Digital Intelligent Automation SYStem) is a distributed control system (DCS) developed by Mitsubishi Heavy Industries, Ltd.(MHI) to take full advantage of a plant's performance in order to achieve high reliability and high operating utilization.
DIASYS was launched in the 1980s as a control system for thermal power plants. Up until now, the system has been supplied for more than 2,200 projects in countries around the world.
DIASYS Netmation has been provided as a control and monitoring system for various facilities/products, including not only thermal power plants but also rocket launch facilities, LNG carriers, plant management systems, and office building management systems.
The latest version of the system is DIASYS Netmation 4S, and, in 2013, we added hardware that has obtained functional safety standards (IEC 61508: 2010) to the line-up. This has enabled us to greatly improve the system's reliability and incorporate protective circuits that make it possible to satisfy Safety Integrity Level (SIL). By providing DIASYS series products that handle everything from small to large-scale systems as well as everything from control and monitoring to protective functions, we respond to a wide range of customer needs.

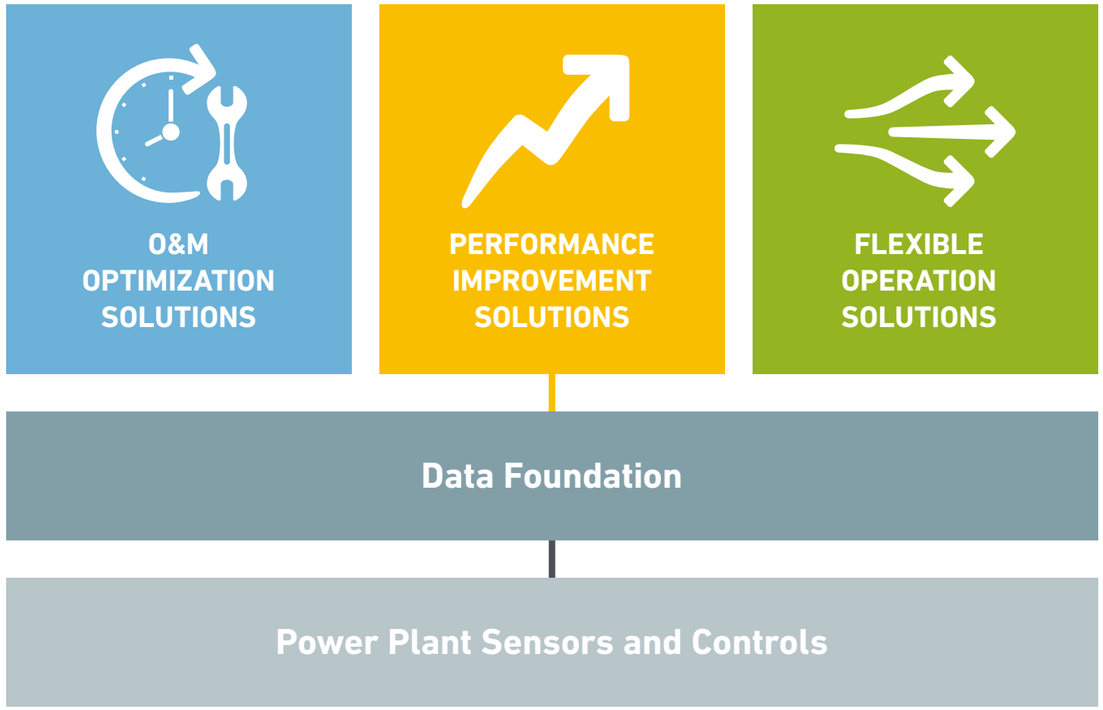


Contents

Solution : ICT Service to Optimize Plants

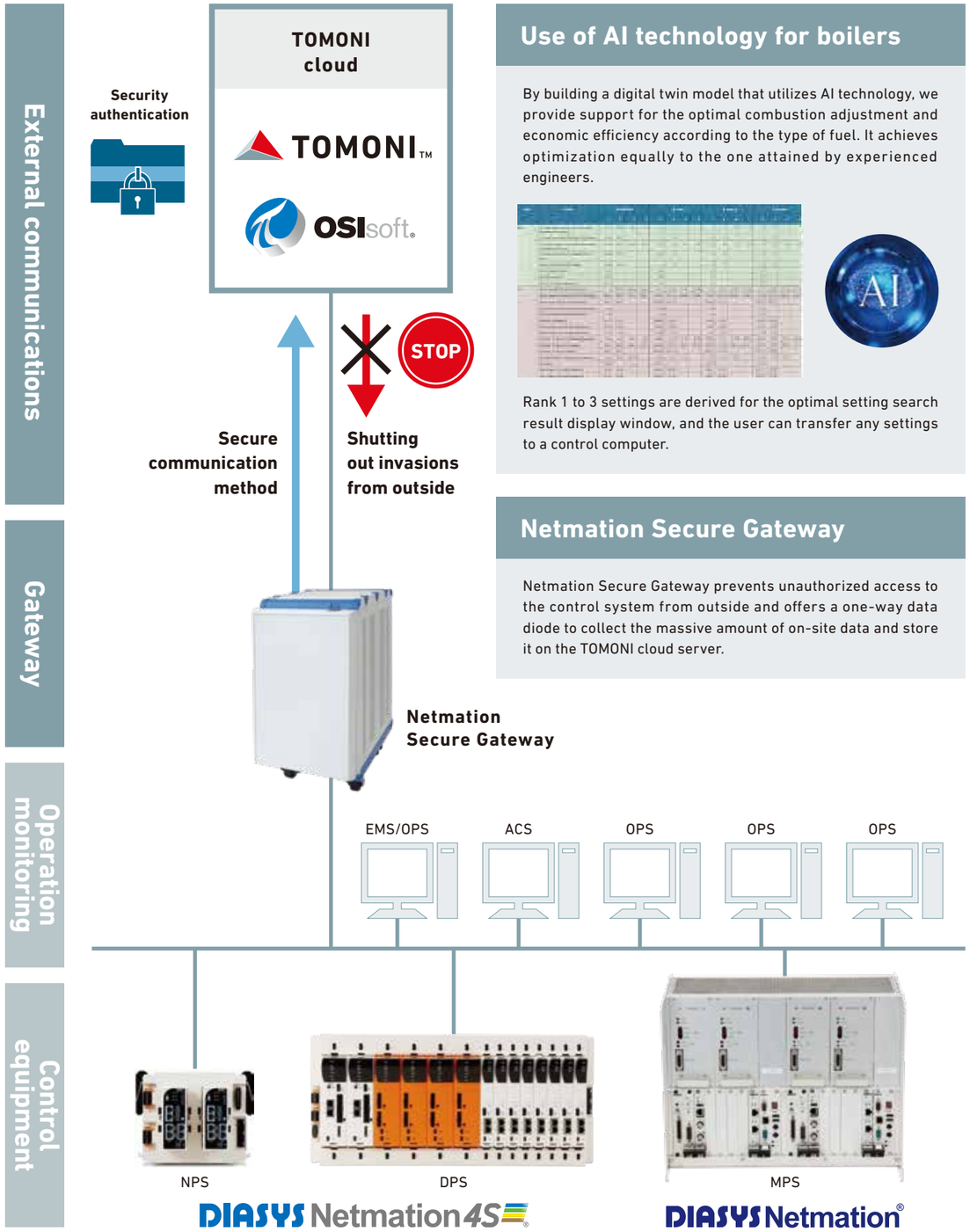
Connection with the ICT service TOMONI™

TOMONI is an innovative digital solution service that utilizes ICT (information and communications technology) to optimize the operations of thermal power generation facilities, including major plant equipment such as turbines and boilers. The service includes three menu items—operation and maintenance (O&M) optimization, performance improvement, and flexible operation—which make it possible to build systems in combination with the existing platforms owned by customers.



For the TOMONI architecture, the DIASYS Netmation series includes the following as part of the Power Plant Sensors and Controls: in addition to real-time computational processing necessary for plant control systems, process event data can be securely and seamlessly sent to the platform provided by TOMONI. This makes it possible for customers to use the various contents provided by TOMONI as the control and monitoring functions necessary for conventional operation.

DIASYS Netmation 4S combines control know-how based on abundant supply experience as a plant manufacturer with analysis technology derived from big data analysis and AI (artificial intelligence) in order to provide devices that can more fully utilize the characteristics of the TOMONI solution and offer stable, reliable support related to customer infrastructure facilities over the long term.



Use of AI technology for boilers

By building a digital twin model that utilizes AI technology, we provide support for the optimal combustion adjustment and economic efficiency according to the type of fuel. It achieves optimization equally to the one attained by experienced engineers.

Rank 1 to 3 settings are derived for the optimal setting search result display window, and the user can transfer any settings to a control computer.

Netmation Secure Gateway

Netmation Secure Gateway prevents unauthorized access to the control system from outside and offers a one-way data diode to collect the massive amount of on-site data and store it on the TOMONI cloud server.

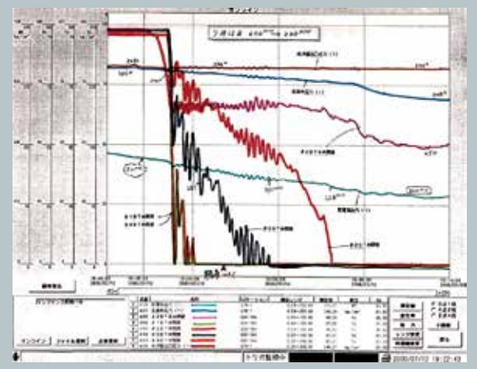
Solution : Simulator Technology that Supports Plant Operations

Features of the high fidelity simulator

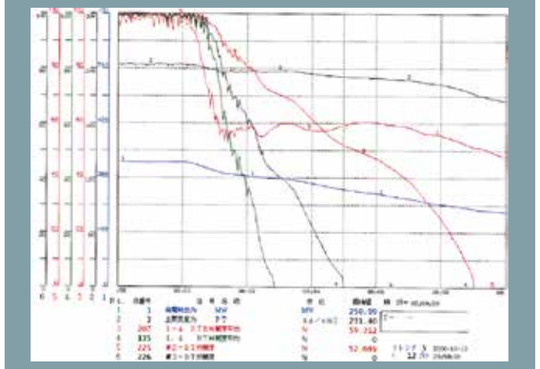
◆Fidelity plant models are utilized to reproduce the operation of the actual plant.

Due to power market liberalization, the expected operations of existing thermal plants are more diverse than ever before. To achieve optimal operations, case studies based on a simulator are essential. These case studies require high fidelity simulation technology that is extremely close to the actual plant's operation. MHI's plant models are a means of solving characteristic equations (material balance, heat balance, and equations of motion) that are faithful to physical equations based on plant-manufacturer design technology. Therefore, simulations that are "high fidelity" compared to actual plants in terms of not only static but also dynamic characteristics are possible. At the same time, because the control software used for actual plants is incorporated into the simulator as logic to control plant facilities, both the plant operation and its control are equivalent to an actual plant, which makes simulation that is extremely close to the operation of an actual plant possible.

Actual plant operation

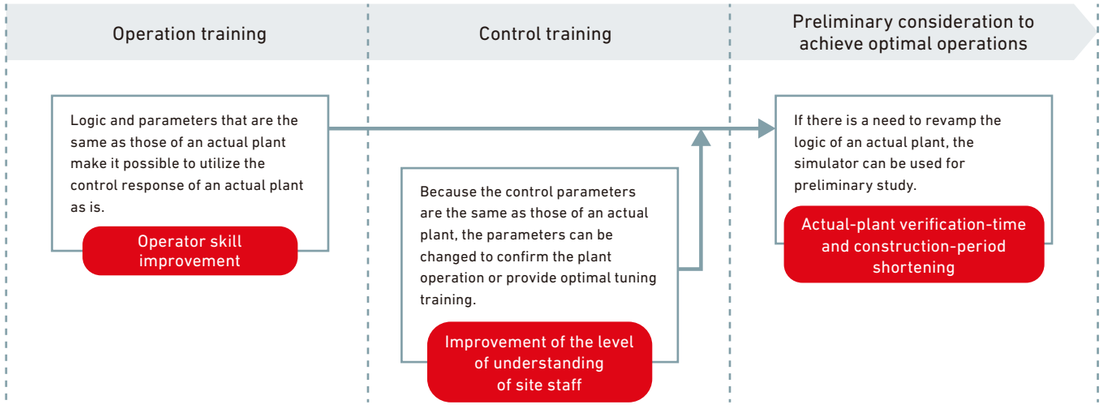


Simulation result



◆Our system contributes to operator training and optimal operations.

The simulator accurately reproduces customer plants' operations. Therefore, the simulator can be utilized for both operator training and verification work aimed at facilitating optimal operations. In order to help customers operation and maintenance technologies and promote the smooth, easy succession of technology, MHI delivers various systems both within Japan and abroad, including everything from standard, compact systems used for training in line with customer needs to operational training simulators that realistically reproduce plant facilities. This makes it possible to build systems in line with the budgets of our customers.

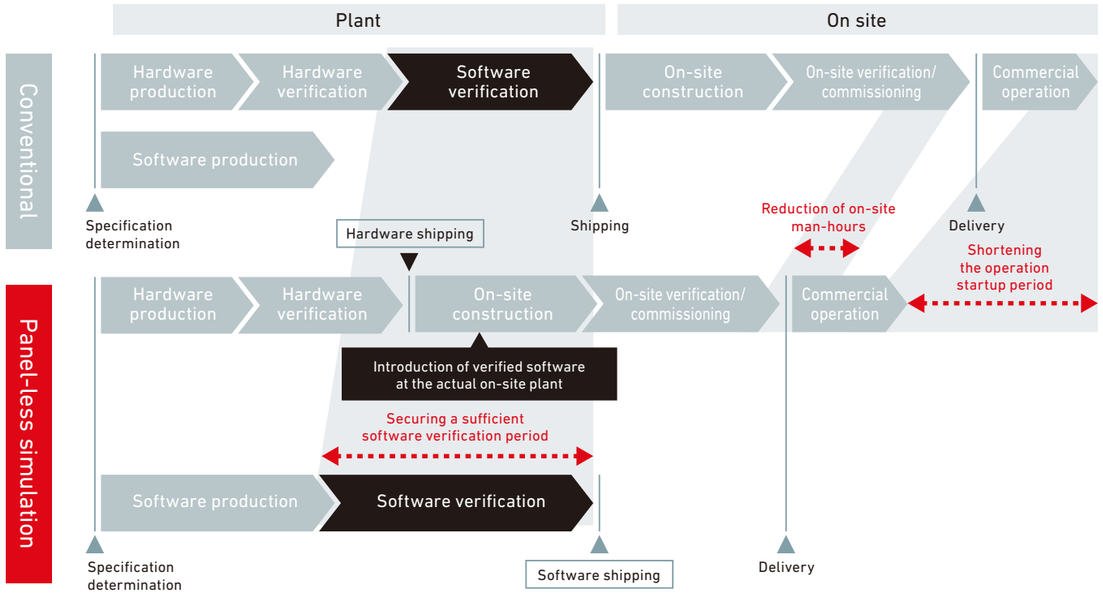


Our system contributes to reducing both the time until control-system introduction and costs.

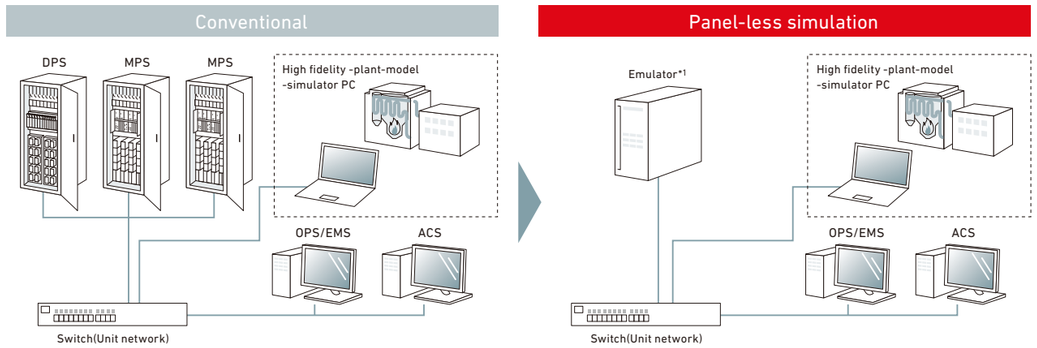
◆Reduction of on-site man hours: panel-less simulation that utilizes high fidelity plant models

Panel-less simulation refers to the incorporation of applications on the DIASYS Netmation 4S control panels into an emulator in order to perform simulation verification of software that includes control-system logic and graphic functions in combination with high fidelity plant models. This makes it possible to achieve just-in-time control-panel delivery on-site without being constrained by the control-panel hardware production period. In addition, because the on-site system launch and adjustment period can be shortened through the high fidelity handling of software design, production, and verification at the plant stage, our system can also contribute to shortening the overall process.

◆Overview of man-hour-reduction through panel-less simulation



Software verification



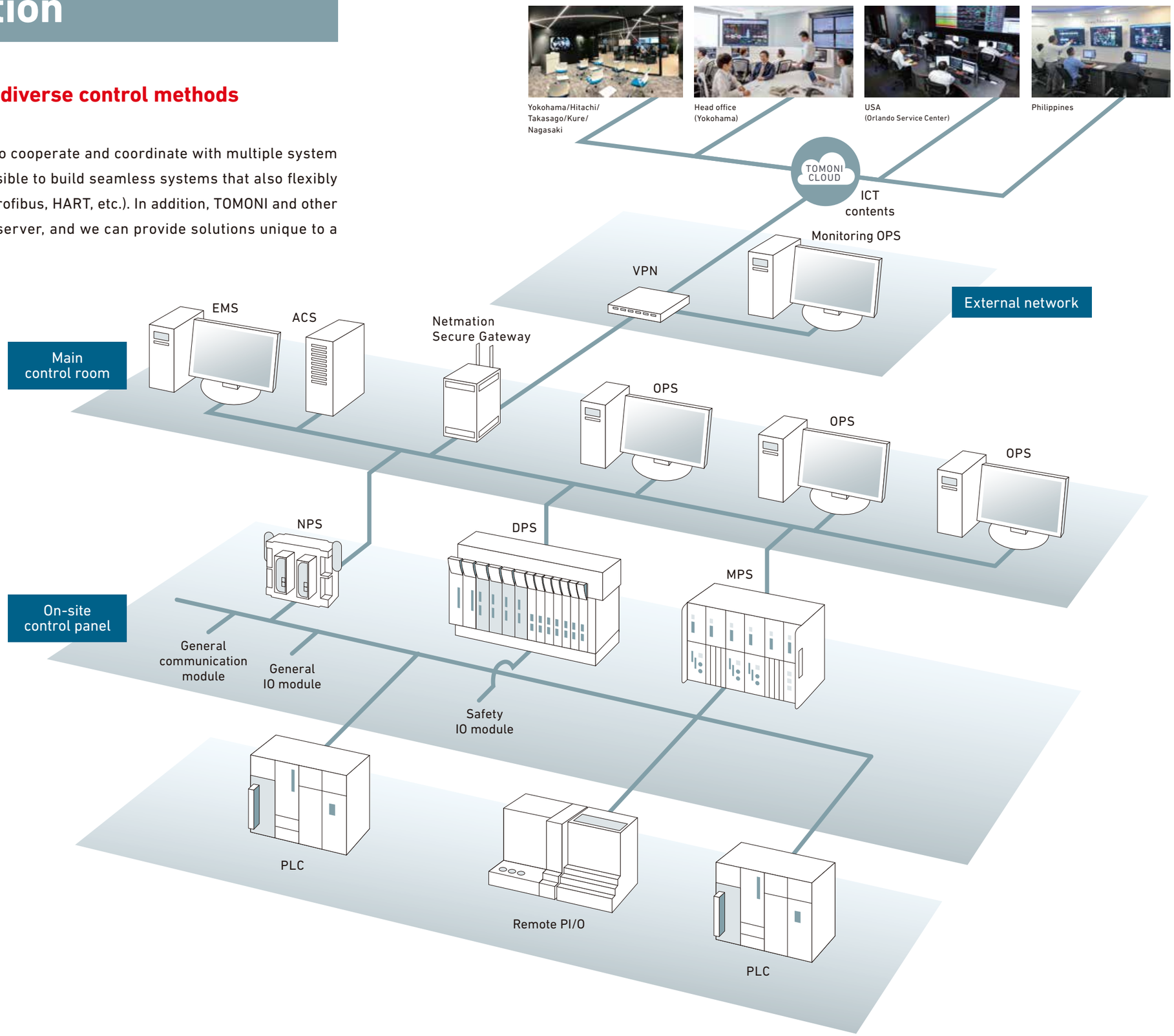
By replacing the DPS and MPS computing functions with an emulator and connecting the high fidelity plant models, OPS/EMS, and ACS to a network, it is possible to secure enough time for verification at the plant even after control panel (hardware) shipping. This makes it possible to reduce the man-hours necessary for on-site system-up verification as well as costs and to speed up the start of operations by customers.

*1 Verification is also done by using an all-in-one compact PC that combines the functions of both an emulator (controller) and high fidelity -plant-model-simulator PC.

System Configuration

A system configuration that supports diverse control methods and enables flexible operations

When building large-scale systems, there is a need to cooperate and coordinate with multiple system suppliers and integrators. Our solutions make it possible to build seamless systems that also flexibly support diverse communication protocols (Modbus, Profibus, HART, etc.). In addition, TOMONI and other host systems can be securely connected to a cloud server, and we can provide solutions unique to a leading plant manufacturer.



OPS····· Operator Station
A terminal used for monitoring and operations. Mobile and remote support are available.

EMS····· Engineering & Maintenance Station
A maintenance terminal used for controller setup, control-logic work, etc.

ACS····· Accessory Station
A terminal used for data storage, document creation, etc.

Netmation Secure Gateway·· A security gateway product used to provide a secure system environment.

NPS····· Netnode Process Station
A compact process controller with the level of performance of an MPS.

DPS····· Dependable Process Station
A controller that can be used for process control or as a safety instrumented system (SIS).

MPS····· Multiple Process Station
A DIASYS system process controller.

PLC····· Programmable Logic Controller
A controller developed as an alternative to a relay circuit.

Human Machine Interface/Engineering Tools

Operation and engineering tools that take full advantage of a wealth of plant manufacturer logic assets and operation results

We have incorporated human machine interface and engineering-tool functions that are based on our wealth of supply experience and know-how as a general plant manufacturer as well as the Microsoft® Windows OS. These functions offer ease of use, operability, availability, and reliability.

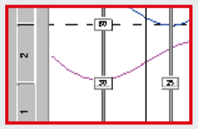
Ease of use based on a wealth of operation results

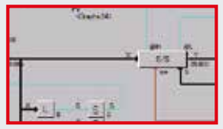
OPS
Operator Station

The system monitoring, alarms/events, trends, control operation logic, and a loop plate(final control element) are completely linked. This contributes to the ability to quickly open the monitoring window and conduct efficient operations with useful functions.

For example:

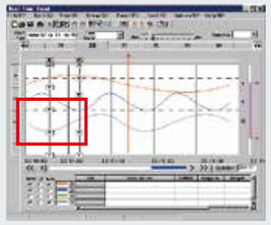
Monitoring-window elements can be dragged & dropped to add trends.





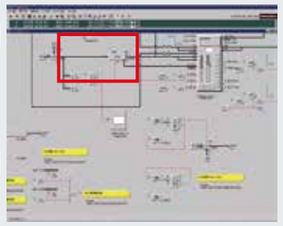
For example:

It is possible to navigate to the control-logic status monitoring from graphics and alarms.



Drag & drop

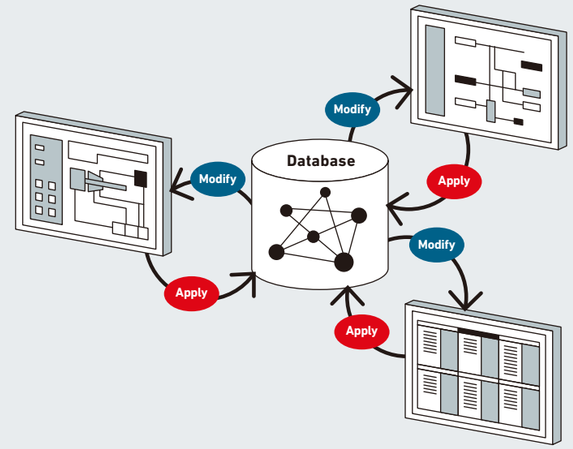
Navigate to logic



Smooth project management with our proprietary integrated database

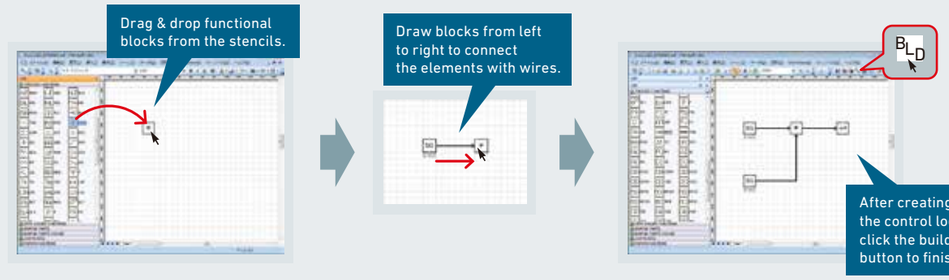
EMS
Engineering & Maintenance Station

All the graphical display parts, control logic, and other design data is centrally managed as objects (parts) by using MHI's proprietary database. When design data is created or changed, because the information of related objects is automatically updated, there is no longer a need for cumbersome item-number management, which makes it possible to promote efficient engineering work.



Simple programming of functional block and element arrangements

Anyone can easily create control logic and display graphics just by dragging & dropping registered functional blocks and elements. Because customers can add or remove facilities and take care of system repairs resulting from operational changes, this system can reduce repair costs.

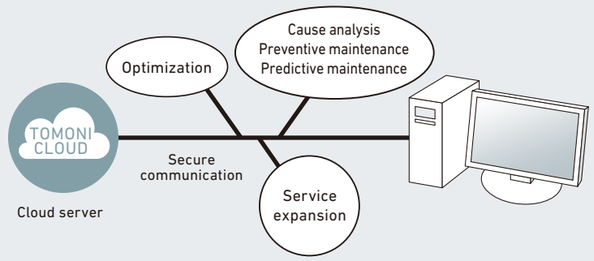


To connected plants/equipment

To efficiently and stably generate power, we recommend our diverse TOMONI contents and service, which take advantage of the MHI group's cutting-edge technology and extensive know-how. To achieve this, it is also necessary to establish a stable, safe network environment for important infrastructure facilities. MHI makes it possible to update to the latest supported OS versions and service packs without impeding continuous system operation in order to secure safety for Netmation Secure Gateway, etc.

- Stable power generation
- Continuous operation
- Efficient operation
- Quick abnormal detection

→ OS and SW upgrades →



Automatic Excel-based creation of simple documents

ACS
Accessory Station

The process data managed in the ACS can be output using any format created with Excel. This makes it possible for anyone to easily create documents by using a tool they are used to.

Comprehensive analysis functions

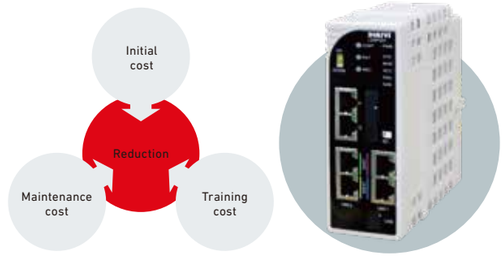
Various types of data are collected and stored to provide support related to plant and customer situational analysis and decision making. In addition, to prepare for the tripping of major facility equipment, the system includes functions for collecting and reporting specific values and signal data.

Situational & behavioral analysis	Trip functions	Time-series data display
• Medium & long-term trends • Event tracing	• Post trip logs • Sequence of events (SOE) reports • Flight recorder	• Digital group trends • Maintenance logs • Operation logs

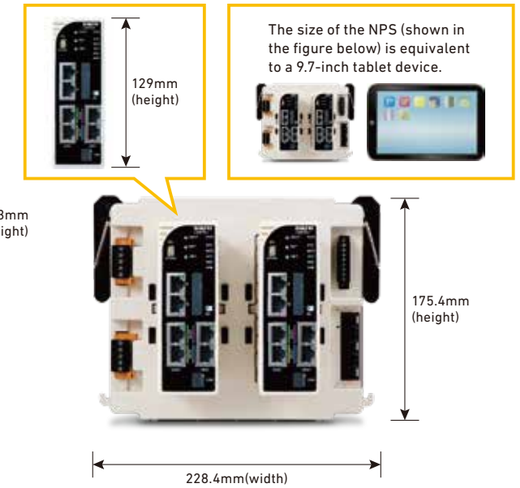
Control Unit : NPS

The installation space can be greatly reduced regardless of the plant scale.

The NPS (Netnode Process Station) is a compact type of controller that makes it possible to flexibly handle facilities applied to the DIASYS Netmation with D-Ring Network I/O System while keeping the MPS (Multiple Process Station) characteristics. This makes it possible to greatly reduce the DIASYS Netmation CPU unit's number of parts and installation space and to continue providing the functions and services of the MPS, the conventional CPU controller, to customers even in the case of small-scale systems.

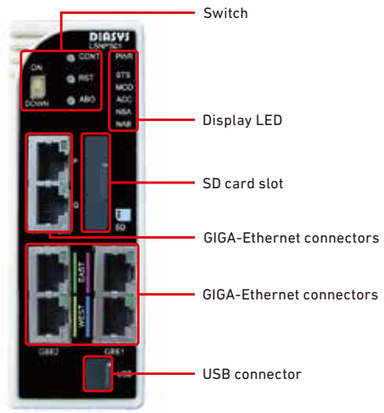


MPS(Multiple Process Station)
DIASYS Netmation®

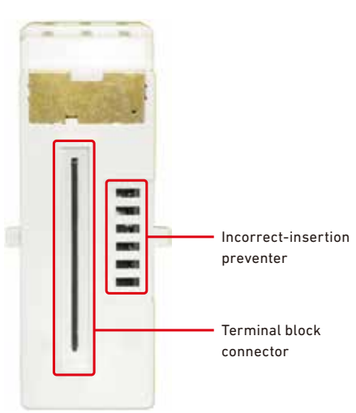


NPS(Netnode Process Station)
DIASYS Netmation4S

Name of each NPS part



Front side

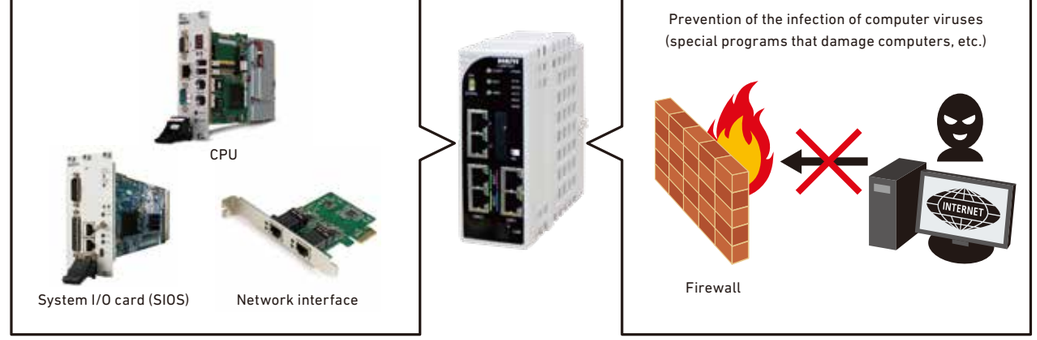


Back side

Provision of all host layer/local communication and computing functions with one unit

The NPS incorporates a firewall function while maintaining performance almost equivalent to that of the MPS. Like the MPS, the NPS makes it possible to establish standby, redundancy, and duplex system, and it is possible to switch from an MPS to NPS or expand with only some minor engineering-tool and human machine interface changes. In addition, it is possible to connect to the D-Ring Network while more or less sticking to the conventional control logic, graphics, and other engineering functions.

NPS characteristics

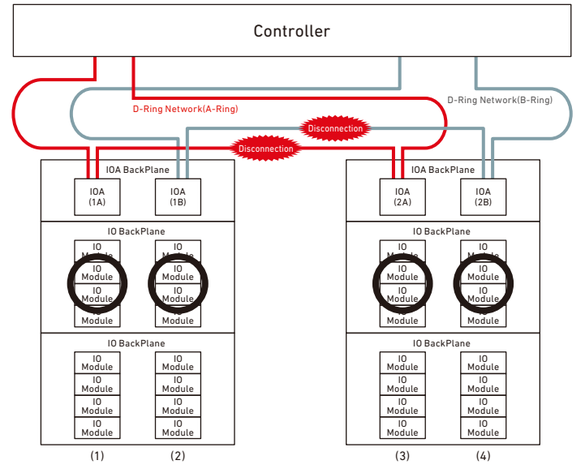


Possible to maintain high reliability through D-Ring Network incorporation

The network connecting the MPS/DPS/NPS and modules is set up as a ring-type D-Ring Network. Due to the D-Ring Network configuration, even if part of the network fails, network can be redirected by bypassing the failure location at a speed of 1/1,000th of a second. This means that the effect of the failure on facilities can be minimized.

The D-Ring Network

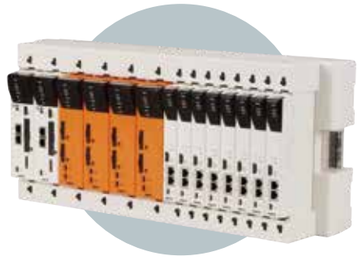
Even if both the A-Ring and B-Ring are disconnected as shown in the figure, (1) to (4) can still be used.



Control Unit : DPS

Possible for process control and safety instrumentation to coexist

For the DPS (Dependable Process Station), a process control system and safety instrumented system have been merged, making it possible to build one control system that incorporates both a digital interlock and process control. Compared to separately building a process control system and safety instrumented system, this makes it possible to reduce capital investment.

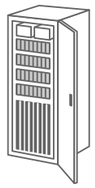


Process control

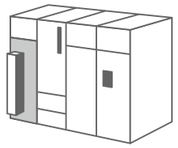
Distributed control system (DCS) and PLC

+

Safety instrumentation



Relay circuit



Safety instrumented system

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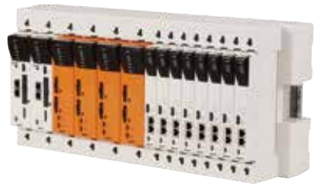
Process control + safety instrumentation

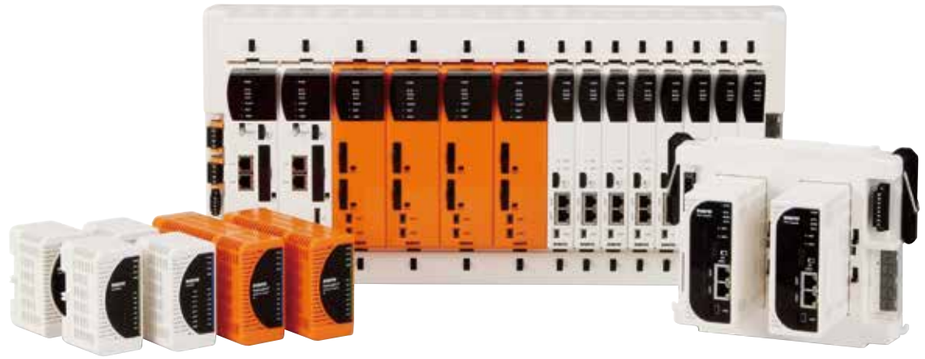


Improved reliability as a result of acquiring IEC 61508: 2010

◆Acquisition of SIL level 3

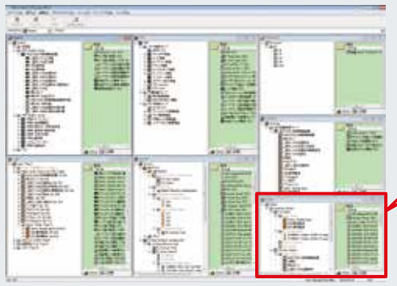
We have obtained SIL level 3, the most demanding safety-instrumented-system standards in the industry, from the international certification authority TÜV SÜD for the DPS. Functional safety systems planned in line with IEC 61508 are assigned a safety integrity level (SIL) rank of from 1 to 4 according to their dangerous failure probability. Higher ranks imply that the system can be applied to more dangerous (risky) facilities.

SIL level	The average probability of time that design functions become impossible when the safety system is triggered
4	10^{-5} or more to less than 10^{-4}
3	10^{-4} or more to less than 10^{-3}
2	10^{-3} or more to less than 10^{-2}
1	10^{-2} or more to less than 10^{-1}



Compatibility with conventional products to reduce capital investment

Integrating process control and safety instrumentation for the DPS makes it possible to write safety control logic on the EMS. No special engineering tools are necessary for functional safety, and functional safety standards can be complied in the same way as existing system operation. Therefore, the customer's capital investment and training costs can be reduced.



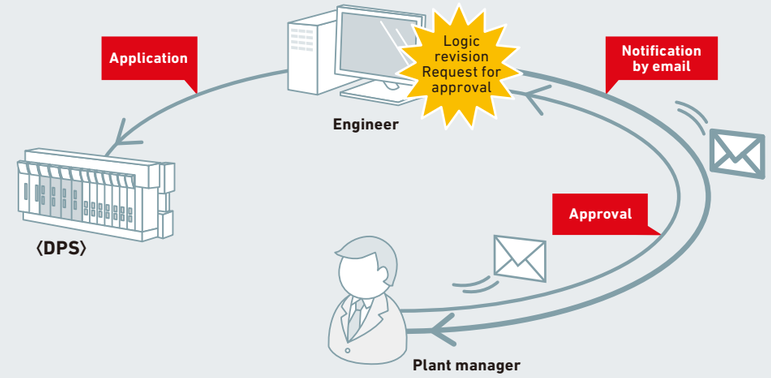
Safety Window

Logic sheets and IO modules/control loop plates are registered to the Function Block (FG) to link instrumentation control and safety instrumentation.

* Build54SP10 and later are supported.

Operational-mistake prevention function to prevent facility breakdowns and stopping

The DPS incorporates a function to ensure the certification procedure when there is a control program change as well as secure manager and other functions. This makes it impossible to make control program changes or important system changes from a monitoring terminal without the agreement of the plant manager.

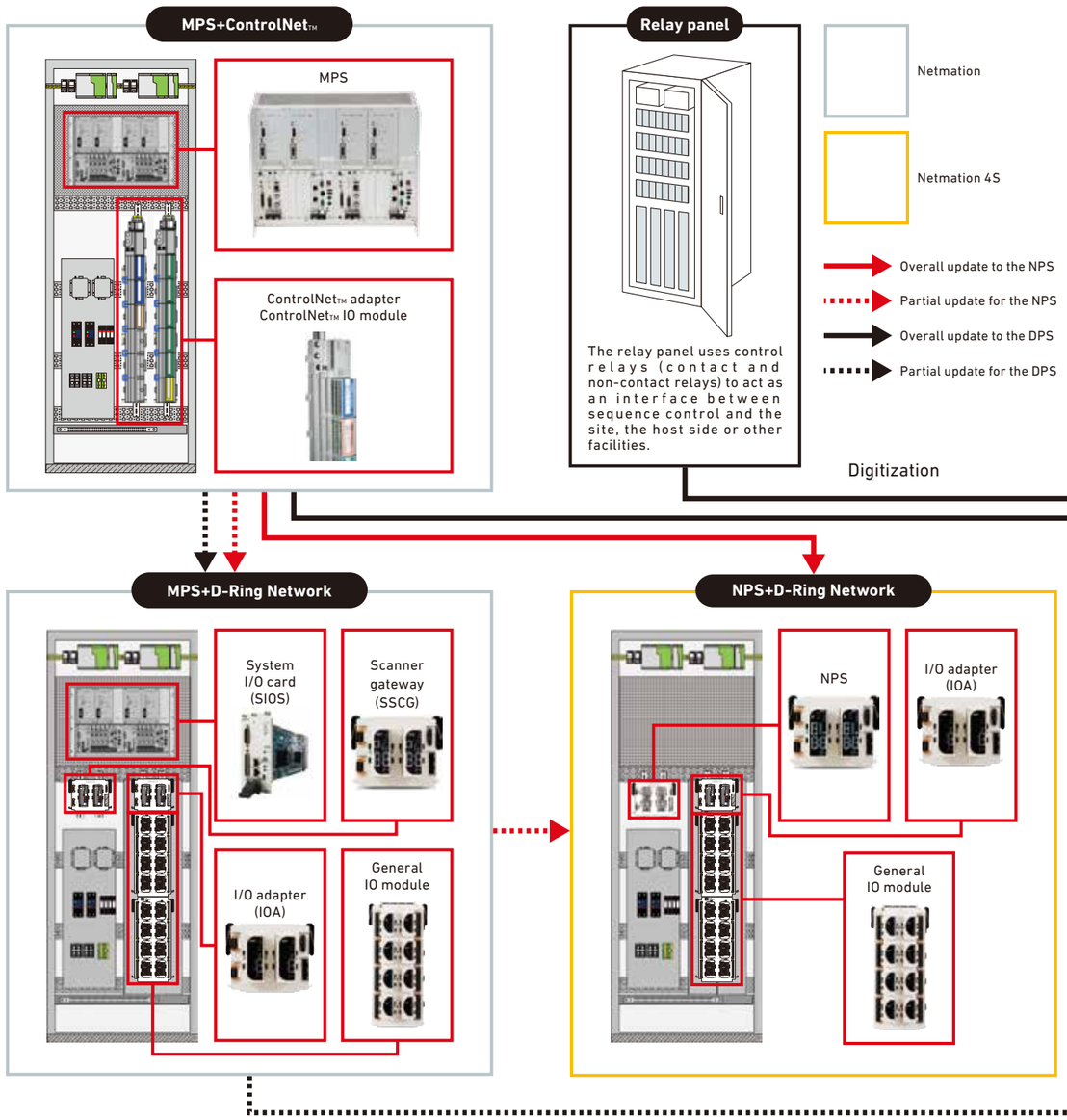


Migration

Reduced total cost through hardware updates

Because DIASYS Netmation 4S is a product that was developed for important infrastructure, its parts were selected and designed to enable long-term continuous operation. However, to help prevent failures due to deterioration, etc., we recommend replacing modules and other hardware as well as updating the system based on a plan. Performing migration (updating) in stages makes it possible for our customers to diversify their capital investment and sequentially upgrade to the latest systems. We propose the best possible solutions according to the existing system configurations and operational situations of our customers.

Your hardware can be updated according to your goals and budget.



The NPS and DPS have made controller consolidation possible due to performance improvement (*compared to before).

As shown by the general specifications for the MPS, NPS, and DPS below, the NPS and DPS are capable of executing control operations with fewer controllers than the MPS due to faster CPU operations and network communication speed.

Item		DIASYS Netmation	DIASYS Netmation 4S	
		MPS	NPS	DPS
Controller	Redundant configuration	Redundant (double)	Redundant (double)	Redundant (quadruple at most)
	Redundant system	Standby redundant system	Standby redundant system	Majority-decision system*1
	Minimum cycle time	10 msec	10 msec	6 msec
	Computing systems	Logical operations	Logical operations	Normal logical operations + diverse operations*2
	Power supply module	Redundant power supply module insertion	General-purpose power supply module application possible	
I/O bus	Communication method	ControlNet™ / D-Ring Network	D-Ring Network	
	Communication protocol	ControlNet™ / Ethernet	Ethernet	
	High performance & high reliability	Redundant	Redundant + loop-back	
I/O module connection	Applied technology	Flex bus (licensed)	Backplane-internal connection (developed in-house)	
	Redundant module connection	Special cable connection	Backplane-internal connection	
	Maximum number of nodes (per controller)	MPS + ControlNet™ 14 nodes MPS + D-Ring Network 95 nodes	95 nodes	95 nodes x 4 loops
	Maximum number of modules (per controller)	MPS + ControlNet™ 560 modules MPS + D-Ring Network 500 modules	2,280 modules	9,216 modules

*1: This refers to a system in which four modules are set up to achieve redundancy, the output of the modules is sent to a circuit that makes a decision based on a majority, and the selected value is output as the final result.
*2: In cases where the DPS is in up to a quadruply redundant configuration and the operation results are inconsistent, there is a vote inside the output module, and the value selected based on a majority decision is output to the output circuit.