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BROCHURE

HiaGuard Safety Instrumented System

Safeguarding Your Production, Optimizing Operational Efficiency



Intelligence For Excellence

www.hollsys.com

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Overview

Providing Safety Assurance for Your Production

HiaGuard SIS (Safety Instrumented System) is developed by HollySys and specifically designed for the industrial automation safety sector. It has been certified by TÜV Rheinland in Germany. The system adheres to IEC 61508 and IEC 61511 standards, achieving SC3 system capability and SIL3 safety integrity levels, making it suitable for safety-related applications.

Since its launch, HiaGuard SIS has been implemented in thousands of functional safety scenarios across various industries worldwide, including refining and petrochemicals, coal chemicals, oil and gas production, storage and transportation, energy and power generation, metallurgy, papermaking, food and pharmaceutical, among others. The system is committed to leveraging cutting-edge technology to enhance the safety and reliability of production units while providing customers with excellent safety assurance and operational efficiency.

High Availability

HiaGuard SIS adopts 2oo3D (2-out-of-3 with Diagnostics) technology, ensuring outstanding advantages in safety, stability, and real-time performance. Additionally, the system supports a 3-2-0 degradation mode, ensuring continued availability under abnormal conditions, with availability reaching up to 99.999%.

Safety Compliance

The system meets international safety standards IEC 61508 and IEC 61511 SC3 system capability level and SIL3 safety integrity level. It has received certification from TÜV Rheinland in Germany, as well as CE Certification (including EMC and LVD), G3 Anticorrosion Certification, CCS, and Achilles Certification.

Accurate Diagnostics

HiaGuard SIS offers comprehensive diagnostic capabilities with a diagnostic coverage of over 90%, allowing precise fault localization down to the channel level. Its 1-ms resolution Sequence of Events (SOE) recording accurately captures operational details. The application of the HART protocol facilitates easier calibration and maintenance of field instruments.



TÜV SIL3



TÜV CE



TÜV G3



Achilles



CCS

Integrated Safety

HiaGuard SIS can be seamlessly integrated with HollySys DCS through a unified system network, sharing physical network resources but maintaining logical separation with different protocols. A failure on the DCS side does not impact SIS safety. Operators can access real-time data from both DCS and SIS via human-machine interface, simplifying data acquisition and management processes and reducing software and hardware costs.

Protocols and Interfaces

HiaGuard SIS is compatible with Profibus, TCP/IP, and Modbus communication protocols. It uses RS485 and Ethernet interfaces to enable one-way or two-way data exchange with other systems via communication stations or switches.

Secure Communication

Communication between HiaGuard system stations adopts a safety communication protocol that complies with functional safety standards. It employs black channel technology to forward and transmit safety data via communication modules and switches, ensuring data security.

HiaGuard Patents and Software Copyrights



15 Patents for Invention

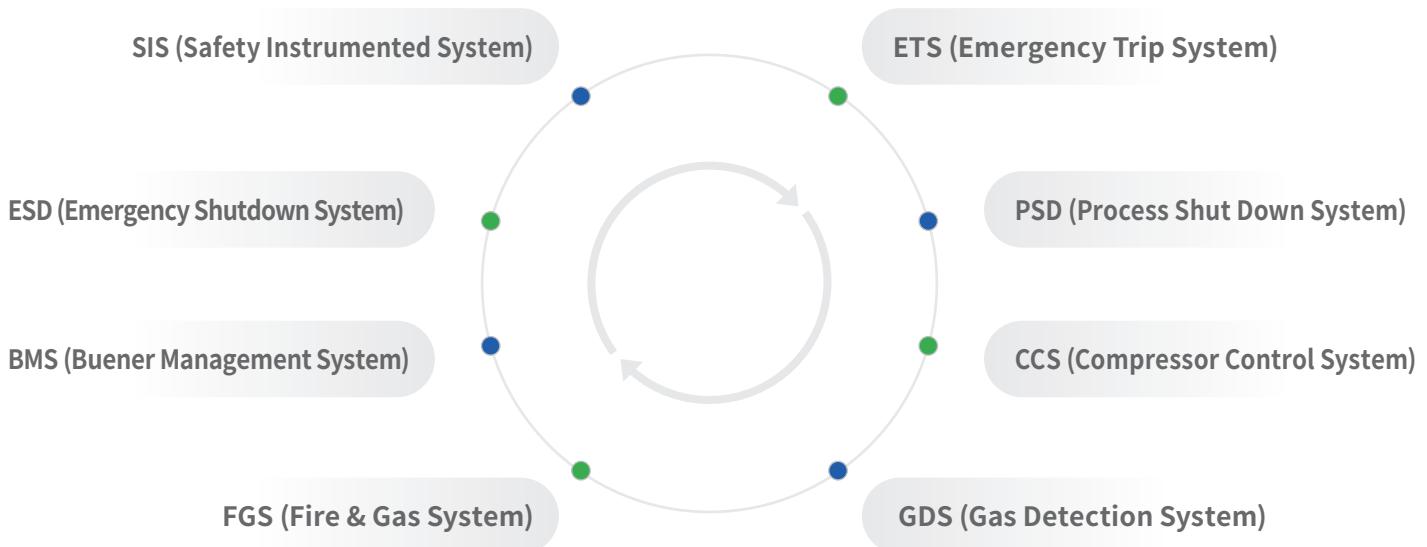


11 Software Copyrights

System Application

Enhancing Operational Reliability of Critical Facilities

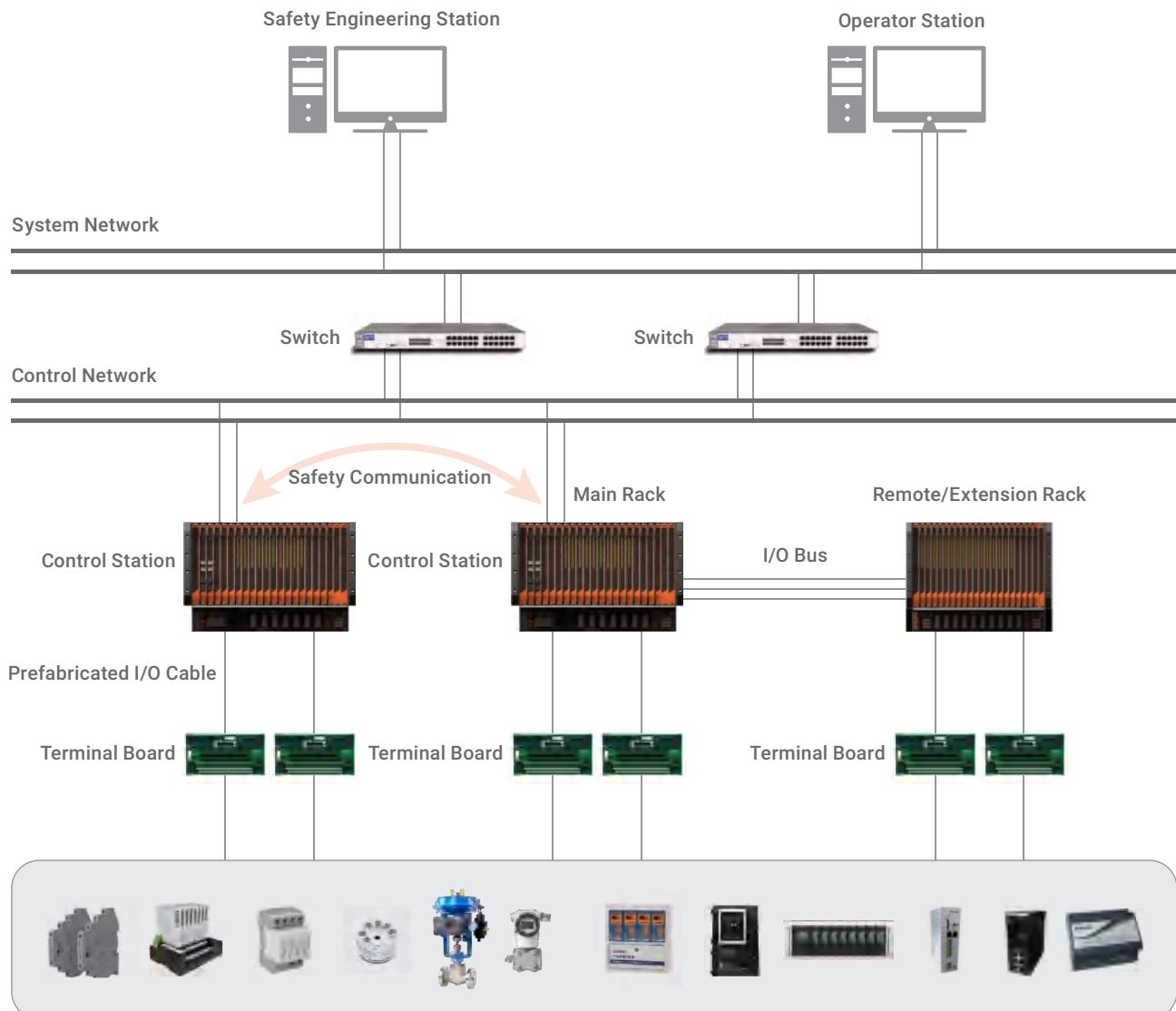
HiaGuard SIS adopts 2oo3D (2-out-of-3 with Diagnostics) technology, suitable for the following applications:



System Architecture

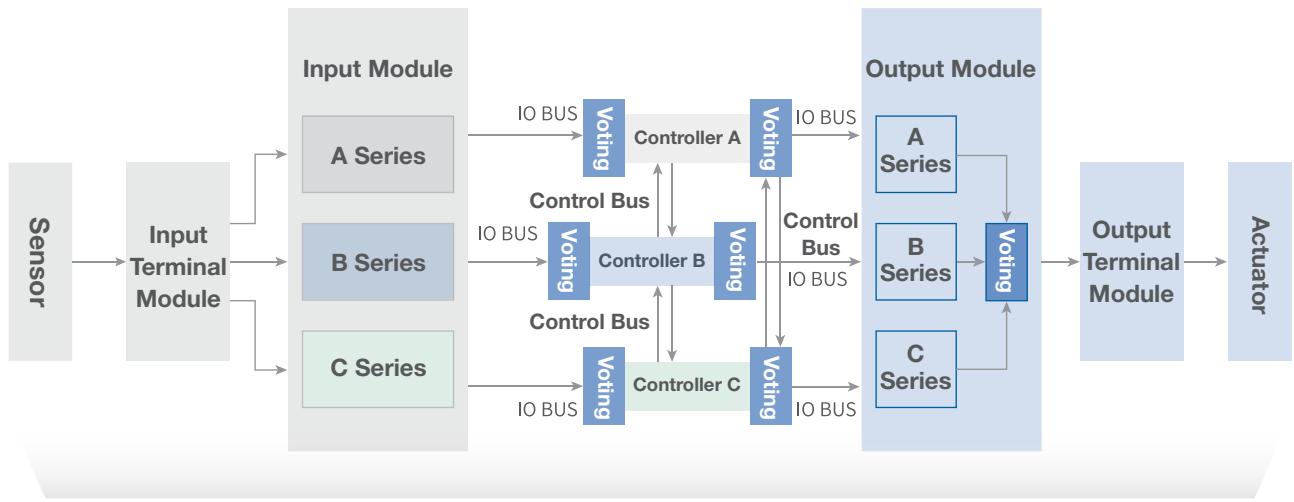
Flexible Architecture for Efficient and Safe Management Across Industries

HiaGuard SIS mainly consists of engineering stations, operator stations, historian stations, and control stations, forming the system network and control network. The control network's nodes consist of control stations and I/O modules. HiaGuard SIS supports up to 15 domains, each supporting 64 control stations, with each single station supporting a maximum of 1,856 I/O points. The main rack supports up to 224 I/O points.



2oo3D (2 out of 3 with Diagnostics) Technology

HiaGuard SIS employs 2oo3D (2 out of 3 with Diagnostics) technology, incorporating triple redundancy, self-diagnostics, and a 2oo3 voting mechanism to significantly enhance safety and stability, meeting diverse user needs.



HiaGuard SIS achieves full triplication across input modules, controllers, and output modules. Components such as controllers, I/O modules, terminal boards, network communication modules, and safety loops meet SIL3 standards according to IEC 61508.

Triple-Redundant Controllers and Control Bus: The system uses three independent controller modules that operate synchronously, with the controllers exchanging data via the CPU bus using a safety communication protocol.

Triple-Redundant and Hot/Standby I/O Modules: Each I/O module is equipped with three independent control buses. The modules are independently configured to meet SIL3 requirements of IEC 61508, and they can be configured redundantly for increased availability.

SIL3 Safety Loops: Data exchange between each controller and its corresponding I/O module uses a safety communication protocol. The safety loop complies with SIL3 requirements of IEC 61508.

2oo3 Voting Mechanism: The output module contains three parallel hardware channels, ensuring reliable output data through a 2oo3 voting mechanism.

Basic Environmental Indicators

Working environment temperature	-10 to 60°C
Operating environment relative humidity	5% to 95% relative humidity, non-condensing
Storage environment temperature	-40 to -80°C
Storage environment relative humidity	5% to 95% relative humidity, non-condensing
Vibration	Accelerated speed: 0.5 g, vibration frequency: 10 Hz ≤ f ≤ 150 Hz
Environmental adaptability	Compliant with ISAS71.04 G3

Electromagnetic Compatibility Requirements

Electrostatic discharge immunity	Compliant with IEC 61000-4-2 ±6 kV contact discharge, ±8 kV air discharge
Radio frequency electromagnetic field radiation immunity	Compliant with IEC 61000-4-3 20 V/m (80 MHz to 1 GHz), 10 V/m (1 GHz to 6 GHz)
Electrical fast transient burst immunity	Compliant with IEC 61000-4-4 5/50 ns waveform, AC power port 4 kV, signal port 2 kV at 5 kHz and 100 kHz
Surge (shock) immunity	Compliant with IEC 61000-4-5; AC power port common mode 4 kV, differential mode 2 kV, signal port common mode 2 kV
Radio frequency field Induced conducted disturbance immunity	Compliant with IEC 61000-4-6 20 V, 150 kHz to 80 MHz
Power frequency magnetic field immunity	Compliant with IEC 61000-4-8 Steady-state 100 A/m, transient 300 A/m
Voltage dips and short interruptions immunity	Compliant with IEC 61000-4-11 AC power port dips to 0% for 1 cycle, 40% for 10 cycles, 70% for 25 cycles, 80% for 250 cycles; short interruptions for 250 cycles
Radiated emission, conducted emission	Compliant with IEC 61131-2, EN 61000-6-4, Class A

System Specification

Maximum number of domains	15
Maximum number of operating stations per domain	64
Maximum number of field control stations per domain	64
Maximum number of I/O modules per station	58 pairs
Maximum number of I/O points per station	1,856 points

Real-Time Response Capability

SOE resolution	1 ms
Operator station data refresh time	< 1s
Operator station command issuance time	< 1s

High Security

Certified to IEC 61508 standard for functional safety SIL3/SC3

Full hardware redundancy and fault tolerance, no single point of failure

System Hardware

Advanced Hardware Provides High Reliability, Stability, and Safety for Critical Operations



Controller

- TMR (Triple Modular Redundancy) architecture adopted
- Three physically independent controllers
- Data exchange between controllers handled by control bus
- Input and output data voted on by the three controllers

Communication Module

- Facilitating data exchange between the controller level and the operator station level
- Providing system time synchronization
- Supporting redundant configuration
- Built-in firewall to protect against external network storms and viruses
- Equipped with Modbus interface to support data communication with third-party devices

I/O Module

- Single I/O module with physical triple redundancy
- Supporting hot/standby redundant configurations
- Supporting online replacement
- SOE (Sequence of Events) accuracy up to 1 ms

Power Supply Module

- 1:1 redundant power supply configuration
- Isolation of system power and field power

System Monitoring Software

Intuitive Interface and Real-Time Monitoring for Enhancing Operational Efficiency and Decision Accuracy

HiaGuard SIS monitoring software simplifies plant operations by providing timely information crucial for decision-making. Its intuitive interface allows users to easily understand operational status and take appropriate actions. The system assists operators in quickly finding proactive solutions, reducing the pressure of time-sensitive situations and ensuring safety in critical moments. It seamlessly integrates with DCS, CCS, and other control systems.

User-Friendly Human-Machine Interface

Designed for simplicity and ease of use, the interface offers a variety of minimalist display styles and eye-catching visual designs, enabling effortless navigation and operation with just one click. The interface not only looks visually appealing but also ensures practicality, supporting widescreen and multi-screen displays for efficient navigation through different screens and content.

One-Click Navigation Function

Each device or measurement point is equipped with a uniquely designed panel that allows one-click access to all related functions, such as alarms, trends, and detailed information. Operators can easily manage complex situations with confidence.

Trend and Alarm Management

Alarms can be managed by region, group, or type, simplifying operations. Customizable alarm icons and color schemes minimize distractions and improve efficiency. Trend tracking helps users anticipate system performance changes over time, gaining valuable operational insights and making informed decisions while ensuring efficiency and precision in addressing operational challenges.

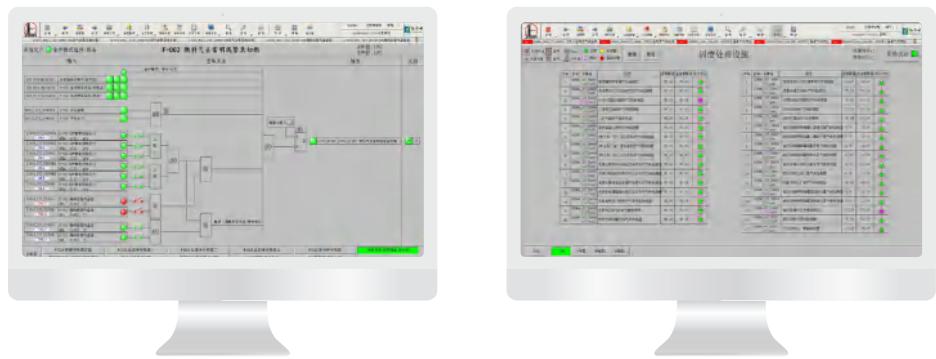
SOE Query

The SOE query function allows SOE records to be searched by time and supports the export and printing of SOE event records.

Real-Time Online Download

Operators can perform real-time downloads online without disturbing production, maximizing productivity and flexibility. The software allows for modifications, downloads, and debugging during operation without the need for shutdowns. Incremental compilation and downloading reduce disruptions, enabling smooth transitions and boosting efficiency, ensuring the highest operational performance and quickest response speed.

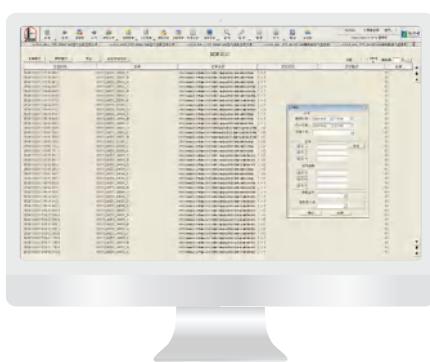
Interlock Diagram



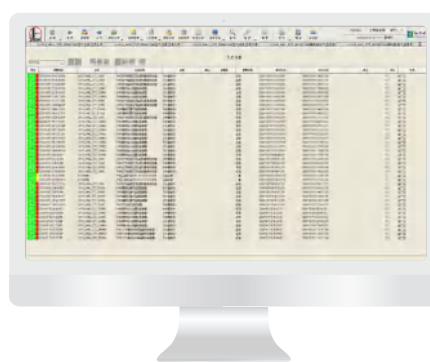
Flow Chart



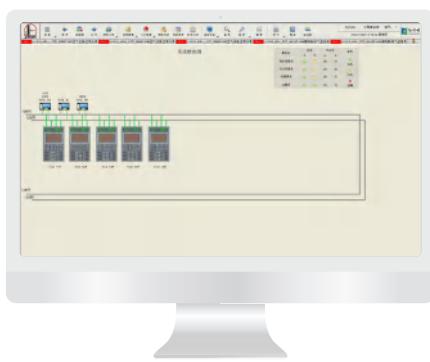
SOE Record



History Record



System Alarm



Trend Analysis



Advanced Configuration Software

Simplifying Management with an Intuitive Interface and Flexible System Customization

HiaGuard SIS' advanced configuration software, Safe-AutoThink (Safe-AT) developed by HollySys, is specifically designed for Safety Instrumented System (SIS). As a critical component for control logic in HiaGuard SIS, Safe-AT meets the SIL3 tool requirements of IEC 61508. Combining cutting-edge technology with a user-friendly interface, Safe-AT provides precise and efficient monitoring and management capabilities, ensuring the safe and reliable operation of your industrial processes. Its flexible scalability also supports future system upgrades and functional expansions.

Graphical Management and Real-Time Monitoring

Projects are managed using a tree structure, providing clear hierarchy and efficient management. Safe-AT supports graphical configuration for task setups, user programs, hardware configurations, variable definitions, SOE, and Modbus. The intuitive interface makes operation simple. In online monitoring mode, users can easily view the operational status and alarm information of modules, check module version details quickly, and enhance the real-time management and control experience.

Flexible Logic Language and Programming Methods

Safe-AT offers three IEC 61131-3 compliant safety programming languages: Ladder Diagram (LD), Function Block Diagram (FBD), and Structured Text (ST). These languages enable users to implement various logic solutions. The system supports automatic decompilation to ensure consistency between source and target projects, allowing users to perform configuration verification to confirm the correctness and completeness of the program.

Offline Simulation Function and Debugging

Safe-AT enables controller and HMI simulation, allowing for program logic debugging and interlock logic modifications in the controller simulation environment, significantly reducing on-site commissioning efforts. The HMI simulation platform provides real-time interface design and user interaction simulation, ensuring the usability and functionality of the operator interface.

Security Permission Features

In Safe-AT, different levels of user permissions are set for various controller operations and access rights. Operations such as downloading programs, starting/stopping IEC tasks, and entering operation modes require users to input a controller password, preventing unauthorized access and reducing the risk of human error.

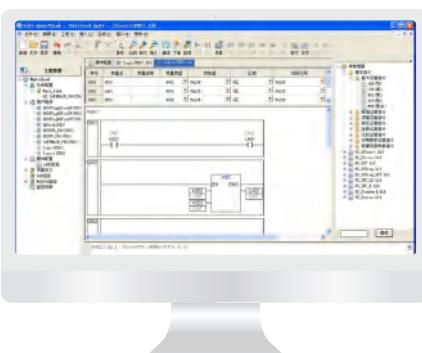
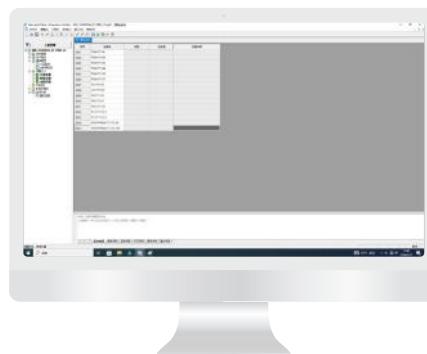
权限内容	Level0	Level1	Level2
编辑修改用户名和密码	✓	✓	✓
设置控制器密码 (下装操作密码)	✓	✗	✗
创建、编辑或删除 Level 1 用户	✓	✗	✗
创建、编辑或删除 Level 2 用户	✓	✓	✗
离线状态进行工程组态	✓	✓	✓
保存工程	✓	✓	✗
下装	✓	✗	✗
运行	✓	✓	✗
停止控制器	✓	✓	✗
监视	✓	✓	✓
退出	✓	✓	✓

Security Permission

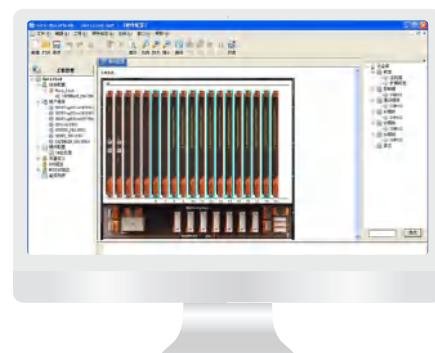


Offline Simulation

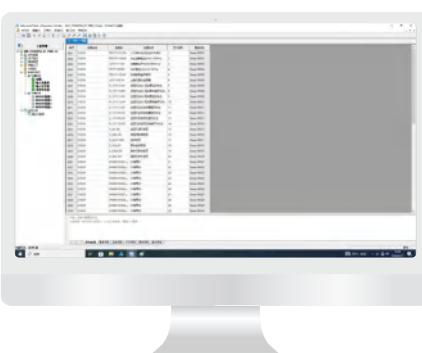
Monitoring List Configuration



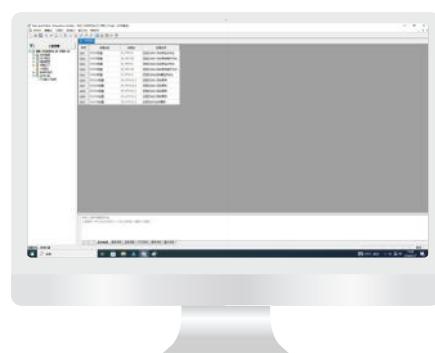
Logic Configuration



Hardware Configuration



Modbus Configuration



SOE Configuration

Services

Full Lifecycle Support and Rapid Response for Optimizing User Experience

With nearly 20 years of experience in functional safety, we offer comprehensive lifecycle services and support backed by a specialized R&D team and over 30 TÜV-certified engineers. HollySys' technical expertise and professional services ensure a solid foundation for your projects.

Project Services

Our extensive project experience, combined with a professional team and a streamlined project management process, ensures efficient, high-quality, and on-time delivery. We provide full lifecycle services from project initiation to operational management, including design, engineering, commissioning, and operations.

Lifecycle Services

Our lifecycle services offer integrated, efficient, and reliable solutions. We minimize downtime from annual maintenance warranties and on-site maintenance to spare parts management. Upgrading and migration services ensure your systems stay up-to-date, adapting to fast-evolving technologies.

Training Services

Our fully equipped training center, staffed by experienced instructors, offers hands-on system training to maximize learning outcomes. Tailored to your operational needs, we provide customized training solutions based on different products and specific participants.

Consulting Services

With leading-edge insights, extensive experience, and advanced technologies, we help clients unlock the value of innovation and accelerate their sustainable competitive advantage. Our consulting services focus on diagnostics and planning of digital and smart manufacturing and engineering management, guiding businesses in their transformation to digital and intelligent operations.



Typical Cases

Cutting-Edge Technology for Safe and Reliable Production Facilities and Steady Growth

Since its market launch in 2013, HiaGuard SIS has been implemented in over 4,000 projects across a wide range of industries, including refining and petrochemicals, coal chemicals, oil and gas, oil and gas storage and transportation, energy and power, metallurgy, pulp and paper, and food and pharmaceuticals.

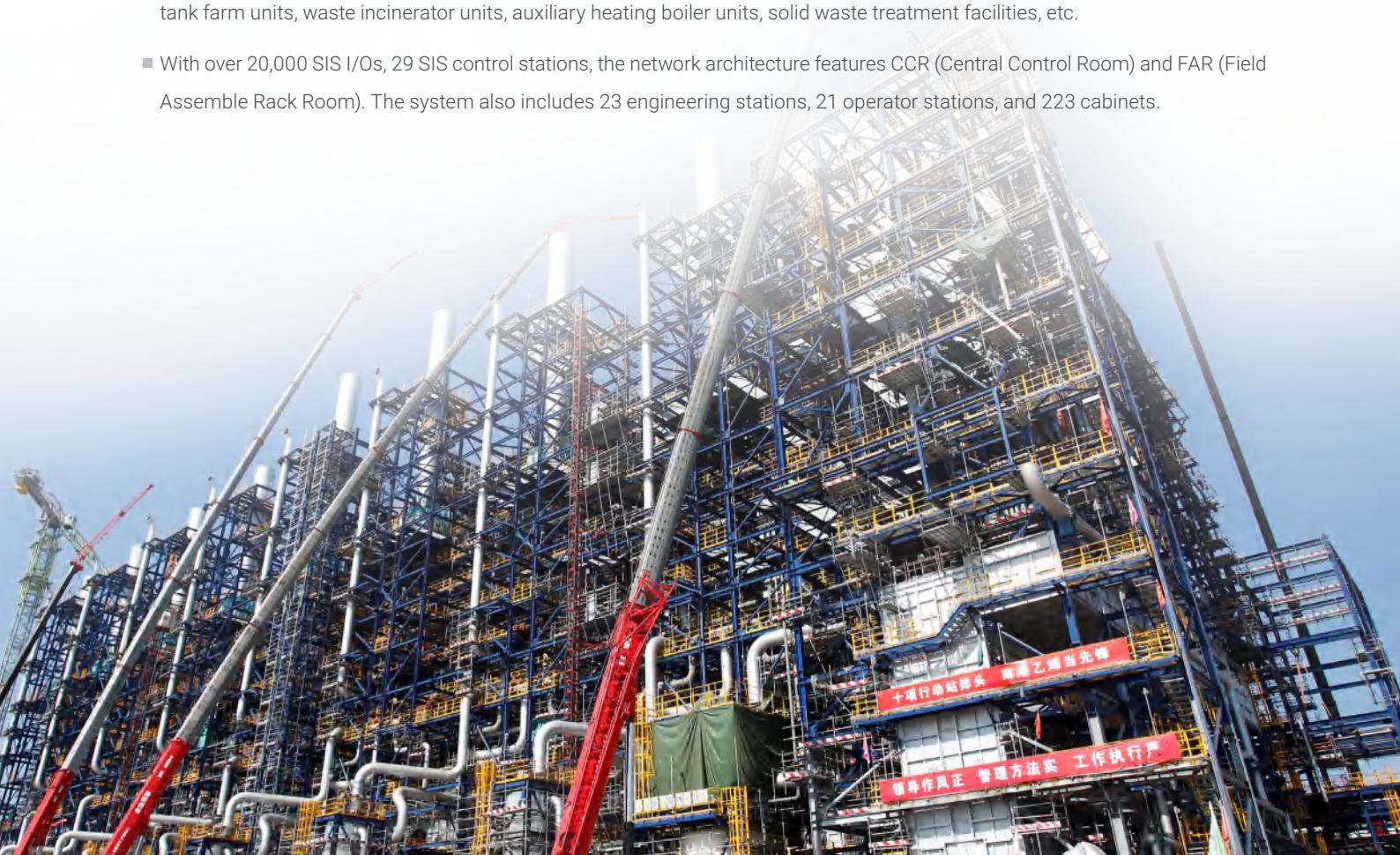
Sinopec Tianjin Nan'gang 1.2 MTA Ethylene & Downstream High-End New Materials Industry Cluster Project (SIS)

Project Background

- Sinopec's first large-scale refining and chemical project focusing on high-end new materials.
- A large integrated SIS project used for the megaton ethylene main units and a key research project in Sinopec's million-ton ethylene engineering, promoting the advancement of critical control systems in major energy sectors.

Solution

- The application equipment of the project includes ethylene cracking furnace, cracking steam and oil hydrogenation units, butadiene extraction units, MTBE/ butene-1 units, aromatics extraction units, LLDPE units, PP units, LAO units, POE units, tank farm units, waste incinerator units, auxiliary heating boiler units, solid waste treatment facilities, etc.
- With over 20,000 SIS I/Os, 29 SIS control stations, the network architecture features CCR (Central Control Room) and FAR (Field Assemble Rack Room). The system also includes 23 engineering stations, 21 operator stations, and 223 cabinets.





Zhongke (Guangdong) Refinery & Petrochemical Dongxing Branch 5 MTA Oil Refinery Retrofitting Project (SIS)

Project Background

The pre-retrofit system had been running for an extended period with incomplete documentation. The customer required an optimized control solution while considering limited cabinet space and cable reuse. The retrofit had to be completed within a tight 45-day schedule.

Solution

The application equipment of the project includes diesel hydrogenation units, continuous reforming units, atmospheric and vacuum distillation units, sulfur recovery units, 2# catalytic units, styrene units, etc. There are 8 sets of SIS control stations with 2,118 SIS points, as well as 6 engineering stations, 7 operator stations and 31 cabinets.

CNOOC Shenzhen Branch Enping 15-1 Oilfield Cluster Development Project (ESD+FGS)

Project Background

It is a landmark project in CNOOC's digital transformation and intelligent oilfield construction, and an offshore oilfield to adopt intelligent solutions at the design stage. It is also the largest offshore oil production platform in Asia.

Solution

HollySys is the primary automation supplier for multiple platforms in the project, providing ESD and FGS with over 6,300 points. The system includes 12 ESD and FGS control stations, using a distributed network structure of CCR (Central Control Room) and FAR (Field Assemble Rack Room) and onshore terminals. It also features 4 engineering stations, 10 operator stations, and 48 cabinets.

Sinopec Guangzhou Branch Safety Instrument System Application Project

Project Background

As the petrochemical and chemical industry rapidly advances toward automation and intelligence, demands for production safety and environmental protection are increasingly stringent. SIS has become a crucial technology for ensuring safe production and regulatory compliance.

Solution

The project encompasses 5 units – aromatic intermediate tank area, flare, polystyrene, distillation and storage tank area – covering over 1,600 points. The system configuration includes 6 SIS controllers, 19 cabinets, 5 engineering stations, and 12 operator stations.

Zhong'an United Coal Chemical (ZAUCC) 1.7 MTA Coal to Methanol and Olefin Conversion Project (GDS)

Project Background

It is a flagship project of Sinopec's integrated coal chemical operations.

Solution

HollySys participated in the project construction in MAV mode. The project involves 9 coal chemical units with over 4,200 GDS points. The system is equipped with 12 control stations, 3 engineering stations, and 16 operator stations.





BASF (Guangdong) Integrated Base Project (GDS)

Project Background

- With a total investment of approximately 10 billion euros, it is the largest single investment by a German company in China.
- The project was launched in November 2019, and its 1st phase includes 10 production clusters, with a focus on a 1 MTA ethylene unit and downstream processing units, each developed using EPC models.

Solution

As a Gas Detection System (GDS) supplier, HollySys provided 10 GDS with over 5,200 points, 17 units, 52 controllers, and 118 cabinets for the 10 production clusters using HiaGuard SIL3 SIS.

Sinopec-SABIC (Tianjin) Petrochemical 1.3 MTA Ethylene Retrofitting Project (GDS)

Project Background

It is a large-scale application of GDS with large single-unit output cracking furnace.

Solution

- The project covers ethylene cracking, separation device, circulating water device, tank farm, HDPE units, low temperature loading and unloading station, fire pump station and glycol device and so on.
- With 2,064 GDS points, the system includes 4 GDS control stations, using a network architecture of CCR (Central Control Room) and FAR (Field Assemble Rack Room). The system also includes 1 engineering station, 12 operator stations, and 20 cabinets.

Luxi Chemical Group Coal Gasification Unit Upgrading Project (SIS)

Project Background

The coal gasification unit upgrading was aimed at enhancing production efficiency, improving technical compatibility and system safety, simplifying operation and maintenance processes, and reducing overall operating costs.

Solution

This project includes 5 coal gasification unit furnaces, with nearly 1,500 SIS points. The system configuration includes 5 control stations, 5 engineering stations, and 5 operator stations.

Qikou 17-3 Platform Central Control System Retrofitting Project (SIS + FGS)

Project Background

It is an offshore platform control system project initiated to replace the old system.

Solution

The pre-retrofit system, a Mitsubishi PLC, was in use from 1995 to 2014. The project completed in 2014 includes nearly 200 SIS points and 200 FGS points.



Appendix

Appendix 1: Standards and Specifications

Functional safety	IEC 61508 Parts 1-7:2010 IEC 61511 Parts 1-3:2016
General standards	IEC 61131-2:2017 IEC 61131-6:2012
	IEC 61326-3-1:2017
	IEC 61000-6-7:2014
	IEC 61000-6-2:2016
	IEC 61000-6-4:2018
Electromagnetic compatibility	IEC 61326-1:2012 IEC 61131-6:2012 IEC 61000-4-11:2004 IEC 61000-6-4:2011 IEC 61000-4:2008 IEC 61000-4:2004 IEC 61000-4:2005
Corrosion prevention	ANSI / ISA 71.04-2013
	NFPA72:2016
	EN54-2:1997/A1:2006
	NFPA85:2015
Application standards	NFPA86:2015 EN50156-1:2015 EN298:2012 EN50130-4:2011+A1:2014
Classification Society Certification	GD22-2015



Appendix 2: Hardware List

Products	Model	Clarification
Power module	QS10	Power supply module, 24 V DC/10 A
	QS20	Power supply module, 24 V DC/20 A
	PRO MAX 240 W 24 V 10 A	Power supply module, 24 V DC/10 A
	PRO MAX 480 W 24 V 20 A	Power supply module, 24 V DC/20 A
Rack	SGM101	Main rack
	SGM110	Extension rack
Controller	SGM201	Controller
Communication module	SGM210	System communication module
	SGM220	Remote I/O communication module (multi-mode optical fiber)
	SGM221	Remote I/O communication module (three-port single-mode optical fiber)
	SGM222	Remote I/O communication module (single-port single-mode optical fiber)
	SGM230	Modbus communication module
	SGM240	I/O communication repeater module
	SGM410	16-channel analog input module
I/O module	SGM410H	16-channel analog input module with HART
	SGM412H	32-channel analog input module with HART
	SGM520	8-channel analog output module
	SGM520H	8-channel analog output module with HART
	SGM610	32-channel digital input module
	SGM610S	32-channel full diagnostic digital input module
	SGM710	32-channel digital output module
I/O terminal board	SGM633	32-channel switch input module
	SGM3410	16-channel analog input terminal module
	SGM3410H	16-channel analog input terminal module with HART
	SGM3412H	32-channel analog input terminal module with HART
	SGM3520	8-channel analog output terminal module with HART
	SGM3610	32-channel digital input terminal module
	SGM3610S	32-channel full diagnostic digital input terminal module
Cable	SGM3620	32-channel digital input relay terminal module (non-safety)
	SGM3710	32-channel digital output terminal module
	SGM3720	32-channel digital output relay terminal module (non-safety)
	SGM3633	Pulse input and overspeed protection terminal module
	SGX002	IO Bus communication extension cable of 2 m, 4 m, 5 m, 10 m, and 15 m to connect two racks
	SGX006-SGX011	78-core pre-fabricated cable of 1.5 m, 2 m, 4 m, 6 m, 10 m, 16 m to connect racks and terminal modules
	SGX012	Modbus module communication extension cable of 3 m
Fault detection module	SGM8610	External cable fault detection module (used with SGM610 module)
Fault detection module	SGM8611	External cable fault detection module (used with SGM610 module)
Placeholder module	SGM020	Empty slot placeholder panel within the rack
Placeholder module	SGM021	Empty slot placeholder module within the rack (European insert corrosion-resistant)

Key Accounts



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