

SPI meets SIS

Using SmartPlant Instrumentation to Document Safety Instrumented Systems

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Implementation
Team



By John Dressel

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Functional safety instrumented systems for the process industry sector

- ◆ **International Electrotechnical Commission (IEC) developed IEC 61511 in 1998**
- ◆ **ISA S84 committee adopted the IEC 61511 standard in 2004 creating ISA 84.01/IEC 61511**
 - These standards called for Safety Instrumented Systems to be designed to automatically respond to potentially dangerous process conditions and take preprogrammed action to mitigate or avoid a dangerous condition
 - The safety-related portion of the Plant Control Systems configuration must remain in place for the lifecycle of the plant
 - Provides a framework for establishing safety integrity levels and hardware fault tolerances
 - Preparation of information and procedures concerning software needed by the user for the operation and maintenance of the SIS

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The screenshot shows the 'FUNCTIONAL SAFETY ZONE' website for IEC 61511. The page features a navigation menu with links for 'ABOUT THE IEC', 'IEC IN ACTION', 'CONFORMITY ASSESSMENT', 'STANDARDS DEVELOPMENT', 'FOR MEMBERS AND EXPERTS', and 'WEB STORE'. The main content area is titled 'IEC 61511, Functional safety: Safety instrumented systems for the process industry sector'. It includes a table of contents with links to 'Introduction', 'IEC 61511-1 Framework, definitions, system, hardware and software requirements', 'IEC 61511-2 Guidelines in the application of IEC 61511-1 - Informative', and 'IEC 61511-3 Guidance for the determination of safety integrity levels - Informative'. There is also a 'WHAT IS RELATED' section with links to 'Horizontal committees and functions', 'Information on Technical Committee', and 'Publications and work in progress'. A 'SEARCH THE SITE' box is visible, and a 'WEB STORE' banner is at the bottom.

Safety Instrumented Systems fit to SmartPlant Instrumentation



- ◆ **Basic Plant Control Systems use SmartPlant Instrumentation to Document:**
 - Indexes
 - Spec Sheets
 - Field Wiring
 - Loop Diagrams
 - Integration to DCS systems
- ◆ **IEC 61511 created Need to Document Safety Instrumented Systems:**
 - Shutdown Systems (ESD),
 - Fire and Gas Systems (F&G)
 - Burner Management Systems (BMS)
 - Safety Interlock (or Instrumented) Systems (SIS)

Plant Control Systems Manufactures Offer Solution for Safety Instrumented Systems



- ◆ **IEC 61508 defines a set of standards for functional safety of electrical or programmable electronic safety-related systems equipment**
- ◆ **IEC 61508 was first published in 1998 with the latest revision published in September of 2005**
- ◆ **Manufactures switched from hard wired Safety systems to safety PLC's and safety networks:**
 - **Internationally Certified**
 - **Lower Installed Equipment Costs**
 - **Heightened Flexibility of Configuration**
 - **Reduced Risk of Process Operator Error**
- ◆ **The SmartPlant Instrumentation now has the burden of documenting the Safety Instrumented System and the Basic Process Control System**

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Safety Instrumented Systems benefit from SmartPlant Instrumentation



- ◆ **Data centric information management**
 - Data is input once and resides only one place and is referenced by other systems with integration.
- ◆ **Reference System data management**
 - Reference System Data for procedures and practices are maintained in the system and readily available to the users
- ◆ **Applying rule bases and data profiles**
 - Rule bases and Data profiles validate data as it is loaded into the databases and govern user input to reduce errors
- ◆ **Automated Document Generation & Management**
 - Documents are controlled for management of Change and automatic report generation from the database

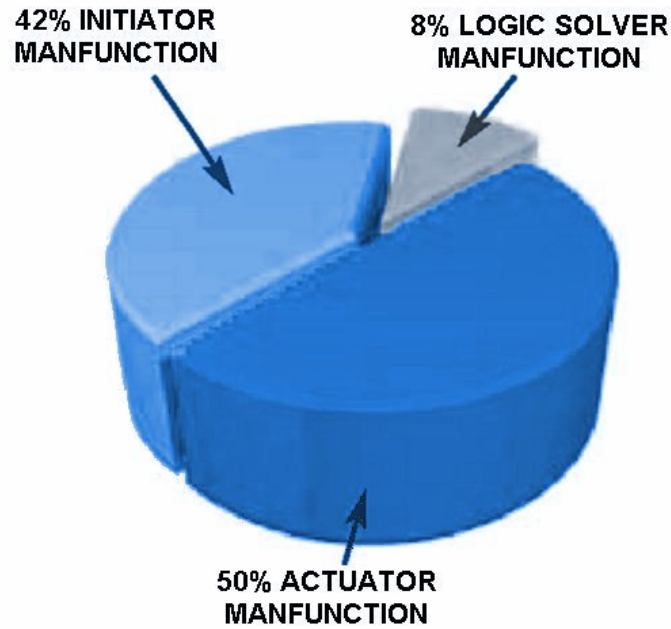
Basic Parts of a Safety Instrumented Systems



- ◆ **Initiators**
 - Primary Sensing Elements (Transmitters & Switches)
- ◆ **Logic Solver**
 - Programmable Logic Controllers or Switch & Relay Logic
- ◆ **Actuators**
 - Final Control Elements (Valves, Motors & Solenoids)



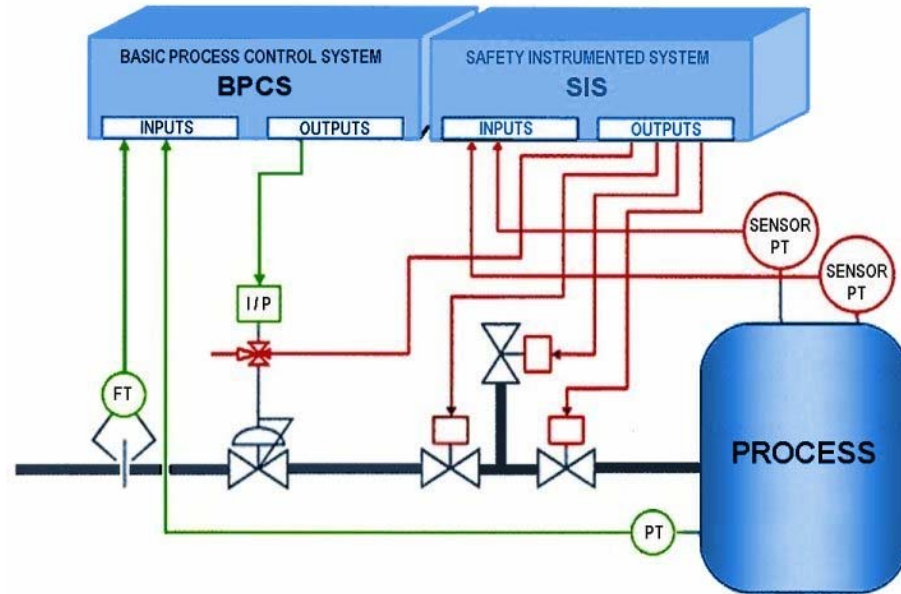
Reliability factors for Safety Instrumented Systems



Per OREDA (Offshore REliability DAta)

- ◆ The most common areas of Failure (92%) are the Initiators and Actuators and their associated wiring systems
- ◆ They are also the two areas that SmartPlant Instrumentation interfaces with the Safety Instrumented System!

Basic Process Control System compared to Safety Instrumented Systems



◆ SIS System Requirements

- Signals are connected to a dedicated Programmable Logic Controller
- Multiple block and bleed Control Valve Configurations
- Partial stroke testing to maintain high SIL ratings
- Power supplied from Redundant UPS systems
- Discrete Outputs Vs Analog
- Redundant I/O

SmartPlant Instrumentation Maintains Safety Instrumented Systems Data



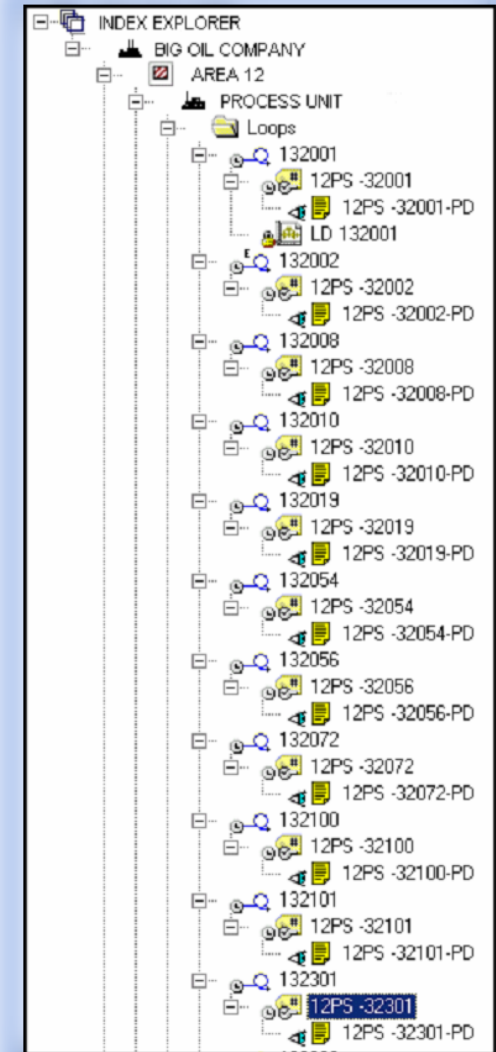
- ◆ **SAFETY INSTRUMENTED SYSTEMS INDEX DATA**
 - All Safety Device Tag Numbers with Related Data
 - Additional Fields of data specific to Safety Devices
- ◆ **SAFETY INSTRUMENTED SYSTEMS SPEC DATA**
 - Specify Safety Devices for Sizing, Selection & Purchase
 - Additional Spec Sheets for Unique Safety Devices
- ◆ **SAFETY INSTRUMENTED SYSTEMS WIRING DATA**
 - All Wiring From Safety Devices to Logic Solver I/O
 - Additional Wiring Requirements for Safety Power System
- ◆ **SAFETY INSTRUMENTED SYSTEMS DOCUMENTS**
 - Reference Document Management System PCS
 - Additional Information Management for Safety Systems
 - Operator Document Retrieval of Safety Information

SAFETY INSTRUMENTED SYSTEMS INDEX DATA



◆ STANDARD BASIC PROCESS CONTROL SYSTEM INDEX DATA

- Plant – Area – Unit Reference
- Instrument Tag Numbers
- Loop association
- Service Description
- Process & Instrument Diagram
- Instrument Function
- Signal Types & I/O Data
- Piping Line Information
- Fabrication Requirements
- Cross References



SAFETY INSTRUMENTED SYSTEMS INDEX DATA



Tag Number	I/O SYSTEM	MAINTENANCE CYCLE	INTERLOCK 1	Service
FT -29407	DCS-DV			K-902 DRY GAS SEAL BUFFER
FT -29480	SIS	6 MONTHS	I-32	MAKE UP & RECYCLE HYDROGEN FEED E-903A
FV -29480	SIS	6 MONTHS	I-32	MAKE UP & RECYCLE HYDROGEN FEED E-903A
FZT -29481	SIS	1 YEAR	I-34	MAKEUP & RECYCLED H2 TO E-903A/B/C
FT -29482	SIS	6 MONTHS	I-30	MAKE UP & RECYCLE HYDROGEN FEED E-903D
FV -29482	SIS	6 MONTHS	I-31	MAKE UP & RECYCLE HYDROGEN FEED E-903D
FZT -29483	SIS	1 YEAR		MAKEUP & RECYCLED H2 TO E-903D/E/F
FT -29485	SIS	6 MONTHS	I-32	MAKE UP & RECYCLE HYDROGEN FEED
FV -29485	SIS	6 MONTHS	I-33	MAKE UP & RECYCLE HYDROGEN FEED
FZT -29486	SIS	1 YEAR	I-34	MAKEUP & RECYCLED H2 TO E-903G/H/I
FT -29487	DCS-DV			FLOW CONTROL OF MAKE UP & RECYCLE HYD
FV -29487	DCS-DV			FLOW CONTROL OF MAKE UP & RECYCLE HYD

- ◆ **Additional Index Data for Safety Instrumented Systems:**
 - **SIL Ratings**
 - **Interlock Numbers**
 - **Maintenance Cycles**
 - **Instrument System Identifiers**
 - **Special Notes for Design Engineering**

- ◆ **User Defined Fields and Tables for Safety Data**

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SAFETY INSTRUMENTED SYSTEMS SPEC SHEETS



- ◆ **STANDARD INSTRUMENT SPEC SHEET DATA**
 - Instrument Tag Numbers
 - Service Description
 - Device sizing Data
 - Design Process Data
 - Operating Process Data
 - Materials of Construction
 - Process Connections Data
 - Signal Connection Data
 - Fabrication Requirements
 - Purchasing Information
 - Revision Control

TAG IDENTIFICATION		DESCRIPTION TYPE		STATUS/REVISION/ISSUE	
ISRA		CONTROL VALVE ASSEMBLY Part 2: Device Specification		Document No.	Issue No.
				Latest revision	Issue status
VALVE BODY AND BONNET					
11	Body type		80	Disclosure type not class	
12	Bonnet style		81	Digital communication and	
14	Inlet cone nominal size	[Rating]	82	Signal power source	
15	Outlet cone nominal size	[Rating]	64	Pressure gauger	
16	Inlet cone trim type		65	Cert/Approval type	
17	Flange facing finish	[Style]	66	Mounting location type	
18	Stem seal type		67	Disclosure material	
19	Face-to-face standard		68		
20	Take boss diameter		69	POSITIONER OR CONTROLLER	
21	Body and Bonnet material		70	Configuration type	
22	Living material		71	Input signal type	
23	Body/Bonnet bolting matl		72	Disclosure type not class	
24	Packing lg bolting matl		73	Signal power source	
25	Gasket material		74	Digital communication and	
26	Packing material		75	Cert/Approval type	
27	Bellows seal material		76	Pressure gauger	
28			77	By-pass manifold	
29			78	Disclosure material	
30			79		
VALVE TRIM					
31	Closure member type		80	PERFORMANCE CHARACTERISTICS	
32	Trim style		81	Max press @ design temp	
33	Shutoff characteristic		82	Max working temperature	
34	Flow direction force		83	Max pressure drop	
35	Port/Orifice diameter		84	Rated flow coeff type	
36	Stem diameter	[Rating]	85	Rated factor F1	
37	Closure member material		86	Rated seat leakage class	
38	Seat ring material		87		
39	Stem material		88	ACCESSORIES	
40	Trim material		89	Air set filter style	
41	Guide/Washer material		90	Air set gauges	
42	Guide bushing material		81	Tubing nominal size	
43	Hard facing/coating		82	Tubing and fitting matl	
44			83		
ACTUATOR					
45	Actuator type		84	SPECIAL REQUIREMENTS	
46	Acting style		85	Custom tag	
47	Effective area		86	Reference specification	
48	Block set URL	[URL]	87	Special preparation	
49	Max supply capability		88	Compliance standard	
50	Handwheel type/posn		89	Construction code	
51	Casing/linder material		90	Software configuration	
52	Diaphragm/D ring matl		101		
53	Take material		102	PHYSICAL DATA	
54			103	Estimated weight	
55			104	Face-to-face dimension	
56			105	Overall height	
57			106	Removal clearance	
58			107	Mfr reference deg	
59			108		
CALCULATIONS AND TEST					
111	TAG NO/ FUNCTIONAL IDENT	MANUFACTURER	TEST OR TEST	ACTION	OUTPUT
112		Block set Travel	LRV	URV	LRV
113		Positioner input-travel			
114		Transducer input-Output			
115		Test pressure			
116					
117					
COMPONENT EVENTS/EXITS					
119	COMPONENT TYPE	MANUFACTURER	MODEL NUMBER		
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SAFETY INSTRUMENTED SYSTEMS SPEC SHEETS



1	Tag Number	SEE LIST	
2	Fire Protection Plan DWG No.		
3	Service	Area Name	SEE LIST
4	Detector Type	EMI Shielding Hz	Infrared Point HC Gas Detector
5	Safety Integrity Level	Approvals	IEC 61508 (SIL Level 2)
6	Area Classification	Zone 2 CENELEC	
7	Output	Range	4-20 mA
8	Gas to be Detected - LPG	BUTANE/PROPANE	
9			
10			

- ◆ **Additional Spec Sheet Data for Safety Instrumented Systems:**
 - Safety Integrity Level Ratings
 - Approvals and Testing Requirements
 - Certifications and Approvals
 - Redundancy or Conditioning Requirements
 - Special Notes for Design Engineering
 - Partial Stroke Testing Requirements (for Valves)
- ◆ **New Spec Sheets May Need to be Added for Safety Devices**

SAFETY INSTRUMENTED SYSTEMS WIRING DATA



◆ SMARTPLANT INSTRUMENTATION STANDARD WIRING DATA

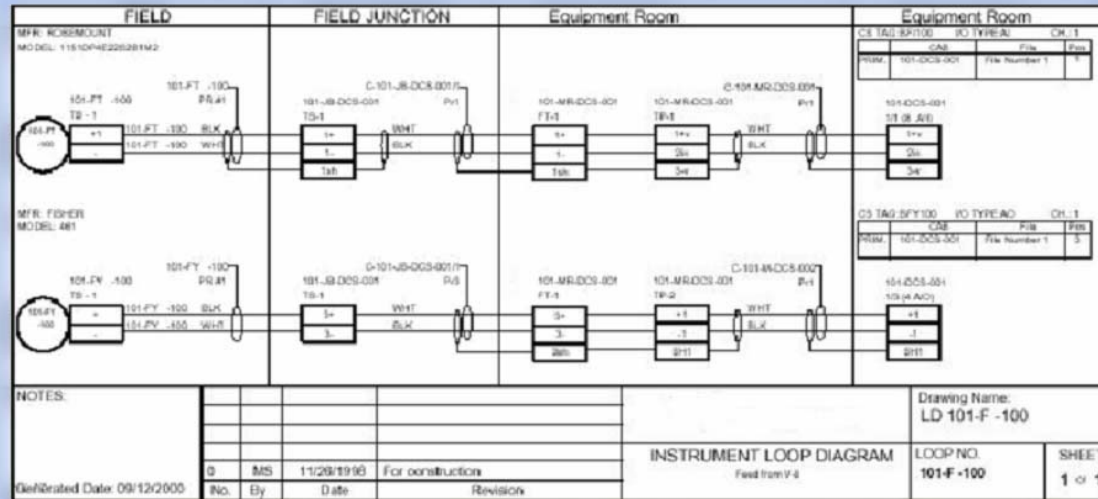
- Wiring of Field Devices
- Signal from Field Devices
- Wiring of Field Junction Boxes
- Home Run Cables and Connectors
- Marshalling Panels and Terminals
- Connections to DCS I/O Cards
- Power Distribution at DCS
- Jumpers and Bus Wiring
- Field Power Wiring
- Grounding Wiring

Connection - SCCB-FGS-01, C251

Terminal strip:
SCCB-FGS-01, 2, 1, C251, C251

Cable	Set	Wire	1	2	3	4	5	6	7	8	9	10	11	12	13		
C251-FGSM-01/FGS-01F	89AFG -5050A	89AFG -5050A	A1	B1	C1	A2	B2	C2	A3	B3	C3	A4	B4	C4	A5	B5	C5
C251-FGSM-01/FGS-01F	89AFG -5030A	89AFG -5030A	A6	B6	C6	A7	B7	C7	A8	B8	C8	A9	B9	C9	A10	B10	C10
C251-FGSM-01/FGS-01F	89AFG -5040A	89AFG -5040A	A11	B11	C11	A12	B12	C12	A13	B13	C13	A14	B14	C14	A15	B15	C15
C251-FGSM-01/FGS-01F	SPARE	SPARE															
C251-FGSM-01/FGS-01F	89AFG -5040F	89AFG -5040F															
C251-FGSM-01/FGS-01F	89OFD -5040E	89OFD -5040E															
C251-FGSM-01/FGS-01F	89AFG -5030E	89AFG -5030E															
C251-FGSM-01/FGS-01F	89AFG -5030H	89AFG -5030H															
C251-FGSM-01/FGS-01F	89PT -5030B	89PT -5030B															
C251-FGSM-01/FGS-01F	89PT -5131B	89PT -5131B															
C251-FGSM-01/FGS-01F	89AFG -5066A	89AFG -5066A															
C251-FGSM-01/FGS-01F	SPARE	SPARE															

SAFETY INSTRUMENTED SYSTEMS WIRING DATA



- ◆ **Issues When Wiring Safety Instrumented Systems:**
 - PLC I/O Redundant Power Distribution uses common bus
 - Maintain Physical Separation between SIS and BPCS wiring
 - Minimize terminals and connections as points of failure
 - Special Colors, Markings and Labels for Safety Systems
- ◆ **May Need to Create Ladder Wiring instead of Loop Diagrams**

SAFETY INSTRUMENTED SYSTEMS DOCUMENTATION



◆ STANDARD AUTOMATION SYSTEM DELIVERABLES

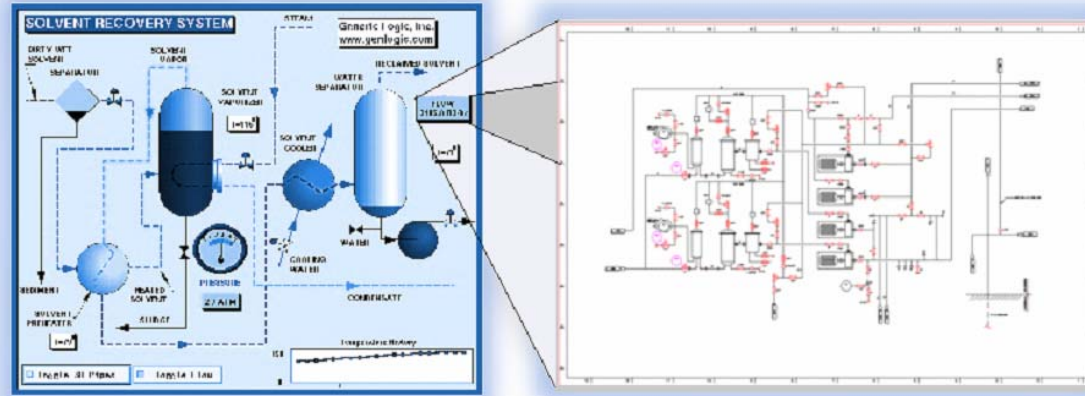
- Instrument Indexes
- Instrument Spec Sheets
- Process Data Sheets
- Sizing Calculation Sheets
- Field Wiring Diagrams
- Junction Box Wiring Schedules
- Instrument Cable Schedules
- Instrument Loop Diagrams
- Maintenance Schedules
- Maintenance Reports
- Instrument Calibration Reports



- ◆ **Not all SIS deliverables can be easily produced or generated with SmartPlant Instrumentation**

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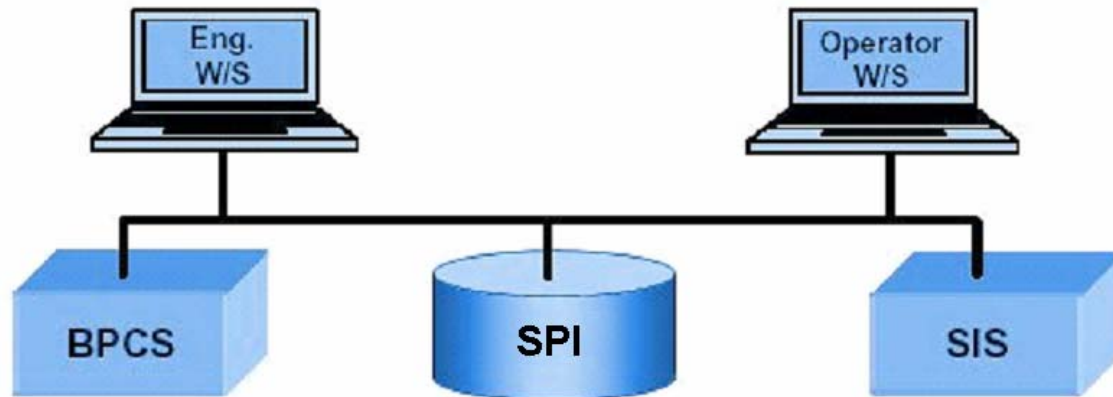
SAFETY INSTRUMENTED SYSTEMS DOCUMENT MANAGEMENT



- ◆ **Dynamic Document Management of Electronic Safety Documents:**
 - Safety Plan
 - Hazard Reviews
 - Pre-Start-up Acceptance Test
 - Safety Requirements Specification
 - Safety Instrumented System Design
 - Operation and Maintenance Procedures
- ◆ **SmartPlant Instrumentation and Safety Documents may be Integrated to provide Operators with another layer of Safety to overall Plant Operations by providing facilities for quick disaster recovery**

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Safety Instrumented Systems Integration To SmartPlant Instrumentation



- ◆ **Documenting and Integrating Safety Instrumented Systems with SmartPlant Instrumentation Results:**
 - Integrity of the Data Centric Environment Provides for Maintaining and Accessing the Safety Instrumented Systems Information
 - Automatic Change Management Updates Reports and Display Screens as Configuration Changes, Helps Meet Regulatory Requirements
 - Controlled Access, and Electronic Records Keeping Needed for the Operation and Maintenance of the Safety Systems
 - Real Time Access to Process Control System and Safety Instrumented Systems Data Provides Facilities for Quick Disaster Recovery

Questions?

ASCII stupid question

Get a stupid ANSI

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