



The Kenexis Vertigo™ safety instrumented system safety lifecycle software provides an all-in-one software solution to the design of SIS in accordance with IEC 61511 /ISA 84. The software provides users with a powerful enterprise solution for developing conceptual designs, documenting/tracking design changes, and maintaining design documentation throughout the life of the system.

Server Hardware Specifications

Vertigo is built on cloud based architecture, based on Microsoft Azure, to create a multi-site multi-user global enterprise software experience. The core of the application framework are Kenexis' powerful server computers that run the application code and store data.

Server Operating System:	Windows Server - 2013
Database Engine:	Microsoft SQL Server – Latest Version
Web Server Engine:	Microsoft Internet Information Services – Latest Version
Server Hardware:	Multi-Core Multi-threaded High Performance Processor Array
Data Storage:	RAID Multi-Drive
Availability:	>99% Guaranteed
Data Backup:	Daily – Offsite; 30 days of backup available; Offsite Annual backup maintained for 5 years

Client Requirements

Users of Vertigo access Kenexis' powerful server architecture through their own client devices through a simple web browser. Vertigo can be accessed by almost any computer, tablet, or even smart phone, in almost any location – worldwide, at any time. This allows diverse work teams across the globe to seamlessly work together regardless of time zone or computer system.

Client Device Types:	Computers (and laptops), Tablet Computers, Smart Phones
Supported Operating Systems:	Windows, Mac OS, Linux, iOS, Android, Windows Phone
Supported Web Browsers¹:	Chrome, Edge, Internet Explorer, Safari, Firefox
Connectivity:	Any variety of internet connectivity

¹ Some more advanced features, such as manipulation of 3D graphics, are only supported by the most recent versions of a browser. Otherwise, Kenexis supports the past three versions of each browser listed.



Client Accounts

Kenexis is robust enterprise software, but it has the flexibility to allow organizations and individual users to set up accounts to meet their own needs.

Account Types:

Concurrent User - This account is accessed from the Kenexis Public Server (shared application code and database). Unlimited users from a single organization are licensed to access the software and associated data, but only the specified number (i.e., the number of licenses) can access the application simultaneously. Professional Accounts are available on an annual basis.

Pay-As-You-Go - This account is accessed from the Kenexis Public Server (shared application code and database). Unlimited users from a single organization are licensed to access the software and associated data with no limit on the number of simultaneous users, and there is no limit on the number of users that can be accessing the application simultaneously. At the end of each calendar month, the account is invoiced for the duration of time that the application was used during that month.

Private Node:

As an option, any user or group of users, can obtain a private node. The private node is operated by the same powerful Kenexis server system that operates the public server, but in a private node the group maintains a separate set of application code and a separate database for results storage. Private nodes can also be customized with custom graphics and custom URL for access.

Private Server:

As an option, any user or group of users, can obtain a private server. The private server allows for complete physical and functional separation from any other users of the Kenexis instrumented safeguard suite. This option provides for a completely separate and dedicated computer system for the user group.

Handling Multiple Project

Vertigo, through the KISS project manager, allows for the creation, manipulation, and management of an unlimited number of projects.

Project Types:

Vertigo – Safety Instrumented System Safety Lifecycle Management
Acorn – Fault Tree Analysis (Included with Vertigo)
Effigy – Fire and Gas Mapping (Sold Separately)
OpenPHA – Process Hazards Analysis (HAZOP and LOPA)

Tracked Project Data:

Study Name, Study Type, Date Modified, Current Revision



Project Actions:

Create New Study, Load Study, Copy Study, Delete Study, Import/Export Study²

Data Libraries

Vertigo contains data libraries that allow for fast and accurate modeling of a wide variety of safety instrumented function configurations. Kenexis has compiled data for most safety instrumented system equipment vendors. In addition to the Kenexis libraries users can create their own custom libraries.

Available Libraries:

Process Connections, Sensor Interface Devices, Sensors, Logic Solvers, Final Element Interface Devices, Final Elements

Equipment Attributes:

Failure Rate (Overall), Safe Failure Percentage, Diagnostic Coverage (Dangerous), Diagnostic Coverage (Safe), Device Type (A or B), Process Parameter Measured Data Trace Reference, Hardware Fault Tolerance, Maximum SIL Capability

Equipment Data Source:

Vendor Literature or Kenexis Analysis of publicly available databases supplemented by Kenexis analysis and confidential sources of failure statistics for process industry facilities. Equipment vendor data is overseen through close coordination with industry through the Kenexis Vendor Coordination Program

Equipment Vendors Included:

ABB, ASCO, Bentley Nevada, Berthold, CCC, Detronics, Emerson, Endress+Hauser, Fisher, HIMA, Kidde, K-TEK, Magnetrol, Masoneilan, Maxon, Mokveld, MSA, Moore Industries, Neles, Pepperl+Fuchs, Rockwell, Rosemount, Siemens, Sierra Monitor, Smar, Triconex, United Electric, Vega, WIKA, Yamatake, Yokogawa, Zellweger,
Other vendors and makes can be added within minutes upon submittal of IEC 61508 Part 2&3 certification report style testing results

The screenshot displays the Vertigo software interface. On the left, a 'Library List' pane shows a tree structure with categories like 'Custom', 'Eds Custom', 'Kenexis Premium', 'Failure Rate Data', 'Sensor Interfaces', 'Sensors', 'Logic Solvers', 'Final Elements', 'Final Element Interfaces', 'SRS General Requirements', and 'Kenexis Standard'. The 'Sensors' category is selected. The main window shows a table of sensor data for 'pressure transmitter'. A 'Sensor Type Details (READ ONLY)' dialog box is open, showing fields for Type, Description, Failure Rate (Per Hour), Safe Coverage (%), Database Reference, Architectural Constraint Type, Percent Safe (%), Dangerous Coverage (%), and Database Revision.

Type	Description	Failure Rate (per hour)	Percent Safe	Safe Coverage	Dangerous Coverage	Arch Const Type	Database Reference	Database Revision
Pressure Transmitter - Manufacturer: Endress+Hauser	Endress+Hauser Model: Deltabar S PMD75 / FMD77 / FMD78 - Differential / Gauge Absolute Pressure	5.17E-7	73.3 %	100.0 %	50.0 %	B	1.166	3.11
Pressure Transmitter - Generic (Hi Trip / Diag / Clean)	Generic Pressure Transmitter - Either Differential Pressure or Gauge Pressure type - Configured for High	1.5E-06	100.0 %	100.0 %	56.0 %	B	1.111	3.01

² Importing and Exporting of complete studies can be performed from an export file generated by Vertigo or other KISS applications. The import/export file will be an .xlsx file with database data. Export/Import files allow transfer of data amount multiple different servers.



Instrumented Protective Function List (SIF List)

Vertigo defines all the instrumented functions that are included in a project or facility in the IPF List. No need to limit application to SIS, all SCAI (Safety Controls, Alarms, and Interlocks) can have their lifecycles (including specifications and proof testing) in Vertigo, easing compliance with the ISA 84.91.03 standard. The IPF list allows for the definition of each function in terms of inputs, outputs, voting logic, and logic solver. This page also allows for access to more detailed information on each function and the ability to delete or edit functions.

IPF List	SIL Verification Summary	Events	Revisions							
+ Add New IPF										
Tag	IPF Description	IPF Type	Selected SIL	Sensors Tag	Voting	Input Group Logic	Final Elements Tag	Voting	Output Group Logic	IPF Notes
	Vibration Stops Compressor (Typical of Many)						(STOP)			
USC-104G	Gas Compressor (C-104) High-High Axial Displacement Stops Compressor	SIF	SIL 1	GT-105A	1001	1001	C-104-M (STOP)	1001	1001	✖
USC-104H	Gas Compressor (C-104) Low-Low Lube Oil Differential Pressure Starts Aux Lube Oil Pump	BPCS	No SIL	PDT-105C (LOW)	1001	1001	P-104B-M (START)	1001	1001	✖
USC-105A	Export Gas Pipeline Low-Low Pressure Closes Outlet Valve	SIF	SIL 1	PT-106B (LOW)	1001	1001	SDV-106 (CLOSE)	1001	1001	✖
Z-FGS-101D	High Pressure Separator Water Deluge	F&G	No SIL	FZT-101A	1001	1001	UZV-101FGS	1001	XooX	Water Deluge of High Pressure Separator Based on Fire Detection
							SDV-101 (S OSEF)	1001		

Document List

The user records information about documents that are referenced by the SIS design basis study, including drawing number, revision, and description. In addition, the ability to create a link to an external database that contains the drawing is available.

+ Add New Document				
Drawing Number	Revision	Document Type	Description	Link
D254.001	1	P&ID	Process Flow Diagram - Gas Production Facility	https://onedrive.live.com/redirect?resid=3D7CB78ABBBF4372193334&authkey=Zw&ithint=file%2cpdf
D254.002-01	1	P&ID	Legend Sheet - Gas Production Facility	https://onedrive.live.com/redirect?resid=3D7CB78ABBBF4372193330&authkey=Zw&ithint=file%2cpdf
D254.002-02	1	P&ID	High Pressure Separator - Gas Production Facility	https://onedrive.live.com/redirect?resid=3D7CB78ABBBF4372193333&authkey=Zw&ithint=file%2cpdf
D254.002-03	1	P&ID	Low Pressure Separator - Gas Production Facility	https://onedrive.live.com/redirect?resid=3D7CB78ABBBF4372193331&authkey=Zw&ithint=file%2cpdf
D254.002-04	1	P&ID	Pipeline Pump - Gas Production Facility	https://onedrive.live.com/redirect?resid=3D7CB78ABBBF4372193332&authkey=Zw&ithint=file%2cpdf

Instrumented Protective Function Groups

Vertigo collects and arranges SIS design basis information in terms of Instrumented Protective Function (IPF) Groups. An IPF Group is a collection of functions that are all related, usually as the result of serving a single piece of major process equipment, or a



plant, or even an entire facility. The IPF Group is used to sort and order instrumentation in the safety requirements specifications and cause-and-effect diagrams.

TAG	DESCRIPTION		
USC-101	High Pressure Separator		✗
USC-102	Low Pressure Separator		✗
USC-103	Export Pump		✗
USC-104	Export Compressor		✗
USC-105	Liquid Export Pipeline		✗

Instrument Type Data

Vertigo contains an extensive library of SIS equipment that includes the failure rate data required for SIL verification. Each study contains an instrument type list where data can be imported from the main libraries. The instrument type data is stored at the study level to ensure that any changes in the master library will not alter the validated and certified results for a particular study. This also allows custom device types to be built and utilized in specific projects.

Process Connections	Sensor Interfaces	Sensor Types	Logic Solver Types	Final Element Interfaces	Final Element Types					
+ Add New Sensor Type										
Type	Description	Failure Rate (Per Hour)	Percent Safe	Safe Coverage	Dangerous Coverage	λ_{SD}	λ_{SU}	λ_{DD}	λ_{DU}	
Axial Displacement Sensor - Generic	No special diagnostics - for use with O&G sample plant only	5.00E-7	50.0 %	0.0 %	0.0 %	0.00E0	2.50E-7	0.00E0	2.50E-7	✗
Flame Detector - Generic - UV/IR Detection	Flame Detector - Generic - UV/IR Detection	6.00E-6	30.0 %	0.0 %	65.0 %	0.00E0	1.80E-6	2.73E-6	1.47E-6	✗
Level Transmitter - Generic (Displacement / Hi Trip)	Generic Level Transmitter - Displacer type - Configured for Low Trip - Low and High signal (<4 mA & >20 mA) PLC Diagnostics	3.00E-6	3.3 %	100.0 %	57.0 %	9.90E-8	0.00E0	1.65E-6	1.25E-6	✗
Level Transmitter - Generic (Displacement / Lo Trip)	Generic Level Transmitter - Displacer type - Configured for Low Trip - Low and High signal (<4 mA & >20 mA) PLC Diagnostics	3.00E-6	55.0 %	100.0 %	7.0 %	1.65E-6	0.00E0	9.45E-8	1.26E-6	✗
Pressure Transmitter - Generic (Hi Trip / Diag / Clean)	Generic Pressure Transmitter - Either Differential Pressure or Gauge Pressure type - Configured for High Trip - Low and High signal (<4 mA & >20 mA) PLC Diagnostics	1.50E-6	10.0 %	100.0 %	56.0 %	1.50E-7	0.00E0	7.56E-7	5.94E-7	✗



Instrument List

Vertigo allows input of a list of instruments that are utilized in a study. The instruments are only contained once in the instrument list, and then can be utilized in multiple different SIF. Each individual instrument is associated with a database instrument type, improving efficiency of data input.

Sensors	Logic Solvers	Final Elements					
+ Add New Sensor							
Tag	Service Description	Instrument Type	Voting	Test Interval (Months)	PFD _{Avg}	STR (Per Hour)	
FT-103B (LOW)	Export Pump Discharge	Pressure Transmitter - Generic (Lo Trip / Diag / Clean)	1oo1	12	2.63E-3	9.00E-7	✖
FZT-101A	High Pressure Separator Fire Detection	Flame Detector - Generic - UV/IR Detection	1oo1	12	6.44E-3	4.53E-6	✖
GT-105A	Gas Compressor Axial Displacement	Axial Displacement Sensor - Generic	1oo1	12	1.10E-3	2.50E-7	✖
LT-101B (HIGH)	High Pressure Separator	Level Transmitter - Generic (Displacement / Hi Trip)	1oo1	12	5.46E-3	1.75E-6	✖
LT-101B (LOW)	High Pressure Separator	Level Transmitter - Generic(Displacement / Lo Trip)	1oo1	12	5.50E-3	1.74E-6	✖
LT-102B (HIGH)	Low Pressure Separator (V-102)	Level Transmitter - Generic (Displacement / Hi Trip)	1oo1	12	5.46E-3	1.75E-6	✖
LT-102B (LOW)	Low Pressure Separator (V-102)	Level Transmitter - Generic(Displacement / Lo Trip)	1oo1	12	5.50E-3	1.74E-6	✖

Facility Overlay:

All equipment items and detectors are drawn on top of the facility overlay graphic to provide context.

Instrument Details – Calculation

Selecting a specific instrument allows information required for performance calculations to be entered and edited. Detailed calculation results for all attributes are presented.

Input Data:

Type:	Selection of the instrument type from the instrument type database.
Tag:	Tag name of the instrument
Description:	Service description for the instrument.
Voting:	Selection of the voting arrangement for the instrument – 1oo1, 1oo2, 2oo2, 2oo3
Testing Interval:	The duration, in months, in between manual function tests for this instrument.
Process Connection:	The instrument type for the process connection (selection)
Sensor Interfaces:	The instrument type for up to two different sensor interface devices like IS barriers (selection)
MTTR (Hours):	Maximum duration required to repair the failed instrument
Common Cause Flag:	Selection that determines whether common cause failure contribution is calculated. If true, input of common cause beta factor is required.
Detected Failure Flag:	Selection that determines whether a detected failure automatically results in movement of the process to a safe state, or continued



Online Testing:

process operation with bad process variable alarm. If not true, input of diagnostic test interval is required.

Imperfect Testing:

Selection that determines whether the contribution of unavailability due to instrument bypassing during online testing is calculated. If true, a test duration is required.

Selection that determines whether the contribution of unreliability due to imperfect manual testing is calculated. If true, a manual proof test coverage factor and instrument useful life duration is required.

Type

Level Transmitter - Generic (Displacement / Hi Trip)

New

Tag

LT-101B (HIGH)

Description

High Pressure Separator

Test Interval (Months)

12

Voting

1oo1

Process Connection

Tubing - Generic (Clean Service)

New

Sensor Interface 1

Intrinsic Safety Barrier - Generic

New

Sensor Interface 2

None

Overall Subsystem Failure Rates

λ_{SD}

λ_{SU}

λ_{DD}

λ_{DU}

λ_{DN}

9.90E-8

1.50E-7

1.65E-6

2.15E-6

0.00E+0

Update

Cancel

Calculated Data:

Summary Failure Rates:

Summed failure rates for the overall subsystem considering the process connection and interface devices in addition to the instrument

PFD_{avg} Contribution:

The calculated contribution to the average probability of failure on demand from each attribute of probability of failure.

STR Contribution:

The calculated contribution to the spurious trip rate from each attribute of spurious trip rate

Total PFD_{avg}:

Total average probability of failure on demand, the sum of all the probability of failure on demand components

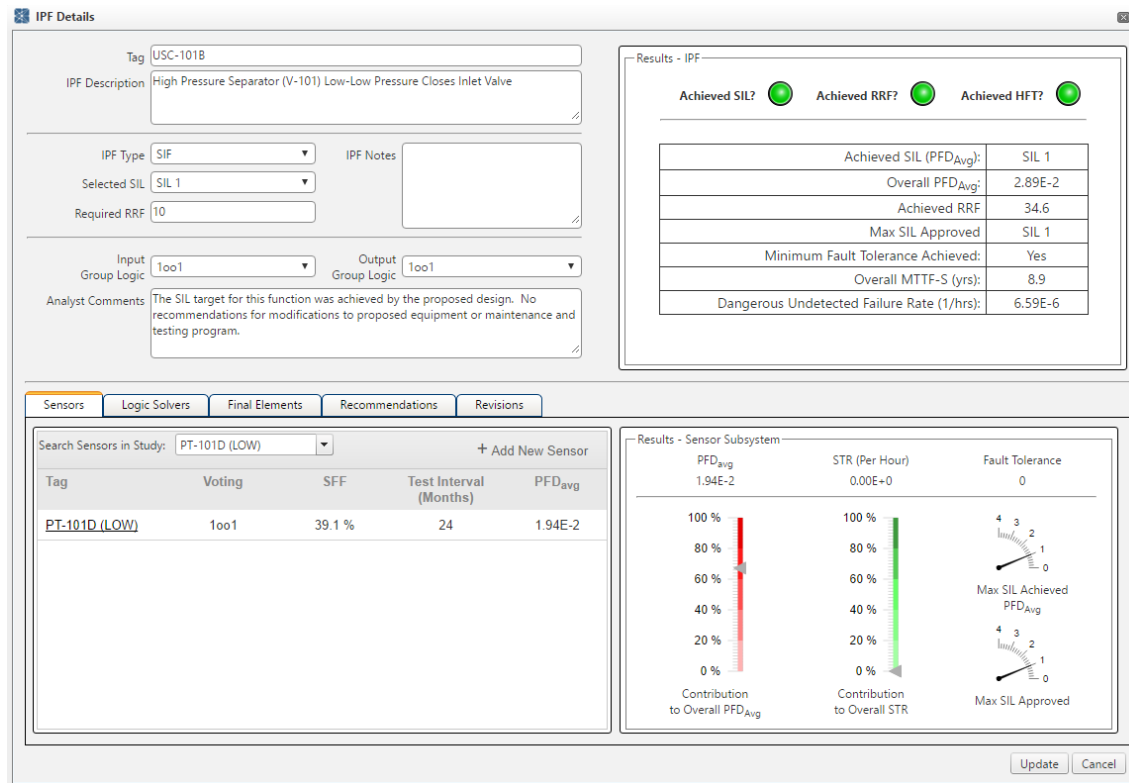
Total STR:

Total spurious trip rate, the sum of all the spurious trip rate components



SIL Verification Results

Vertigo provides SIL verification and conceptual design review results. This includes the achieved SIL along with a host of other metrics supporting the verification of achieved SIL.



SIL Achievement Flags:

Indicator lights quickly show whether a SIF has achieved its various performance targets for SIL, RRF, and hardware fault tolerance (HFT) Safety integrity level achieved by the design only considering the average probability of failure on demand calculation.

Achieved SIL (PFD):

Overall PFDavg:

The overall average probability of failure on demand achieved by the SIF considering the sensor, logic solver, and final element subsystems. Performance of the individual subsystems can be viewed in their respective tabs.

Achieved RRF:

Risk reduction factor (1/PFD) achieved by the safety instrumented function.

Max SIL Approved:

The maximum SIL that the SIF is approved for use in considering both the probability of failure on demand and architectural constraints (i.e., minimum fault tolerance).

Min Fault Tolerance Achieved:

Flag indicating whether or not the required minimum fault tolerance for the SIF has been achieved. Calculation performed in accordance



with IEC61511 tables and IEC 61508 tables, least restrictive result utilized.

Overall MTTF(S):

The overall mean time to fail safe for the SIF, consider all subsystems.

Dangerous Undetected Fail Rate:

Rate of dangerous undetected failures of the SIF. This figure would be utilized if the SIF were a continuous mode SIF.

The tabular results are presented in combination with graphical indicators to enhance understanding of the performance metrics. More information is available on other tabs including calculations details for the sensor subsystem, logic solver subsystem, and final element subsystem, along with access to recommendations that are related to the SIF, and a tracking of revisions for the SIF.

Safety Requirements Specifications

Safety Requirements Specifications (SRS) information is stored and edited in a relational database format so that information only needs to be edited in one location, but can be reported in a variety of ways that may be required by users of the information. SRS information is stored at the following levels.

- Project / SIS Level
- Instrumented Protective Function Group Level
- Instrumented Protective Function (or SIF) Level
- Instrument Level

SRS General Requirements

At the project or SIS level, SRS information can be entered as General Requirements that apply to all portions of an SIS. General requirements can be entered and edited individually, or imported in bulk from libraries.

Item	Req Group	Requirement
1.1	Purpose	This document specifies the safety requirements of Instrumented Protective Functions (IPF) associated with the Gas Plant at the Texas City Facility. All IPF together represent the Safety Instrumented System (SIS). This document also specifies requirements for all of the functional activity performed by the SIS regardless whether or not it is safety critical. This specification describes both the functional requirements and integrity requirements of each IPF.
1.2	Purpose	Where applicable, this specification is designed to be in compliance with ANSI/ISA 84.01-2004 Application of Safety Instrumented Systems for the Process Industries and IEC 61511 Functional Safety – Safety Instrumented Systems for the Process Industries.
2.1		applies to the SIS of the Gas Plant, including the IPF identified in the Gas Plant Safety Instrumented System design basis report and other additional non-safety critical actions.
2.2		specifies requirements for functional safety and safety integrity of the Gas Plant Unit SIS design as per consensus standards from ISA and IEC (where applicable) and Client engineering practices that guide users of the Gas Plant in achieving functional safety. This SRS provides general functional requirements of the SIS and details that are specific to achieving functional safety. This document does not provide a comprehensive specification of the detailed design. The selection of specific equipment devices, materials of construction, details of piping, configuration, and wiring, consideration of ambient conditions in device selection, details of installation, and other very important considerations for safety instrumented system design, but are outside of the scope of this document. The detailed design contractor of the SIS specified in this document shall be responsible for the implementation of these SRS requirements provides only one component in achieving a safe process design.



SRS Cause-and-Effect Diagrams

Functional logic for the SIS can quickly and easily be generated for IPF groups. The bulk of the cause and effect diagram is automatically generated based on assignment of IPF groups to instruments. Only the intersections that define output responses to input activations need to be defined.

USC-101

			Voting	1oo1
			Description	High Pressure Separator Inlet
			Tag	SDV-101 (CLOSE)
Tag	Description	Voting	SC	
LT-101B (HIGH)	High Pressure Separator	1oo1	<input checked="" type="checkbox"/>	X
LT-101B (LOW)	High Pressure Separator	1oo1	<input checked="" type="checkbox"/>	X
PT-101D (HIGH)	High Pressure Separator	1oo1	<input checked="" type="checkbox"/>	X
PT-101D (LOW)	High Pressure Separator	1oo1	<input checked="" type="checkbox"/>	

Update

SRS Details – Sensors

SRS General Requirements	IPF Requirements	Sensor Requirements	Logic Solver Requirements	Final Element Requirements																																
+ Add New Sensor																																				
<table border="1"> <thead> <tr> <th>Tag</th> <th>Service Description</th> </tr> </thead> <tbody> <tr><td>LI-105-B/U/F/H/J</td><td></td></tr> <tr><td>TT-104 (HIGH)</td><td></td></tr> <tr><td>PT-102B (HIGH)</td><td></td></tr> <tr><td>GT-105A</td><td>Gas Compressor Axial Displa</td></tr> <tr><td>PT-102B (LOW)</td><td></td></tr> <tr><td>PT-103A/C (LOW)</td><td></td></tr> <tr><td>EZT-101A</td><td>High Pressure Separator Fire</td></tr> <tr><td>PT-104C (HIGH)</td><td></td></tr> <tr><td>PT-105B (LOW)</td><td></td></tr> <tr><td>XT-105-A-F</td><td></td></tr> <tr><td>LT-110 (LOW)</td><td>Compressor Lube Oil</td></tr> <tr><td>PT-101D (LOW)</td><td>High Pressure Separator</td></tr> <tr><td>LT-101B (LOW)</td><td>High Pressure Separator</td></tr> <tr><td>PT-101D (HIGH)</td><td>High Pressure Separator</td></tr> <tr><td>LT-101B (HIGH)</td><td>High Pressure Separator</td></tr> </tbody> </table>					Tag	Service Description	LI-105-B/U/F/H/J		TT-104 (HIGH)		PT-102B (HIGH)		GT-105A	Gas Compressor Axial Displa	PT-102B (LOW)		PT-103A/C (LOW)		EZT-101A	High Pressure Separator Fire	PT-104C (HIGH)		PT-105B (LOW)		XT-105-A-F		LT-110 (LOW)	Compressor Lube Oil	PT-101D (LOW)	High Pressure Separator	LT-101B (LOW)	High Pressure Separator	PT-101D (HIGH)	High Pressure Separator	LT-101B (HIGH)	High Pressure Separator
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Sensor SRS Details

SRS Basic Data

Tag: PT-101D (LOW)

Service Description: High Pressure Separator

IPF Group: USC-101

Trip Type: HH

EU Low: 0

Units: PSIG

Bypass Tag: HS-PT101D

Data Sheet Reference: PT-101D SPEC

Input Type: AI

Safety Critical: ☒

Data Reference: D254.002-02

Trip Setting: 400

EU High: 500

Trip Setting Tolerance: 2

Startup Override & Timer: N/A

Safety Manual: Vendor Manual 001

Action On Failure: Set output to 3.8 mA

Element Response Time: 0.3

Update Cancel

IPF Group:

Selection for which IPF from the IPF list that this instrument is associated with.

Data Reference:

Selection for the document in the document list where that is the data sheet for this instrument.



Trip Type:	Selection of the type of trip activation – LL, L, H, or HH
Trip Setting:	The set point for the trip in engineering units
EU High/Low/Units:	Engineering unit range for the instrument including high, low, and units.
Element Response Time:	The time duration in which the instrument is expected to response to a demand.
Input Type:	Type of electrical input the device provides to the logic solver – analog input (AI), digital input (DI)
Data Reference:	Selection for the drawing in the drawing list where this instrument is contained.
Startup Override & Timer:	Data specifying the type of startup overrides or startup timers that are required for this instrument
Bypass Tag:	Tag number information for the bypass for the instrument
Safety Manual:	Selection for the document in the document list where that is the safety manual for this instrument.
Safety Critical:	Flag indicating whether or not this instrument is safety critical.

SRS Details – Logic Solver

The screenshot displays the 'Logic Solver SRS Details' dialog box within a software interface. The background shows a table with tabs for 'SRS General Requirements', 'IPF Requirements', 'Sensor Requirements', 'Logic Solver Requirements', and 'Final Element Requirements'. The 'Logic Solver Requirements' tab is active, showing a list of logic solvers with columns for 'Tag' and 'Service Description'. Two entries are visible: 'DCS' and 'SIS PLC'. The 'SIS PLC' entry is selected, and its details are shown in the dialog box. The dialog box has a title bar 'Logic Solver SRS Details' and a close button. It contains a section 'SRS Basic Data' with four fields: 'Tag' (SIS PLC), 'Service Description' (Safety PLC Logic Solver), 'Element Response Time' (0.25), and 'Safety Manual' (Safety Manual PLC3 - v1.1). At the bottom of the dialog are 'Update' and 'Cancel' buttons.

Element Response Time:	The time duration in which the instrument is expected to response to a demand.
Service Description:	Service description for the instrument.
Safety Manual:	Selection for the document in the document list where that is the safety manual for this instrument.



SRS Details – Final Element

TECHNICAL DATA

Target Leakage Rate:	Specified maximum leakage rate for valve used as SIF final element
Target Leakage Class:	Specified leakage class for valve used as SIF final element
Drawing Reference:	Selection for the drawing in the drawing list where this instrument is contained.
IPF Group:	Selection for which IPF from the IPF list that this instrument is associated with
SIF Action:	Action taken by the final element to move the process to a safe state
Maintenance Override Tag:	Tag number for maintenance override switch for the final element
SIF Reset:	Tag number for reset switch for the final element
Reset Location:	Location of the reset switch
Data Sheet Reference:	Selection for the document in the document list where that is the data sheet for this instrument
Element Response Time:	The time duration in which the instrument is expected to response to a demand.
Safety Manual:	Selection for the document in the document list where that is the safety manual for this instrument.
Bypass/Handjack/Handwheel:	Specification of a manual means of operating or bypassing an SIS valve.

Proof Test Tracking and Reporting

Vertigo includes the ability to track proof test and report out on the results of the testing. Each individual instrument can be tracked for testing. Vertigo provides lists of all instruments with summary information regarding testing interval, last tested date, due date, and indicator flag for test status. For each individual instrument a summary of testing page can be displayed which will provide information on commissioning and decommissioning dates, along with a listing of all of the test and repair events for the



device. Individual test / repair records for each device are entered that include the date of the test / repair, the result, failure mode of failure if a failure occurred, and notes related to the test / repair.

The screenshot displays the 'Sensor Testing' tab in the Vertigo software. A table lists various sensors with columns for Tag, Service Description, Instrument Type, Test Interval (Months), Date Last Tested, Test Due Date, and Status. A 'Test Details' dialog box is open, showing fields for Type, Tag, Service Description, Test Interval, Date Commissioned, and Date Decommissioned. A 'Sensor Test Details' sub-dialog is also visible, showing fields for Date, Result, Failure Mode, and Notes.

Tag	Service Description	Instrument Type	Test Interval (Months)	Date Last Tested	Test Due Date	Status
LT-101B (HIGH)	High Pressure Separator	Level Transmitter - Generic (Displacement / Hi Trip)	12	Aug 1 2016	Aug 1 2017	Green
LT-101B (LOW)					Jul 1 2017	Green
LT-102B (HIGH)					Jun 1 2017	Yellow
LT-102B (LOW)					May 1 2017	Yellow
LT-110 (LOW)					Dec 31 2016	Yellow
PDT-105C (LOW)					Jan 1 2015	Red
PT-101D (HIGH)					Aug 15 2017	Green
PT-101D (LOW)					Jan 1 2016	Red
PT-102B (HIGH)						Grey
PT-102B (LOW)						Grey
PT-103A/C (LOW)						Grey

Reporting

Vertigo has extensive and flexible means for reporting data out of the database into a variety of report types and formats. Multiple reports have been defined for various stages in the SIS safety lifecycle and different activities. Each report allows customization of the scope of information that can be selected to report.

The screenshot displays the 'Generate Report' dialog box in the Vertigo software. A table lists various IPF descriptions with columns for Tag, IPF Description, IPF Type, and Select SIL. The table is filtered to show only 'SIF' (Safety Instrument Function) items.

Tag	IPF Description	IPF Type	Select SIL
<input checked="" type="checkbox"/>	USC-101A High Pressure Separator (V-101) High-High Pressure Closes Inlet Valve	SIF	SIL 2
<input checked="" type="checkbox"/>	USC-101B High Pressure Separator (V-101) Low-Low Pressure Closes Inlet Valve	SIF	SIL 1
<input type="checkbox"/>	USC-101C High Pressure Separator (V-101) High-High Level Closes Inlet Valve	SIF	No SIL
<input checked="" type="checkbox"/>	USC-101D High Pressure Separator (V-101) Low-Low Level Closes Liquid Outlet Valve	SIF	SIL 1
<input checked="" type="checkbox"/>	USC-102A Low Pressure Separator (V-102) High-High Pressure Closes Inlet Valve	SIF	SIL 1
<input checked="" type="checkbox"/>	USC-102B Low Pressure Separator (V-102) Low-Low Pressure Closes Inlet Valve	SIF	SIL 1
<input checked="" type="checkbox"/>	USC-102C Low Pressure Separator (V-102) High-High Level Closes Inlet Valve	SIF	SIL 2
<input type="checkbox"/>	USC-102D Low Pressure Separator (V-102) Low-Low Level Closes Liquid Outlet Valve	SIF	No SIL
<input checked="" type="checkbox"/>	USC-102E Low Pressure Separator (V-102) Low-Low Level Stops Pump	SIF	SIL 2



When a report is generated, it is presented in the user interface. From there it can be viewed and directly printed. Also, the report can be exported in a variety of formats for further processing.

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Export to the selected format
Export
Acrobat (PDF) file
Excel Worksheet
TIFF file
Word Document

Input Worksheet

Tag USC-101A

IPF Description High Pressure Separator (V-101) High-High Pressure Closes Inlet Valve

Overall Input Performance

Overall PFD _{avg}	1.47E-02	Max SIL Achieved (PFD _{avg})	SIL 1
Fault Tolerance	0	Max SIL Approved	SIL 1
Overall STR (Per Hour)	9.06E-07	Input Group Logic	1oo1

Input Group Loop List

Input Tag	Voting	Safe Failure Fraction	Test Interval (Months)	PFD _{avg}	STR (per hour)
PT-101D (HIGH)	1oo1	39.4 %	12	1.47E-02	9.06E-07

Sensor Loop Details: PT-101D (HIGH)

Service Description High Pressure Separator

Test Interval 12 Months Voting 1oo1

Element	Instrument Type	λ_{SD}^*	λ_{SU}^*	λ_{DD}^*	λ_{DU}^*	λ_{DN}^*
Sensor	Pressure Transmitter - Generic (Hi Trip / Diag / Clean)	1.50E-07	0.00E+00	7.56E-07	5.94E-07	~
Process Connection	Tubing - Generic (Clean Service)	0.00E+00	0.00E+00	0.00E+00	8.00E-07	~
Sensor Interface 1						~
Sensor Interface 2						~
Loop Total		1.50E-07	0.00E+00	7.56E-07	1.25E-06	1.39E-07

* All failure rates are in units of failures per hour

Failure Component	Factor(s)	PFD _{avg} Contribution	STR Contribution (Per Hour)
Dangerous Undetected	MTTR: 72 Hours	5.50E-03	
Spurious Failure			0.00E+00
Common Cause	Beta Factor: 0.005	0.00E+00	0.00E+00
Detected Failure			9.06E-07
Imperfect Testina	Proof Test Coverage: 0.9	9.16E-03	~

Validation

Vertigo has been extensively validated to demonstrate that the results presented are accurate. The validation includes traceability of all equations and calculation methods back to standards body documents describing calculation requirements, manual calculations of all steps in the calculation process for all potential variations in all parameters affecting the calculations.