Vertigo – Technical Data
SIS Design Basis Software

The Kenexis Vertigo™ safety instrumented system design basis management software provides and 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 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. Servers are maintained on Kenexis cloud based systems.

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. Effigy can be access by almost any computer, 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 Browsers[1]:	Internet Explorer, Chrome, Firebox, Safari
Connectivity:	Any variety of internet connectivity

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[1] Some more advanced features, are only supported by the most recent version of a browser. Otherwise, Kenexis supports the past three versions of each browser listed.

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Client Accounts

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

Account Types:	Professional – Named User – This account is accessed from the Kenexis Public Server (shared application code and database). Only the single named user associated with the account is licensed to access the software and associated data. Professional Accounts are available in Annual or Project (60 day) durations.
	Professional – Simultaneous 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 (minimum of two) can access the application simultaneously. Professional Accounts are available in Annual or Project (60 day) durations.
	Operating Enterprise – This account can be accessed from the Kenexis Public Server (shared application code and database), but a dedicated server or dedicated node is recommended. Unlimited users from a single organization are licensed to access the software and associated data with no limit on the number of simultaneous users. Operating Enterprise Accounts are available in and annual duration and licensing is based on the number of tags in the database.
Private Node:	As an option, any user or group of users, can obtain a private node. The private node is operating 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.

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Handling Multiple Project

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

Project Types:	Vertigo – Safety Integrity Level Verification and SRS
	Effigy – Fire and Gas Mapping (Sold Separately)
	Audit – Audit and Assessment Database (Sold Separately)
Tracked Project Data:	Study Name, Study Type, Study Facility, Study Owner (User Name and Full Name), Date Modified, Current Revision
Project Actions:	Load Study, Copy Study, Delete Study, Baseline Study (Set Revision), Import Study[2]

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

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 Vendors Included:	ABB, ASCO, Bentley Nevada, Berthold, CCC, Delta Controls, Detronics, Draeger, Drexelbrook, Emerson, Endress+Hauser, Fire Sentry, Fireye, Fisher, HIMA, Kidde, Krohne, K-TEK, Magnetrol, Masoneilan, Maxon, Mokveld, MTS, Micro Motion, MSA, Moore Industries, Neles, Pepperl+Fuchs, Phoenix Contact, Ronan, Rockwell, Rosemount, Siemens, Sierra Monitor, Smar, Triconex, United Electric, Vega, Wandfluh, Watlow, 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*

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

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Instrumented Protective Function List (SIF List)

Vertigo defines all of the instrumented functions that are included in an SIS design basis in the IPF List. 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.

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Drawing List

The user records information about drawings 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.

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. 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.

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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.

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

Instrument List – Sensor

In the instrument list, information required for performance calculations and details for safety requirements specifications are entered and edited, and results on an instrument by instrument basis are presented.

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Type:	Selection of the instrument type from the instrument type database.
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)
Tabular Results:	The instrument type for up to two different sensor interface devices like IS barriers
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 process operation with bad process variable alarm. If not true, input of diagnostic test interval is required.
Online 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.
Imperfect Testing:	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.
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.
IPF Group:	Selection for which IPF from the IPF list that this instrument is associated with.
Data Sheet Reference:	Selection for the document in the document list where that is the data sheet for this instrument.

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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.

Instrument List – Logic Solver

Type: Selection of the instrument type from the instrument type database.

Test Interval: The duration, in months, in between manual function tests for this instrument.

Element Response Time: The time duration in which the instrument is expected to response to a demand.

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.

Instrument List – Final Element

The final element instrument data collected for final elements is similar to that collected for sensors. Additional information for SRS development is also collected.
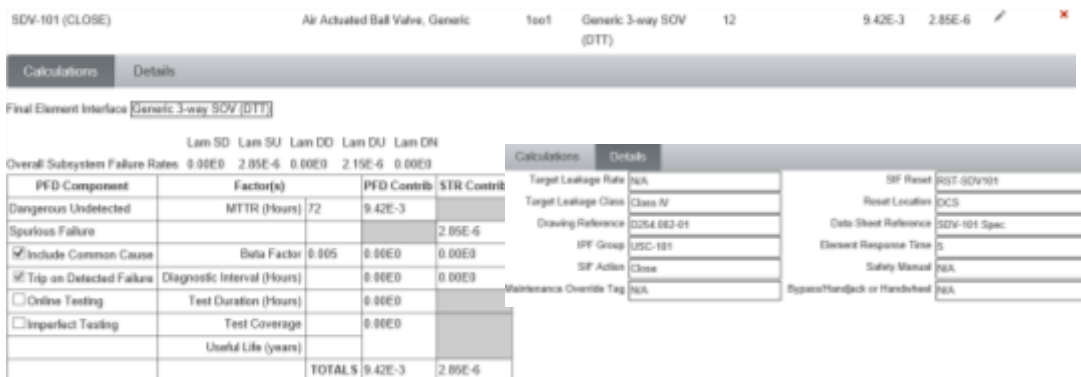
Target Leakage Rate: Specified maximum leakage rate for valve used as SIF final element

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.

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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.

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.
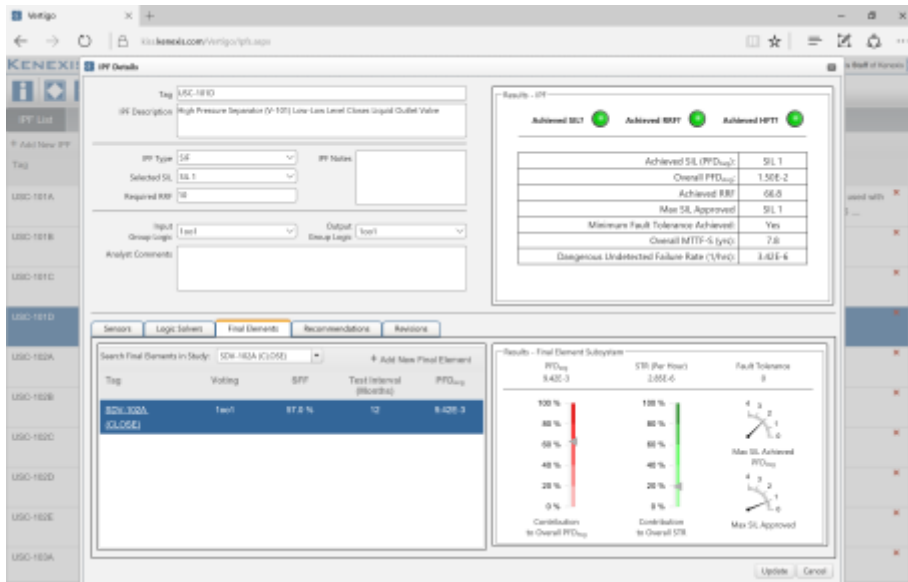
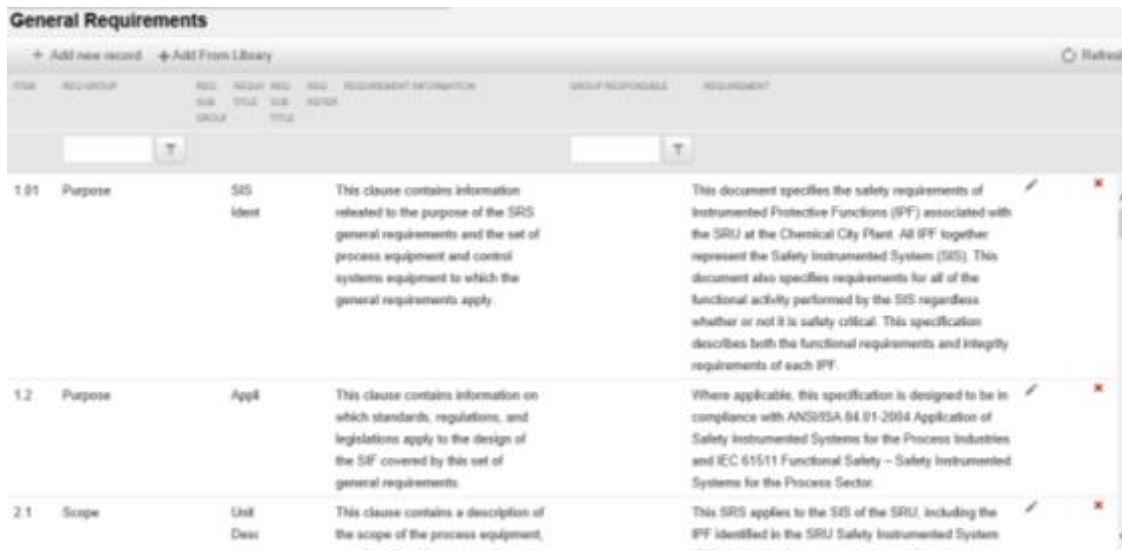|	
Achieved SIL (PFD):	Safety integrity level achieved by the design only considering the average probability of failure on demand calculation.
Overall PFDavg:	The overall average probability of failure on demand achieved by the SIF considering the sensor, logic solver, and final element subsystems. 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.

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

More information is available on other tabs including calculations details for the sensor subsystem, logic solver subsystem, and final element subsystem, along with SRS details that are related to the SIF, and a tracking of revisions for the SIF.

Safety Requirements Specifications

In addition to the safety requirements specification fields associated with individual instruments and individual SIF, Vertigo includes the capability of specification of general requirements and notes, along with the development of cause and effect diagrams to demonstrate system logic.

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				Voting	1oo1
				Description	High Pressure Separator Inlet
				Tag	SDV-101 (CLOSE)
Tag	Description	Voting	SC		☑
LT-101B (HIGH)	High Pressure Separator	1oo1	☑	X	
LT-101B (LOW)	High Pressure Separator	1oo1	☑	X	
PT-101D (HIGH)	High Pressure Separator	1oo1	☑	X	

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.

About Kenexis

Kenexis is an independent engineering consulting firm headquartered in Columbus, Ohio. For more information, www.Kenexis.com.