

### Open PHA PHA, HAZOP &LOPA Software

#### **User's Manual**

Rev 3

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#### Introduction

This guide describes how to use the Open PHA and Open PHA Cloud-Premium Process Hazards Analysis Software. Open PHA is standalone desktop application available on Windows, Mac OSX, and Linux based operating systems. The Open PHA Desktop Edition available at no-cost and can be downloaded from the following link.

#### https://www.kenexis.com/software/openpha/download/

Open PHA Premium is a module in the Kenexis Integrated Safety Suite (KISS). KISS provides technical safety professionals with a cloud-based multi-user platform for the full range of technical safety engineering tasks. Open PHA Cloud-Premium has a collection of premium tools which are not available in the desktop edition. You can request a free Open PHA Cloud-Premium trial at the following link or contact info@kenexis.com for pricing options.

https://www.kenexis.com/software/request-open-pha-premium-trial/

#### **About Kenexis**

Kenexis is an independent engineering consulting firm. We ensure the integrity of instrumented safeguards and industrial networks. Using skills in risk analysis, reliability engineering, and process engineering, we help establish the design and maintenance specification of instrumented safeguards, such as safety instrumented systems (SIS), alarm systems, fire and gas systems.

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# **Section 0 – Quick Reference**

#### 0.1 Definitions

The following terms are used regularly in Open PHA.

Term	Definition	Acronym
Process Hazard Analysis	A qualitative study performed to identify process hazards that can adversely affect people, property, and the environment.	РНА
Layer of Protection Analysis	A semi-quantitative study used to identify required risk reduction and recommend layers of protection if needed.	LOPA
Target Mitigated Event Likelihood	The maximum tolerable risk (expressed as a frequency). Also known as target frequency.	TMEL
Mitigated Event Likelihood	The level of risk (expressed as a frequency) of a harmful event considering risk reduction provided by safeguards and independent protection layers (IPLs).	MEL
Independent Protection Layer	Safeguards that are specifically designed to prevent the hazard identified, independent from initiating event or other IPL, provide at least one order of magnitude risk reduction, and auditable (e.g. operator intervention, pressure relief, etc.)	IPL
Safeguard	Safeguards prevent the scenario from occurring (preventative) or reduce the impact of the scenario (mitigative).	
Risk Reduction Factor	Amount of risk reduction required to mitigate risk to a tolerable level (reciprocal of Probability of Failure on Demand)	RRF
Conditional Modifier	Factors that relate to conditions necessary for the hazardous event to occur (e.g. occupancy, probability of ignition, etc.)	СМ

# **Section 0 – Quick Reference**

#### 0.2 Hotkeys

The following hotkey combinations are available when working in Open PHA.

At any time the available hotkeys can be displayed in Open PHA by holding down the hotkey combination Ctrl + H.

General				
Hot Key	Action			
Ctrl + H (hold)	Display Hotkey Map			
F1 – F10	Navigate Primary (Horizontal) Toolbar			
Ctrl + F1 – F10	Navigate Secondary (Vertical) Toolbar			
Ctrl + N	Create New Study			
Ctrl + O	Open Existing Study			
Ctrl + S	Save Study			
Ctrl + H	Toggle Hotkey Map (Hold)			
Alt + F4	Exit Open PHA			
Ctrl + Number	Navigate Primary Dropdown Menu (Above Worksheet)			



# **Section 0 – Quick Reference**

With Cell(s) Selected – Dark Blue Highlight			
Hot Key	Action		
Ctrl + C	Copy Selected Cell(s)		
Ctrl + X	Cut Selected Cell(s)		
Ctrl + V	Paste Cut/Copied Cell(s)		
Delete	Delete Selected Cell(s)		
Ctrl + Enter	Create New Row		
Escape	Deselect Cell(s)		
Arrow Keys	Select Neighboring Cells		
Ctrl + Up Arrow	Move Row Up		
Ctrl + Down Arrow	Move Row Down		
Tab	Select Next Cell		
Ctrl + Left Mouse	Select Additional Cells		
Shift + Left Mouse	Select Many Additional Cells		
Shift + Left Mouse	Select Many Additional Cells		



#### With Cell(s) Active – Blue Border

Hot Key	Action
Ctrl + Enter	Create New Row
Ctrl + A	Select All Text in Active Cell
Alt + Arrow Key	Make Neighbor Cell Active

# **Section 1 – Getting Started**

#### 1.1 Creating a New Study

When you launch a new instance of Open PHA you will be greeted with the Start Menu (shown below).

The start menu is only displayed in Open PHA desktop, not in Open PHA Cloud-Premium. In Open PHA Cloud-Premium, studies are either created or opened from the KISS study manager.

Welcome - Start Menu		
	Recent Files	
Create New Study	HAZOP 6.opha	Ø
	New Sample Gas Plant.opha	Ø
Open File	Open PHA Study.opha	Ø

The Start Menu consists of two buttons and a selectable list of recently opened files. Clicking on the file name of a recent file will open the associated Open PHA study. Files can be removed from the recent files list by clicking the remove button (circle with slash through it). The two buttons to the left of the recent files list can be used to create new studies, or open existing studies. When selecting to create a new study, you will be presented with a series of dialogues to guide you through configuring your PHA/LOPA data structure.

# **Section 1 – Getting Started**

To create a new PHA/LOPA study in Open PHA Cloud-Premium first select a facility from the facility list. The new study you create will be located inside this facility. With a facility selected (highlighted blue), click on the "add new study" button in the main action ribbon and select Open PHA for the study type.

KENEY	S INTEGRA	TED SAFETY SUITE	Signed In As Ken	exis Staff of Kenexis
🛨 - 🚹	7 🗵 🔒 🛃			
Arbor		Filter Studies		
Open PHA		Study List	Date Modified	Туре
Vertigo	erating Company	Bayou Bay_Gas Plant	11 Sep 2018	Vertigo
		Bayou Bay Gas Plant HAZOP	04 Nov 2018	Open PHA
		USC-101A - High Pressure Separator (V-101) High-High Pressure Closes Inlet Valve	05 Nov 2018	Arbor
		HAZOP محطة غاز بابو خليج	04 Nov 2018	Open PHA

Once a study is created, Open PHA will open another dialogue window (shown below) to set up the data structure for the file. Open PHA is designed to support numerous PHA methodologies and because of this, a data structure needs to be established when the study is created. The first options to choose from, as shown above, are a cause indexed (Option A) or consequence indexed (Option B) data structure. Cause indexed means that for each cause in the PHA, there can be one or more consequences for that cause. Cause indexed studies are good for HAZOP, what if, and checklist PHAs. Consequence indexed is the inverse of cause indexed; where each consequence can have one or more cause. Consequence indexed studies are best for HAZOP, SIL selection, and LOPA methodologies. Consequence indexing is best for these methodologies because it allows for the aggregation of risk. Aggregation of risk is useful to SIL selection because it enables you to assign a single SIL requirement to a SIF, whereas without it, SIL requirements would be assigned to a SIF for each applicable scenario.

# **Section 1 – Getting Started**

#### Select PHA/LOPA Template

Please Select the Data Structure Template for your PHA/LOPA Study.

Option A:

Standard (Cause-Indexed) PHA/LOPA: Each cause has one or more consequences.

<u>Option B:</u> Consequence-Indexed PHA/LOPA: Each consequence has one or more causes. Appropriate for SIL Selection and aggregation of risk.

Option A	Option B

Once you decide which data structure is best for your PHA, simply click one of the boxes to select the option you want to use. This will configure the indexing of the file and bring up another dialogue window (shown below) to select the LOPA style.

Select Style of LOPA
Please Select the Style of LOPA you would like to perform.
Option A: Explicit: Use TMEL targets, frequencies and probabilities of failure.
Option B: Implicit: Use risk ranking targets, likelihood categories and LOPA credits.
Option A Option B

As seen in the dialogue window above, the two options for LOPA style are implicit and explicit. The implicit LOPA style uses risk ranking targets, likelihood categories and LOPA credits to assign SIL requirements. The explicit LOPA style uses TMEL targets, initiating event frequencies, and probabilities of failure to assign SIL requirements. Like before, to select the option you want to use for the study, click either the "Option A" or "Option B" button in the bottom right of the window. This will complete the setup of the file and you are now ready to begin working with your study.



Before getting into setting up to the study to meet your PHA needs, it is a good idea to familiarize yourself with the workspace.

#### 2.1 The Navigation Toolbar

🖹 🚺 Study	Data 🦻 Nodes	Deviations	다. PHA Worksheets	UDPA Worksheets	Check Lists	<sup>1</sup> / <sub>3</sub> ≡ Recommendations
C Safeguards	🚑 Parking Lot	😭 Risk Criteria	O Premium Tools	- HBack		

The navigation toolbar serves as the primary means for navigating the Open PHA study editor interface and appears on all pages in the editor. Depending on the width of the window that the user has selected, the toolbar will line break and display on multiple rows, as required. This section details the available buttons on the toolbar:

Button	Description
	<ul> <li>The Study Data button will navigate to the Study Data section. From this section you can document high level information about your study, such as:</li> <li>General Information (Location, Facility, Operating</li> </ul>
Study Data	Company, etc.) <ul> <li>Documents List</li> <li>Participant List</li> <li>Sessions</li> <li>Revision History</li> </ul> Additionally, column visibility can be adjusted from the study data section
ပို Nodes	The Nodes button will navigate to the Nodes list. The Nodes list is where you can define nodes and their attributes (intention, boundary, operating conditions, etc.)
<b>B</b> Deviations	The Deviations button will navigate to the Deviations list for the selected node. The Deviations list allows you to edit deviations for each node. These deviations will be used in the PHA Worksheet.



Button	Description
िन्दी PHA Worksheets	The PHA Worksheets button will navigate to the PHA Worksheet for the selected node. The PHA worksheet is the primary workspace for building and working with PHA scenarios.
LOPA Worksheets	The LOPA Worksheets button will navigate to the LOPA Worksheet for the selected node. The LOPA worksheet is the primary workspace for building and working with LOPA scenarios.
Check Lists	The Check Lists button will navigate to the Check Lists Categories Worksheet. The Check Lists Categories Worksheet allows the user to define multiple check lists that are available for each study and navigate between the individual checklists.
∃ ■ Recommendations	The Recommendations button will navigate to the Recommendations list. This list allows you to track and edit recommendations made in the PHA & LOPA Worksheets and view where recommendations have been used throughout your study.
Safeguards	The Safeguards button will navigate to the Safeguards and IPL lists. Like the recommendation's lists, you can view, modify and delete safeguards and IPL's used throughout your study and view where each item has been referenced.
Parking Lot	The Parking Lot button will navigate to the Parking Lot list. This list allows you to track and edit Parking Lot Items created during the PHA & LOPA.
Risk Criteria	The Risk Criteria button navigates to the Risk Criteria page. In the Risk Criteria page, you are able to edit the risk matrix, severity and likelihood used in the PHA and LOPA.



Button	Description
✿ Premium Tools ▼	The Premium Tools button opens a drop down menu that contains the Open PHA premium features, including the Report Generator and Study Translator, synchronization and import tools.
<b>H</b> Back	The Back button navigates back to the Study Manager page (Only In Open PHA Premium).



#### 2.1.1 Application Toolbar - Desktop Version

File View Security Help

In addition to the navigation toolbar, the desktop version of the software also has an application toolbar. The table below provides details on the four buttons available in this toolbar.

Button	Description
File	The File button allows the user to open a new file, create a new file, save the file, and exit the program.
View	The View button allows the use to minimize the window, zoom in & out, and enter full screen mode.
Security	The Security button allows the user to enable file encryption and password protection.
Help	The Help button contains the software version number and a button that opens a link to the Kenexis Support webpage.





#### 3.1 Open PHA Workspace Tables

The table is a staple of the Open PHA interface and is used extensively creating, editing and maintaining the study's worksheets. An example is shown below for a few PHA scenarios.

Study Data	₽ Nodes Severations	Ļ	į PH	A Worl	ksheets	U Lo	PA Workshee	ts 🚦	E Recommendation	ons 🗘 Safeguards 🗲	b Parkir	ng Lot 📦 Risk Crite	ria 🔯 Premium Tools 💌
A Worksh	eets	_											
(HP Gas) Pr	roduction Header through H	ligh P	ressu	ire Sep	arator (V	-101)	to Gas Export	t Pipe	line				
4 %	∎ <b>* ~  ~ !</b> Q Q	0										00:	➡ Search Worksheet
										Con	sequences	5	
Deviation	Consequence	s	F				B LOPA Rec	wired		Causes	Safeguar	ds	PH/
	consequence	-	-	^	-		20171100	lanca	Cause	Safeguard		Safeguard Type	
High Pressure	1.1.1 Potential overpressure of V-101. Potential loss of mechanical integrity. Botential putture of								1.1.1.1 Production header pressure	1 Relief valve PSV-101A opens to	flare P	ressure Relief Device	
	High Pressure Separator resulting in large release of								1200 psig.	2 PT-101D high pressure shutdow HP separator inlet valve SDV-10	n closes SI 1.	15	
	or explosion.									3 Control valve PV-101B will open	to flare. B	PCS	
		4 •	3 •	3 🔻	3		¥ Yes		1.1.1.2 External fire in the vicinity of	1 Relief valve PSV-101A opens to	flare P	ressure Relief Device	
									101.	2 PT-101D high pressure shutdow HP separator inlet valve SDV-10	n closes SI 1.	IS	
										4 Fire detection system allowing ti personnel evacuation	me for FI	GS	
										5 Control valve PV-101B will open No credit taken for this IPL due t inadequate sizing.	to flare. Bi	PCS	
2 Low Pressure	1.2.1 Potential breach of high pressure pipeline with subsequent pressure reduction								1.2.1.1 Production header pipeline leak or rupture	6 PT-101D low pressure shutdown mitigates hazard by closing SDV	-101. SI	IS	
	to HP Separator M-101. Potential hydrocarbon release to environmental and subsequent impacts. Potential fire/explosion.	4 •	3 •	2 •	0		)	•	(due to vehicle impact) upstream of SDV-101.	7 Automated low pressure shutdo upstream of the production hear	wn B der.	PCS	
3 High Temperature	1.3.1 No credible causes	•	•	•		·		•	1.3.1.1				
4 Low Temperature	1.4.1 No credible causes - Auto- refrigeration of gas flashing across PV-101A not expected to result in safety concerns.			•	,			•	1.4.1.1				
5 High Level	1.5.1 Potential overfill of the High Pressure Separator M-101 with liquid flow to the Gas Export								1.5.1.1 Failure of control loop LIC- 101 such that	8 High level shutdown LT-101B clo inlet valve SDV-101	ises Sl	15	
	Pipeline. Potential for Off-Spec								liquid outlet	9 Operator response to high level	alarm O	Operator Intervention	

All tables are provided with a consistent set of controls to allow you to interface with the data in various ways. This section provides a summary of the controls which are typical for tables in Open PHA.

#### 3.1.1 Workspace Toolbar

The Workspace Toolbar is displayed at the top of each worksheet in the study. This toolbar, shown below, is a collection of controls used for interacting with the worksheet.



There are twelve different controls on this panel (from left to right):

- 1. Add New Row
- 2. Copy Row(s)

- 3. Cut Row(s)
- 4. Paste Row(s)
- 5. Delete Row(s)
- 6. Move Row Up
- 7. Move Row Down
- 8. Export to Excel
- 9. Previous
- 10. Next
- 11. Replace All
- 12. Search Box

#### 3.1.1.1 Adding Rows to a Table

Rows can be added to a table by clicking on the "Add New Row" button located at the top left corner of the workspace, above the headers as shown below. This will insert a new row below the selected row.

Kenexis Open PH	A							
File View Securit	y Help							
Study Data	₿ Nodes <b>Deviation</b>	s	j PH	A Wor	ksheets		Vorksheets	E Recomm
PHA Worksh	eets							
1. (HP Gas) Pr	oduction Header through I	High P	ressu	ire Se	parator (	/-101) to Ga	as Export Pipe	line
€₽≈	🖪 🖻 🔺 🗸 I Q Q	∎ 🖨						
Deviation	Consequence	s	E	А	L	RR	LOPA Required	Cause
1.1 High Pressure	1.1.1 Potential overpressure of V-101 Potential loss of mechanical integrity. Potential rupture of High Pressure Separator resulting in large release of hydrocarbons and potential fire or explosion.	9						1.1.1.1 Product header operate 1200 ps

Alternatively, rows can be added to tables by selecting a row and pressing the Ctrl and Enter keys on the keyboard.

#### 3.1.1.2 Copying Rows in a Table

Rows can be copied in a table by clicking on the "Copy Row(s)" button located at the top left corner of the workspace, above the headers as shown below. This copies the selected row. If you would like to copy more than one row, select a row by clicking on

it, then hold the "Control" key and click to select the additional row(s) you would like to copy; or if you want to select rows, use the "Shift" key and click to select every row two rows that you have selected.

🔀 Kenexis Open PH	A							
File View Securit	y Help							
Study Data	₿ Nodes <b>S</b> Deviation	is I	<u>រ៉</u> ្នា PH	A Wo	rksheets		Vorksheets	<b>≣</b> Recomm
PHA Worksh	eets							
1. (HP Gas) Pr	oduction Header through	High	Pressu	ure Se	parator (	/-101) to G	as Export Pipe	line
<b>+</b> 🔁 🔀	🖪 🖻 🔺 🗸 II Q Q	∥ 🖨						
Deviation	Consequence	s	E	А	L	RR	LOPA Required	Cause
1.1 High Pressure	1.1.1 Potential overpressure of V-10 Potential loss of mechanical integrity. Potential rupture of High Pressure Separator resulting in large release of hydrocarbons and potential fin or explosion.	ı. e						1.1.1.1 Product header operate 1200 ps

use duct der rate 0 ps

Alternatively, rows can be copied by selecting a row and pressing the "Control" key along with the "C" key (Ctrl + C) on the keyboard.

#### 3.1.1.3 Cutting Rows from a Table

Rows can be cut from a table by clicking on the "Cut Row(s)" button located at the top left corner of the table, above the headers as shown below. This cuts the selected row. If you wish to cut more than one row, select a row by clicking on it, then hold the "Control" key and click to select the additional row(s) you would like to cut.



Жк	enexis Open PH	IA								
File	View Securit	ty Help								
2	Study Data	₽ Nodes	<b>Deviation</b>	ıs 📮	j PH	A Wor	ksheets		Worksheets	E Recomm
Pł	HA Worksh	eets								
1.	. (HP Gas) Pi	roduction Hea	ader through	High P	ressu	ire Se	parator (\	/-101) to	Gas Export Pipe	line
6	• 4 <mark>≫</mark>	<b>i i i</b>	<b>୰</b> ∥ ପ୍ ପ୍	∥ 🖨						
	Deviation	Conse	quence	s	E	А	L	RR	LOPA Required	Cause

Alternatively, rows can be cut by selecting a row and pressing the "Control" key along with the "X" key (Ctrl + X) on the keyboard.

#### 3.1.1.4 Pasting Rows in a Table

Rows can be pasted in a table by clicking on the "Paste Row(s)" button located at the top left corner of the table, above the headers as shown below. This pastes the selected row. If you wish to paste more than one row, select a row by clicking on it, then hold the "Control" key and click to select the additional row(s) you would like to paste.

🞇 Kenexis Open PH	A							
File View Securit	y Help							
Study Data	♀ Nodes ■ Deviations	다	į PH	A Wor	ksheets		Vorksheets	E Recomm
PHA Worksho	eets							
1. (HP Gas) Pr	oduction Header through H	ligh P	ressu	re Se	parator (V	'-101) to Ga	as Export Pipe	line
€ 4 %	🖪 🛍 🔺 🗸 ॥ Q. 🔍 ॥	•						
Deviation	Consequence	s	E	А	L	RR	LOPA Required	Cause
1.1.1. Bals Deserves	1		-					

Alternatively, rows can be pasted into tables by selecting a row and pressing the "Control" key along with the "V" key (Ctrl + V) on the keyboard.

#### 3.1.1.5 Deleting Rows from a Table

Rows in a table can be deleted by clicking on the "Delete Row(s)" button located at the top left corner of the table, above the headers as shown below. This deletes the selected row. If you wish to delete more than one row, select a row by clicking on it, then hold the "Control" key and click to select the additional row(s) you would like to delete.



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Alternatively, rows can be deleted by selecting a row and pressing the "Delete" key on the keyboard.

#### 3.1.1.6 Moving Rows Up in a Table

Rows in a table can be moved up by clicking on the "Move Row Up" button located at the top left corner of the table, above the headers as shown below. This moves the selected row up.

📉 Ke	nexis Open PH	A								
File	View Securit	y Help								
4	Study Data	₽ Nodes	Deviations	다	į PH.	A Wor	ksheets		/orksheets	<b>≣</b> Recomm
PH	A Worksh	eets								
1.	(HP Gas) Pr	oduction He	ader through H	igh P	ressu	ire Se	parator (\	/-101) to Ga	as Export Pipe	line
8	名 %	Ē 🖻 🔼	୍ହ ∥	₽						
	Deviation	Consequence		s	E	А	L	RR	LOPA Required	Cause
1.1	High Pressure	1.1.1 Potential ov Potential lo integrity. P High Pressu resulting in hydrocarbo or explosion	verpressure of V-101. ss of mechanical otential rupture of ure Separator large release of ns and potential fire n.							1.1.1.1 Product header operate 1200 ps

#### 3.1.1.7 Moving Rows Down in a Table

Rows in a table can be moved down by clicking on the "Move Row Down" button located at the top left corner of the table, above the headers as shown below. This moves the selected row down.

Nellexis Open in	A								
ile View Securit	y Help								
Study Data	₿ Nodes	Deviations	Ļ	į PH.	A Wor	ksheets		Worksheets	E Recomm
PHA Worksh	eets								
1. (HP Gas) Pr	oduction Hea	ader through H	igh P	ressu	ire Sej	parator (\	/-101) to	Gas Export Pipe	eline
€ 2 %	🔁 🖻 🔺 🚺	<mark>√</mark> ∥ର୍ ତ୍ ∥	₽						
Deviation									
	Conse	equence	S	E	А	L	RR	LOPA Required	Cause

#### 3.1.1.8 Exporting to Excel

To export the worksheet to Excel, click the "Print" button at the top of the workspace. This will export the worksheet currently visible in the main workspace to an a Microsoft excel file.

🔀 Kenexis Open PH	łA								
File View Securi	ty Help								
Study Data	Nodes	Deviations						/orksheets	E Recomm
PHA Worksh	eets								
1. (HP Gas) P	roduction He	ader through Hi	igh P	ressu	ire Se	parator (\	/-101) to Ga	as Export Pipe	line
€ 42 ≫	r 🖻 \Lambda	♥    Q ⊕							
Deviation	Cons	equence	S	E	A	L	RR	LOPA Required	Cause
1.1 High Pressure	1.1.1 Potential ov Potential lo integrity. P High Pressu resulting in hydrocarbo or explosion	verpressure of V-101. ss of mechanical otential rupture of ure Separator large release of ns and potential fire n.							1.1.1.1 Product header operate 1200 ps



When opening files generated with the excel export tool you may receive messages from your spreadsheet application about the file format and extension of the file being opened, similar to the message shown below.

Microsof	off Excel	×
	The file format and extension of 'PHA Worksheets.xis' don't match. The file could be corrupted or unsafe. Unless you trust its source, don't open it. Do you want to open it anyway	?
	Yes <u>N</u> o <u>H</u> elp	

This is normal and expected behavior as the files generated with the excel export tool do not exactly match the specification for Microsoft Excel (\*.xls) file format. However, your spreadsheet application will be capable of these files, simply select yes to attempt to open the file when prompted with the above message.

#### 3.1.1.9 Searching a Table

Every table in Open PHA is searchable. To search in a table, click the Search Worksheet box, as shown below, and then type to search the table.

			-	$\square$ $\times$
Recommendatio	ons 😲 Safeguards 🚗 P	arking Lot Risk Criteria	Q <sub>a</sub> Premium loois	
าย				•
		⊙ ⊙ ≓	Search Worksheet	
	Consequ	ences		
	Causes			
Cause	Safeguard	Safeguard Type		PHA Recor
.1.1.1 Production header pressure	1 Relief valve PSV-101A opens to flare	Pressure Relief Device		<b>A</b>
1200 psig.	2 PT-101D high pressure shutdown clos HP separator inlet valve SDV-101.	ses SIS		_
	3 Control valve PV-101B will open to fla	re. BPCS		_
.1.1.2 External fire in the vicinity of HP Separator V-	1 Relief valve PSV-101A opens to flare	Pressure Relief Device		_
101.	2 PT-101D high pressure shutdown clos	ses SIS		

When the search results in a hit, the searched text will be highlighted in the table. Additionally, the search function features buttons to find and jump to search hits.



1	Recommendatio	ons 🛈 Safeguards	😝 Parking Lot	Risk Criteria	✿ Premium Tools ▼	
pe	line				PT-101D	<b>•</b> ]
_			Consequences			
		Cause	S			
ed	Cause		Safeguards			PHA Recor
		Sateguard		Safeguard Type		
	1.1.1.1 Production header pressure operates above	1 Relief valve PSV-101A opens	to flare Pressure	Relief Device		Î
	1200 psig.	2 PT-101D high pressure shutd HP separator inlet valve SDV-	own closes SIS -101.			
		3 Control valve PV-101B will op	pen to flare. BPCS			
•	1.1.1.2 External fire in the vicinity of HP Separator V-	1 Relief valve PSV-101A opens	to flare Pressure	Relief Device		
	101.	2 PT-101D high pressure shutd HP separator inlet valve SDV-	own closes SIS -101.			

Lastly, the search feature also includes a replace all function. To replace text in a table, click the "Replace" button (located to the left of the Search Worksheet textbox) and an additional textbox will appear, as shown below. To replace text in a table, search for the text you wish to replace by typing in the Search Worksheet textbox, and then enter the text you wish to replace it with in the Replace With textbox. Finally, click the "Replace" button to replace the text in the table.

			—	$\Box$ $\times$
Recommendatio	ons 🖨 Safeguards 🚗 Par	king Lot 🕞 Risk Criteria	🛱 Premium Tools 💌	
-			φ	
ne				•
	🔂 🔮 Search	Norksheet	Replace With	
	Consequen	ces		
	Causes	1ards		
Cause	Safeguard	Safeguard Type		FIA Recoi
1.1.1.1 Production header pressure operates above	1 Relief valve PSV-101A opens to flare	Pressure Relief Device		
1200 psig.	2 PT-101D high pressure shutdown closes HP separator inlet valve SDV-101.	SIS		
	3 Control valve PV-101B will open to flare	BPCS		
1.1.1.2 External fire in the vicinity of HP Separator V-	1 Relief valve PSV-101A opens to flare	Pressure Relief Device		
101.	2 PT-101D high pressure shutdown closes HP separator inlet valve SDV-101.	SIS		

#### 4.1 Study Data

The Study Data tab contains tables for peripheral study data used for bookkeeping, such as Team Members, Drawings, and Revision History. Also contained within the Study Data tab is the Settings page where study properties can be edited.

#### 4.1.1 Study Data Page

The table below consists of the pages that make up the Study Data tab, as well as a short description of each page.

Button	Description
	The Overview page contains a form for general information, this includes Study Name, Facility, Project Number, etc.
	The Team Members page contains a table in which team members and their information can be recorded.
	The Sessions page has a table for recording sessions and related information such as duration and session description.
	The Attendance page contains a grid where you can mark Present, Partial, or Absent for each team member in each session
	The Documents page provides a table to record drawing information, such has title and description.
+	The Revalidation History page contains a table to keep track of PHA revalidations.
୭	The Revision History page contains a table to keep track of revisions
J.C.	The Settings page allows you to edit the columns that are displayed for each and every page or worksheet in the study.

#### 4.1.2 Overview Page

The Overview page, as shown below, is a place for documenting high level general information about your study. With this page you can record the study name, project number, general notes, etc.







#### 4.1.3 Team Members Page

The Team Members page contains a table to record the meetings participants, as well as information about them, such as company, expertise, and contact info.

File View	v Security Help				
📑 Stu	idy Data 🧚 Nodes 🛢 Devi	iations	s <b>UDPA Worksheets</b>	Recommendations 🛱 Sa	feguards 😝 Parking Lot 😭
Ima	Team Members				
	82 🕺 🖹 🛍 🔺 🔪	🖌 II Q 🔍 II 🖨			
	Name	Company	Title	Expertise	Comments
≜≕	Scarlett Ann Gray	Kenexis	Senior Engineer	Facilitator	
	Brutus Buck lye	Kenexis	Staff Engineer	Scribe	
	Joe Koffolt	GOGO	Operations Manager	Operations	
	Myra Lake	GOGO	HSE Manager	HSE	
	Theo Oval	GOGO	Shift Operator	Operations	
	Wood E. Hayes	GOGO	Instrumentation Reliability Manager	Engineering	
	Horace Shu	GOGO	Process Engineer	Enigneering	
-					
Ľ±					
C					

#### 4.1.4 Sessions Page

The Sessions page is where you document the PHA sessions. In this grid, you can record the meeting date, duration, overview of topics/nodes covered and who facilitated the meeting.

File Vie	w Security H	lelp						
📑 St	udy Data 🔋	<sup>9</sup> Nodes Seviations	다. PHA Worksheets	LOPA Worksheets		ndations 🛱 Safeguards	🖨 Parking Lot	Risk Crite
102	Sessions							
	🕀 🗘 8	K 🖪 🖻 🔺 🗸 I Q	🔍    🖨					00
	Date	Duration	Session	Faci	litator	Scribe	Comm	ents
<b>≜</b> ≡	08/29/2017	8 hours	Day 1	Scarlett a	Ann Gray 🔹	Brutus Buck Iye	•	
-0-0	08/30/2017	8 hours	Day 2	Scarlett /	Ann Gray 🔹	Brutus Buck Iye	•	
	08/31/2017	4 hours	Day 3	Scarlett /	Ann Gray 🔹	Brutus Buck Iye	•	
202	1							
	-							
ac .								
	-							

#### 4.1.5 Attendance Page

The Attendance page (shown below) displays a grid to keep track of which participants were present during the sessions. Each participant can be marked as Absent, Partial, or Present for each session.

File View	Security H	elp			
💄 Stu	dy Data 🦹	Nodes	Deviations	្ព្រៃ PHA	Worksheets
	Attendanc	e			
	<b>₽</b> ∎Q	Q			
		Scarlett Ann Gray	Present <b>•</b>	Present 🔻	Present 🔻
		Brutus Buck Iye	Present 🔻	Present 🔻	Present 🔻
		Joe Koffolt	Partial 🔻	Absent 🔻	Partial 🔻
+	Team Members	Myra Lake	Partial 🔻	Partial 🔻	Partial 🔻
		Theo Oval	Present 🔻	Present 🔻	Present 🔻
		Wood E. Hayes	Present 🔻	Present 🔻	Present 🔻
		Horace Shu	Present 🔻	Present 🔻	Present 🔻
			08/29/2017	08/30/2017	08/31/2017
				Sessions	



#### 4.1.6 Documents Page

The Documents page contains a table to record the documents that were available to the team for the PHA sessions. In this table, you can record document numbers/titles, revision numbers, and descriptions of the documents.

File Viev	v Security Help		, ,		
🔒 Stu	ndy Data 🤌 Nodes 🛢 Dev	viations	s <b>UDPA Worksheets</b>	<sup>1</sup> <sub>2</sub> <sub>3</sub> ⊟ Recommendations	eguards 🖨 Parking Lot 🧃
(mail	Documents				
	🔁 🖓 🗶 🖪 🖻 🔺 🖻	✔    Q @    🖨			
	Drawing	Revision	Document Type	Description	Link
	D-254-001	1	PFD	Gas Production Facility	https://onedrive.live.com/redir? resid=3D7CB78ABBBF4372!19334&auth
<b>fff</b>	D-254-002 Sh. 1 of 6	1	P&ID	Legend Sheet - Gas Production Facility	
	D-254-002 Sh. 2 of 6	1	P&ID	High Pressure Separator - Gas Production Facility	
	D-254-002 Sh. 3 of 6	1	P&ID	Low Pressure Separator - Gas Production Facility	
	D-254-002 Sh. 4 of 6	1	P&ID	Pipeline Pump - Gas Production Facility	
	D-254-002 Sh. 5 of 6	1	P&ID	Gas Compressor - Gas Production Facility	
	D-254-002 Sh. 6 of 6	1	P&ID	Gas Compressor Utility Details - Gas Production Facility	
J.C.		-			·

#### 4.1.7 Revalidation History Page

The Revalidation History page allows you to keep track of the PHA revalidations. In this table, you can record the revalidation start and end dates, as well as comments for the revalidation.



#### 4.1.8 Revalidation History Page

Revision history is only available in Open PHA Cloud-Premium. For more information on this feature, please refer to the Premium Tools discussion in this user's manual.

#### 4.1.9 Settings Page

The Setting page, shown below, is where fields can be hidden or unhidden for the study. To make a column visible, click on either the slider on the right, or the text itself. If the slider is blue, then the field is visible. To hide a column/field, simply click on the slider or text and the slider will turn gray. The Settings page manages all of the fields in the study and allows for a high degree of customization.

File Vie	w Security	Help				
💄 Sti	udy Data	₿ Nodes	Deviations	다. PHA Worksheets	<b>D</b> LOPA Worksheets	
	v Security udy Data	Help Nodes Nodes Name Compar Title Departin Expertise Expertise Experier Phone N E-Mail A Comme essions Date Duration Session Facilitate Start Da End Dat Comme evalidation I Start Da End Dat Comme Pacintate Start Da End Dat Comme Session Descipt Intentio Boundai Descipt Color Hazardo Equipme Codes Drawing D	rs by hent e loce Jumber kddress hts h or hts History te e nts history te e nts history to conditions ng Conditions how South Tags hts hts hts hts hts hts hts ht		LOPA Worksheets	i≡ Reco
		Deviation D G Pa	ons eviation uide Word arameter esign Intent			
			PSSIONS			

#### 4.2 Risk Criteria

The Risk Criteria tab is used to manage the risk criteria used for the study. It contains the Risk Matrix, Likelihood Categories, Consequence Categories, and Risk Rankings pages.

#### 4.2.1 Likelihood Categories Page

The Likelihood Categories page, as seen below, allows the user to define likelihoods and assign a frequency and code to each one. When choosing likelihoods in the PHA worksheet, the Codes will populate a drop-down list from which the user can select a likelihood.

The frequency column is used as a place to describe the likelihood in terms of frequency. The input to this column is not used in any calculations, but rather serves as a descriptor to the likelihood.

KE						٥٨
<b>NEI</b>	NEA			as Piai	IL PHA-LUP	A
		Study Data 🌵 Nodes 🚦	Deviations	្ព្រៃ PH	A Worksheets	U L
	Likelih	ood Categories				
	8 4	) 🏁 🖪 🛍 🔺 🗸 🛛	Ð			
	Code	Description	Fr	equency		
	0	Insignificant	1E	-4		
	1	Very Unlikely	1E	-3		
	2	Unlikely	1E	-2		
•	3	Occasional	1E	-1		
	4	Frequent	1E	+0		
	5	Very Frequent	1E	+1		

#### 4.2.2 Consequence Categories Page

The Consequence Categories Page, seen below, is used to define consequences used in the risk matrix. As with the Likelihood, the Code will be used in a drop-down list in the PHA Worksheet to select a consequence category. The TMEL entered into this table is the TMEL used in the LOPA Worksheet. Using the figure below as an example; in the LOPA Worksheet, if Consequence Category 5 – Very High is selected Open PHA will automatically populate the TMEL cell with 1E-5.

KEI	NEX	(IS O	PEN	PHA	Gas Plar
B		Study Data	$\mathcal P$ Nodes	Deviatio	ns ঢ় PH
	Conse	quence Ca	tegories		
	Safety	,			
8	8 4	) 🄀 🖪	ŵ 🔨 🗸	∥ 🖨	
	Code		Descriptio	n	TMEL
	5	Very High -	Multiple Fata	lities	1E-5
	4	High - Singl	e Fatality		1E-4
	3	Medium - So Hospitalizati	evere Injury ( ion, Dismemt	Extended perment)	1E-3
	2	Low - Lost T Extended Ho	ime Injury No ospitalization	ot Requiring	1E-2
	1	Very Low - N	/linor Injury, I	First Aid	1E-1
	0	None - No S Consequence	Significant Sa :e	fety	1E+0



Additionally, a Consequence Categories table exists for each consequence type (safety, environment, asset, reputation & community). To change between the different consequence types simply click the drop-down window near the top of the workspace (located under Consequence Categories) and click on the consequence type you wish to select.

#### 4.2.3 Risk Rankings Page

The Risk Rankings Page houses the risk ranking table. This table allows the user to identify, describe and rank risk. Below is an example of the Risk Rankings Page from a study that uses the explicit LOPA method.

isk	Rankings		
<b>Ð</b> 1	🖻 🔺 🗸 🛛 Q 🔍 🛛	8	
Code	Description	Color	Priority
7	Very High	•	1
6	Very High	•	2
5	High	•	3
4	Medium High	•	4
3	Medium	•	5
2	Medium Low	•	6
1	Low	•	7
0	Very Low	•	8

The Risk Rankings table includes a column to assign a color to a risk rank; and as shown above, clicking on a cell within the color column will open a drop-down menu from which the color can be selected. This pop-up window contains the color picker tool. To select a color, simply select one of the default colors by clicking the box housing the color you want to select, or use the slider on the right to alter the hue and the cursor on the left to adjust brightness/tint. As you make changes in the color picker tool, the color in the cell will change and give you a preview of the color. When you are pleased with the color, simply click the "choose" button to select that color. If you wish to discard the changes you have made, click the "cancel" button.

When working in a study that uses the implicit LOPA style, an additional column is present in the Risk Rankings table. This column is the number of LOPA credits required to mitigate the risk to a tolerable level. The value entered in these cells are used in the LOPA to calculate the risk gap. Only numerical values should be entered into this column.

B	8	Study Data 🎉 Nodes 🍔 De	viations	PHA Wor	ksheets	LOPA Worksh
F	Risk F	Rankings				
	Code	Description	Color	Priority	Require	d LOPA
	7	Very High	<b>•</b>	1	3 Crec	lits
	5	Very High		2	3	
1	5	High	•	3	2	
2	4	Medium High	•	4	2	
6.6.1	3	Medium	•	5	1	
-	2	Medium Low	•	6	0	
	1	Low	•	7	0	
Ī	)	Very Low		8	0	

#### 4.2.4 Risk Matrix Page

Now that the likelihood and severity categories, and risk rankings have been established, the Risk Matrix can be created. The matrix will automatically build a grid containing the correct number of rows and column. If the consequence or severity categories do not appear in the correct order, click on the corresponding tab and rearrange the categories using the "Move Row Up" or "Move Row Down" buttons. Once the axes are configured correctly, you can populate the Risk Matrix by clicking on a cell and selecting a Risk Ranking from the list as shown below.



#### 4.3 Nodes

The Nodes tab contains the Nodes table, shown below. This table serves as a placeholder for information pertaining to each node, such as its intention, boundary, the drawings it's located on, and the color used to highlight the node. The Nodes table lays the foundation for PHA worksheets as a worksheet will be created for each of the rows in the Nodes table.

🛉 🖺 🔠 Study Data 🦞 Nodes	Deviations I PHA Worksho	rets 🕕 LOPA Worksheets 🗦 Re	commendations      Gafeguards	Risk Criteria	4 Back
lodes					
0 @ x 6 @ ^ v 8					
Description	Intention	Design Conditions	Operating Conditions	Drawing	Comment
(HP Gas) Production Header through High Pressure Separator (V-101) to	Entry of high pressure gases into the process from the wellheads and	MAWP = 1200 psig @ 300 F	700 psig @ 70 F (From production header)	D-254-002 Sh. 2 of 6	
Gas Export Pipeline	production manifold, and transfer of low pressure gas for delivery to the sales gas export pipeline.		350 psig @ 40 F (From HP separator)	D-254-002 Sn. 5 61 6	
(Liquid Stream) High Pressure	Low pressure separator receives	MAWP = 75 psig @ 300 F	50 psig @ 38 F	D-254-002 Sh. 2 of 6	
Separator (V-102)	high pressure separator.			D-254-002 Sh. 3 of 6	-
(Gas Stream) Low Pressure Separator (V-102), Gas Compressor (C-104), and	Transfer of low pressure gas for compression and delivery of	MAWP = 75 psig @ 300 F (LP Separator) 50 psig @ 70 F (Compressor Suction)	50 psig @ 70F (LP Separator) 50 psig @ 70 F (Compressor Suction)	D-254-002 Sh. 3 of 6	
Compressor Discharge Cooler (H-105) (includes gas spillback to Low Pressure Separator)	compressed gas to the sales gas export pipeline. Compressor discharge gas is cooled by H105 before delivery to the export pipeline or spillback to M102.	350 psig @ 300 F (Compressor Discharge)	350 psig @ 300 F (Compressor Discharge)	D-254-002 Sh. 5 of 6	
(Liquid Stream) Low Pressure Separator (V-102) through Export	Delivery of high pressure liquid to export liquid pipeline	MAWP = 75 psig @ 300 F (LP Separator) 2150 psig @ 300 F (Pump Discharge)	50 psig @ 50 F (LP Separator) 2150 psig @ 55 E (Pump Discharge)	D-254-002 Sh. 3 of 6	
Pump (P-103) to Export Liquid Pipeline (includes liquid spillback to Low Pressure Separator from Export Pump)	engen s menne gripsenië)	e roo baya de looo e l'equité procharges	in one houst on a second processingles.	D-254-002 Sh. 4 of 6	
Global Considerations					

Open PHA features a "deep copy" function; meaning that if a node is copied then, the associated Deviations and PHA Worksheet will be copied as well. The deep copy is useful in situations where a node is identical or similar to another. In these situations, a node can be copied, pasted, and then only the information that is different be changed. This is much more efficient that building out a new node from scratch and helps to expedite the PHA meetings.

#### 4.4 Deviations

The Deviations page holds the Deviations table. This table serves as a place to record the deviations that will be analyzed in the PHA. The Deviations page is also the other building block to the PHA worksheets. Each row in the Deviations table will generate a row in each of the PHA worksheets. The most important column in the Deviations table is the Deviation column. This column will be carried over to the PHA worksheet. The Deviation listed in each row of the table can also be broken down into a guide word and parameter for recordkeeping purposes, as shown below.

KENEXIS	OPEN PHA G	as Plant PHA-LOPA	
🗋 🖺 🎒 Study D	ata 🦻 Nodes 🥃 Deviations	PHA Worksheets UDPA Worksh	heets 🗄 Recommendations 🖨 Safeguards
Deviations			
1. (HP Gas) Productio	on Header through High Pressure	Separator (V-101) to Gas Export Pipelir	ne
84×60	∧ ∨ I ⊖		
Deviation	Guide Word	Parameter	Comments
1.1 High Pressure	High	Pressure	
1.2 Low Pressure	Low	Pressure	
1.3 High Temperature	High	Temperature	
1.4 Low Temperature	Low	Temperature	
1.5 High Level	High	Level	
1.6 Low Level	Low	Level	
1.7 High Flow	High	Flow	
1.8 Low Flow	Low	Flow	
1.9 Reverse Flow	Reverse	Flow	
1.10 Misdirected Flow	Misdirected	Flow	
1.11 Other Than Flow	Other Than	Flow	
1.12 Composition	Abnormal	Concentration/Composition	
l			

Although not displayed above, the table also contains fields for Intent, Sessions and Revisions. Additionally, the "deep copy" function also exists in the Deviations tab. For example, if a row in the Deviations table is copied, it will also copy the associated row in the PHA Worksheet.

#### 4.5 PHA Worksheets

When opening the PHA Worksheets tab, the workspace will open a blank worksheet prepopulated with deviations from the Deviations Table. If the Deviations table was not completed prior to starting on the PHA Worksheet, simply enter the deviations into the Deviation column and this will populate the Deviations column in the Deviations table. The example below is of the consequence indexed type.



KENEXIS	DPEN PHA Gas Plant PHA-LC	PA												
🗅 🖺 🗿 Study D	Data P Nodes E Deviations 🎞 PHA Worksheets	U LOPA W	/orksheets	{≣ Recomm	endations (	Safeguard	a 🙀 Parki	ng Lot 📦	Risk Criteria	<b>H</b> Back				
PHA Worksheets														
1. (HP Gas) Production	on Header through High Pressure Separator (V-101) to	Gas Export P	ipeline									•		
0 2 × 1 0	∧ ∨    ⊖													
				1						Consequences				
Deviation	Consequence	S Before Safeguards	E Before Safeguards	A Before Safeguards	L Before Safeguards	RR Before Safeguards	s	L	RR	LOPA Required	Cause	luses		
1.1 High Pressure	1.1.1 Potential overpressure of V-101. Potential loss of						1				1.1.1.1 Production header pressure	Relief valv		
	Pressure Separator resulting in large release of hydrocarbons and potential fire or explosion.										operates above 1200 pag.	PT-101D H HP separa Control va		
											1.1.1.2 External fire in the vicinity of HP	Relief valv		
		4 •	3	3	3	4	4 •	0 •	0		Separator V-101.	PT-101D h HP separa Fire detect personnel Control va No credit inadequat		
1.2 Low Pressure	<ol> <li>Potential breach of high pressure pipeline with subsequent pressure reduction to HP Separator M- 101. Potential hydrocarbon release to environmental and subsequent impacts. Potential fire/explosion.</li> </ol>	4 •	з •	2	1 .	2	4 •	o •	0		1.2.1.1 Production header pipeline leak or rupture (due to vehicle impact) upstream of SDV-101.	PT-101D I hazard by Automate upstream		
1.3 High Temperature	1.3.1 No credible scenarios				e - 39						1.3.1.1			
1.4 Low Temperature	1.4.1 No credible causes - Auto-refrigeration of gas flashing across PV-101A not expected to result in safety concerns.										1.4.1.1			
1.5 High Level	1.5.1 Potential overfill of the High Pressure Separator M- 101 with liquid flow to the Gas Export Pipeline. Potential for Off-Spec product.										<ol> <li>5.1.1 Failure of control loop UC-101 such that liquid outlet valve is too much closed.</li> </ol>	h High level valve SDV Operator i 101A - no failure		
									-		1.5.1.2 Failure of shutdown valve SDV- 102A to the closed position.	High level valve SDV		

To fill in consequences or causes, simply click the cell and begin typing. To fill in likelihoods or severities, click the cell to pull up a drop-down menu and then select the category you want from that menu. When filling out the Safeguards for a scenario, Open PHA will pull up a window containing safeguards used in the study. As you type, the window will filter the list of safeguards to only the safeguards containing text that matches what was typed. Selecting an item from the list will insert it into the cell.

KE	NEXIS	OPE	N PH	A Gas I	Plant PHA	-LOPA					
	Study	Data 🎖 No	des 🛢 Dev	iations 📮	PHA Worksh	ieets 🚺 LO	PA Workshee	ts ≟≣ Rec	ommendations	🚯 Safeguards 🛛 🖨 Parking Lot 🧯	👌 Risk Criteria 🛛 📢 Back
PHA V	/orksheets										
1. (HP	Gas) Product	ion Header t	through High	Pressure Se	parator (V-10	1) to Gas Exp	ort Pipeline				
<b>B</b> <i>Q</i>	1 🏍 🖪 🖻		A								
			<u> </u>						Consequences		
	S	E	Α	I. Pafara	DD Pafara					C	auses
	Before	Before	Before	Safeguards	Safeguards	S	L	RR	LOPA Required	Cause	Safeguards
	Safeguards	Safeguards	Safeguards								Safeguard
s of h										1.1.1.1 Production header pressure operates above 1200 psig.	Relief valve PSV-101 opens to flare
f											PT-101D high pressure shutdown closes
											HP separator inlet valve SDV-101.
											Control valve PV-101B will open to flare.
										1.1.1.2 External fire in the vicinity of HP	Relief value PSV-101 opens to flare
	4 .	3 .	3 .	3 .		4 •				Separator V-101.	Neller valver 5V for opens to hare
							Ť				PT-101D high pressure shutdown closes
											HP separator inlet valve SDV-101.
											Fire detection
									Fire detection syst	em allowing time for personnel	Control valve PV-101B will open to flare.
									evacuation		No credit taken for this IPL due to
											inadequate sizing.
h										1.2.1.1 Production header pipeline leak o	r PT-101D low pressure shutdown mitigates
or M-	4 •	3 .	2 .	1 •	2	4 •	0 .			rupture (due to vehicle impact)	hazard by closing SDV-101.
mental		-	-				-			upstream of SDV-101.	Automated low pressure shutdown
										1011	upstream of the production neader.
	•	•		•		•	•			, 1.3.1.1	
										1.4.1.1	
lt in	•	•	•	•		•	•		•	,	
or M-										1.5.1.1 Failure of control loop LIC-101 suc	h High level shutdown LT-101B closes inlet
<u>a</u> .										that liquid outlet valve is too muc	valve SDV-101
										closed.	Operator response to high level alarm LT-
											101A - not independent from control loop failure
										1.5.1.2 Failure of shutdown valve SDV-	High level shutdown LT-101B closes inlet
										102A to the closed position.	valve SDV-101

#### KENEXIS DPEN PHA Gas Plant PHA-LOPA

B B Study Data V Nodes Deviations U Nodes Deviations U LOPA Worksheets D LOPA Worksheets Recommendations D Safeguards A Parking Lot Risk Criteria C Back
PHA Worksheets

1. (HP Gas) Production Header through High Pressure Separator (V-101) to Gas Export Pipeline

#### 🔁 🖓 🗶 🖪 🖻 🔺 🗸 I 🖨

									Consequences		
	S	E	А							Ca	uses
	Before	Before	Before	L Before	RR Before	s	L	RR	LOPA Required	C	Safeguards
	Safeguards	Safeguards	Safeguards	Sareguards	Sareguards					Cause	Safeguard
oss of ligh e of n.										1.1.1.1 Production header pressure operates above 1200 psig.	Relief valve PSV-101 opens to flare PT-101D high pressure shutdown closes HP separator inlet valve SDV-101. Control valve PV-101B will open to flare.
								Update Referen	ce?	ricinity of HP	Relief valve PSV-101 opens to flare
	4 •	3 •	3 •	3 •	4	4 •	0	This item ha update the n	s an existing refere eference or create	ence. Do you want to a new object?	PT-101D high pressure shutdown closes HP separator inlet valve SDV-101. Fire detection system allowing time for personnel evacuation Control valve PV-101B will open to flare.
											No credit taken for this IPL due to inadequate sizing.
vith ator M-										1.2.1.1 Production header pipeline leak or rupture (due to vehicle impact)	PT-101D low pressure shutdown mitigates hazard by closing SDV-101.
onmental osion.	4 •	3 *	2 •	1 *	2	4 *	0	• 0		upstream of SDV-101.	Automated low pressure shutdown upstream of the
	•	•	•	•		-		•	•	1.3.1.1	
jas sult in	•	•		•		•		•		1.4.1.1	
rator M- ine.										<ol> <li>1.5.1.1 Failure of control loop LIC-101 such that liquid outlet valve is too much closed.</li> </ol>	High level shutdown LT-101B closes inlet valve SDV-101 Operator response to high level alarm LT- 101A - not independent from control loop failure
										1.5.1.2 Failure of shutdown valve SDV- 102A to the closed position.	High level shutdown LT-101B closes inlet valve SDV-101

#### 4.6 LOPA Worksheets

The LOPA worksheet is extremely similar to the PHA worksheet but displays the columns which are relevant to Layer of Protection Analysis rather than PHA. Where possible (for example Cause and Consequences), data will be shared across the PHA and LOPA worksheets.

The LOPA worksheets are filtered based on the state of the "LOPA Required" field shown in the PHA Worksheets. If the LOPA Required field is set to "Yes", the PHA scenario will be displayed in the LOPA worksheet, otherwise it will be hidden.



If you create a new LOPA scenario from the LOPA worksheets, a new corresponding PHA scenario will be created with the LOPA Required field set to Yes. Any information about the deviation, cause or consequence which is entered on the LOPA worksheet will also be applied to the associated PHA scenario(s).

#### 4.6.1 Implicit vs Explicit LOPA

When creating a new Open PHA study you are prompted to select a LOPA style. The options include Implicit and Explicit.

The more common style of LOPA is the explicit LOPA in which the team establishes a TMEL target based on a consequence severity, then explicitly defined frequencies of cause and applies frequency modifiers such as conditional modifiers, enabling events



and probabilities of failure for IPL's. The Explicit LOPA methodology is widely used and understood throughout industry and won't be further discussed here.

Implicit LOPA's are less common but are fully supported in Open PHA. In an implicit LOPA, the LOPA team works with the concept of "LOPA credits". In implicit LOPA's a likelihood category is applied to a cause and a consequence severity is applied to the consequence. The combination of these two results in a risk rank, just like PHA. If you select an implicit LOPA style for your study you will be prompted to enter the number of required LOPA credits for each risk rank (see *Section 4.2.3*). If this information is entered it will be used by the LOPA worksheets to calculate the number of LOPA credits required based on the likelihood and consequence categories for the cause-consequence pair. Subsequently a LOPA gap will be calculated which is equal to the number of Required LOPA credits minus the number of IPL credits. In the case of no IPL's the LOPA Gap will be equal to the number of required LOPA credits as shown in the figure below.



Each IPL Credit will reduce the LOPA Gap by one. The goal of an implicit LOPA is to reach a LOPA Gap of zero which implies tolerability of risk. Typically, an IPL credit of 1 corresponds to a PFD of 0.1 and a LOPA credit of 2 corresponds to a PFD of 0.01 as shown in the figure below.





#### 4.7 Check Lists

The Check Lists tab contains tables that allows you to display and navigate all the check lists that are incorporated in a PHA study. When the check list categories tab is selected, a list of all the check lists contained in the study is shown, along with the number of questions in the check lists and how many (and what percentage) have been completed.

Description	Completed Questions	Total Questions	Percent Complete	Comments
1 Inherently Safer Checklist	3	10	30%	
2 Facility Siting Checklist	0	15	0%	
3 Human Factors Checklist	0	14	0%	
4 Global Considerations Checklist	0	15	0%	

The other tab on this page provides access to the individual checklist worksheets. The Check Lists Worksheets page is shown in the following figure. At the top of the page, there will be a drop-down list that allows the user to navigate between all the check lists that are available. Below that, the check list worksheet table is available. In this table the user can view/add/edit check list questions, provide an answer to the question along with a justification of the answer that was provided. The worksheet also provides a column to allow recommendations to be generated and documented

 $\left| \right\rangle$ 

PHA / LOPA

for individual checklist items. The recommendations from checklists are further summarized in the Recommendations tab which is discussed in the next section.

🖪 🖓 💥 🖪 🛍 🔺 🗸 I Q Q I 🔒		⊙ 🔮 ≓ Search Worksheet									
Question	Answer	Justification	Check List Recommendation								
1.1 Minimize Inventory - Is it feasible to reduce hazardous feedstock inventory with just-in-time deliveries?	No 🗸	The feed stock inventories have been optimized to minimize inventory while ensuring sufficient material is available to meet all contractual obligations									
1.2 Minimize Inventory - Is it feasible to reduce inventory by managing supply contracts with key vendors of hazardous feedstocks?	No 🗸	Feed stock supplier coordination has already been optimized.									
1.3 Minimize Inventory - Is it feasible to produce hazardous raw materials in situ from less hazardous feedstocks and rapidly consume the more hazardous feedstocks?	Yes 🗸	The production of alpha-chemical can be performed on site by using beta- chemical as a precursor, and then immediately decomposing it for the reaction to create delta chemical. This will replace storage of alpha with beta which is less dangerous to store.	1 Consider replacing alpha-chemical a a feed stock with beta-chemical. This will require building a process step to create alpha from beta and then immediately consume the alph in the next stage of reaction withou intermediate storage.								

#### 4.8 Recommendations

The Recommendations tab contains a table that is used to keep track of the recommendations that were made throughout the course of the study and to provide easy navigation between the list of recommendations and the study worksheet that contain those recommendations in context. This table helps to manage the recommendations by allowing you to designate the priority which should be placed on the recommendation, the responsible party, the status of the recommendation, and a reference, with hyperlink (in the Cloud-Premium version) for the recommendation to help track down the recommendation within the study. As shown in the following figure, recommendations are separated by the study worksheet type in which the recommendations were generated: PHA, LOPA, or Checklist. Navigation between recommendations based on study type is performed by clicking on the tabs at the left.

	1
$\sim$	
$\nearrow$	

	ચ ∥ 🖨					00	<b>≓</b> Sei	arch V	/orkshe	et	_			
						Referenced Locations								
PHA Recommendation	Priority	Responsible Party	Status	Comments	Reference	L Before Safeguards	s		L		F			
1 Consider adding a check valve to the inlet pipeline to HP Separator M-101 to prevent reverse flow through the pipeline.	Medium Y	Piping	In Progress 👻		<u>1.9.2</u>	3	• 0	*	0	×				
2 Consider adding a SDV which closes	High 🗸	Instrumentation and	In Progress 👻		<u>3.1.1</u>	3 .	• 4	~	0	~				
on PT-104D HH, in the gas compressor spill back line to the		Control			3.1.2	3 .	• 0	~	0	~				
Low Pressure Separator M-102.					<u>3.1.3</u>	3 `	• 4	~	0	~				
3 Ensure PSV-102 is adequately sized	Low 🗸	Scarlett A. Gray	Completed ¥		<u>3.1.1</u>	3 •	• 4	~	0	~				
to vent all flow from M-101 for this consequence.					<u>3.1.2</u>	3 `	• 0	~	0	~				
eeneedeenee.					<u>3.1.3</u>	3 .	• 4	~	0	~				
4 Consider adding a check valve to	Low 👻	Scarlett A. Gray	Under Review 💙		<u>3.1.1</u>	3 `	4	~	0	~				
spillback pipeline to the LP					<u>3.1.2</u>	3 `	• 0	~	0	~				
HP Separator M-101 gas outlet.					<u>3.1.3</u>	3 `	• 4	~	0	~				

#### 4.9 Safeguards

Safeguards entered in the Safeguards column of the PHA Worksheet or in the LOPA worksheet will also exist in the Safeguard table within the Safeguards Tab. Each time a different safeguard is put into the worksheet (regardless of the study worksheet in which it was generated), an entry is also created in this table. The Safeguards tab contains a list of safeguards that allows the user to manage how they are used and displayed between the different study worksheets. Each safeguard can flagged as either a PHA safeguard, displaying on the PHA Worksheet, or as an IPL, displaying on the LOPA worksheet – or both. This list is also the library used by the PHA / LOPA worksheets to assist in populating the Safeguard or IPL column with safeguards that have previously been used

🔁 🖓 💥 🖪 🛍 🔺 🔪	₽	Search Worksheet								
Safeguard	Туре	Safegua	ard	IPL		Tag	Selecte SIL	d	PFD	Reference
9 Operator response to high	level Operator	Yes	~	No	~			~		1.5.1.1
alarm LT-101A - not indepe	ndent Response to									<u>1.5.1.2</u>
	Alaini									<u>1.5.1.3</u>
10 Relief valve PSV-102, whic sized for gas blow-by	h is Pressure Relief Valve	Yes	~	Yes	~	PSV-102		*	0.01	<u>1.6.1.1</u>
11 Low level shut down LT-10 closes low pressure separa inlet SDV-102A	11B Safety ator Instrumented Function	Yes	~	Yes	~	UZC-101C	SIL 2	~	0.01	<u>1.6.1.1</u>
12 Operator response to low	laval Operator	Ves	~	No	~			~		

The worksheet also provides a reference, with hyperlink, to where those safeguards are used in the study. When the hyperlink is clicked, the Open PHA will ask which

worksheet (PHA or LOPA) that is desired to be viewed, and then will navigate to that scenario in the selected worksheet. This feature that shows all of the scenarios in which a safeguard is used is an essential tool in the process of safeguard or IPL rationalization.

	Safeg	guards		
	•	2 🔀 🖪 🖻	∧ ∨    Q Q    → Search Worksh	eet
t		Туре	PHA or LOPA Worksheets?	Reference
	vel	Operator Response to	Would you like to view this referenced location on the PHA or LOPA worksheets?	<u>1.5.1.1</u>
	Gent	Alarm	PHA Worksheets Cancel	<u>1.5.1.2</u> <u>1.5.1.3</u>
	is	Pressure Relief Valve	Yes Yes PSV-102 0.01	<u>1.6.1.1</u>
	B or	Safety Instrumented	Yes         Yes         UZC-101C         SIL 2         0.01	<u>1.6.1.1</u>
	•			

# PHA / LOPA



#### 4.10 Parking Lot

The Parking Lot page, shown below, is used to keep track of items or issues that may not be worthy of a recommendation, but still warrant a change of some kind. A typical parking lot item is to verify or amend a P&ID. In addition to showing the parking lot items, this page also provides a summary view of all the comments that were made on the PHA and LOPA worksheets, along with hyperlink navigation to all of the places where those comments were made on the study worksheets.

Parking Lot Issue	Response	Responsible Party	Start Date	End Date	
Drawings have not been updated with handwritten notes fron the last field inspectior	Drafting to add modifications after completion of HAZOP.	Drafting			
				1	

LOPA Comments								
🖸 🖓 🛰 🖪 🛍 🔺 🗸 🔍 🔍 🔍	l 🖨	🚱 🔮 💳 Search Worksheet						
LOPA Comment	Reference	]						
Review the relief valve sizing calculations to ensure that the relief valve was appropriately sized.	<u>1.1.1</u>							
		•						

#### 5.1 Premium Features Overview

This section of the user's manual is dedicated to premium features which are only available in Open PHA Cloud-Premium. Open PHA Premium is the cloud-based version of Open PHA which is integrated with the Kenexis Integrated Safety Suite.

#### 5.1.1 Open PHA Cloud-Premium Login

When your Open PHA Premium license is activated you will receive instructions via email with your login credentials. Once you have received this package, it means that your account has been configured and is ready to use. You can access your account by directing your browser to <u>https://kiss.kenexis.com</u>. This will navigate your browser to the KISS login page, shown below.

https://kis.keneils.com/Account X     +			-	×	
← → C (a) https://ksi.kenexi.com/Account/Login.aspx	04	☆	<b></b>	) :	
Eigen for bound to safety.         Username:         Password:         Sign in         Fryst Password:         Sign in         Fryst Password:         Sign in         Fryst Password:         Sign in         Fryst Password:					

From here you can login using the login credentials provided in your KISS welcome email. If you've lost your temporary password, it can be restoring by using the "Forgot Password?" link. If you've lost your username, please contact <u>support@kenexis.com</u> for assistance.

Once logged into your KISS account you'll be ready to create new Open PHA studies or import existing Open PHA studies created using the Open PHA desktop edition.

Creating a new study is covered in *Section 1.1* of this user's manual. Importing is covered in the following section.



# 5.2 Importing and Exporting Studies in Open PHA Premium

The Open PHA desktop edition and Open PHA Premium are designed to work in tandem. The Open PHA desktop edition gives you the ability to work with Open PHA studies without an internet connection. This is particularly useful when facilitation of PHA studies takes you to places where internet connection is limited.

The Importing and Exporting tools of Open PHA Premium allow you to easily move studies between the Kenexis Integrated Safety Suite and your computer. Once a study has been imported in the Open PHA Premium and KISS, all of the premium features described in the section will be available. If at any time you need to work without an internet connection, you can use the export tool to create a local copy of a study which can be edited with the Open PHA desktop edition.

To import an Open PHA desktop file to Open PHA premium, perform the following steps:

- 1.) From the KISS Study Manager page, select a facility where you would like to store your Open PHA study.
- 2.) In the main action ribbon, click the Import Study button.
- 3.) Use the file dialog to select the file to import and click open the start the import.

Once the import is complete your study will be automatically opened in Open PHA Premium.



The process can be reversed using the export study tool allowing you to move your study from Open PHA Premium to a file stored locally on your computer which can be opened with the Open PHA desktop edition.

To export an Open PHA Premium study to your computer, perform the following steps:

- 1.) From the KISS Study Manager page, select the facility where your study is located to load the study list.
- 2.) Locate your study in the study list and left click anywhere in the row other than the study name to select it. Once selected the row will be highlighted blue.
- 3.) In the Main Action Ribbon, click the export study button to start the download.

KENEXIS INTEGRAT	TED SAFETY SUITE
	Filter Studies
Facility List Arbor Fffiqy	Study List <u>Open PHA Study</u> Texas City Gas Plant HAZOP
Open PHA Vertigo	
Open PHA Studyopha 🔨	

#### 5.3 Premium Report Generation

The standard version of Open PHA has the ability to export worksheet information to Microsoft excel files using the export to excel button described in *Section 3.1.1.8* of this manual. The Open PHA premium report generation tools provide a wider set of options and features for report generation.

To generate a report, click on the premium tools button in the navigation toolbar and select report generator from the drop down.

	Study Data 🦻 Nodes	Deviations	PHA Worksheets	U LOPA Worksheets	Check Lists	ERecommendations	
🗘 Safeg	uards 😝 Parking Lot	📦 Risk Criteria	🔅 Premium Tools	<b>H</b> Back			
(mail	Overview		Report Generator				<b>^</b>
	Stu	udy Name Texas C	Spell Check				
	Study Co	ordinator Scarlett	t Translate Study				
	Study Coordinator Co	ntact Info scarlett	Revision Manager				
		Facility Bayou I	Synchronize with Ver	tigo			
203	Facility	/ Location Chemic	Import As Working Re	evision			
	Facil	ity Owner GOGO	Library - Node Templa	ates			
		Unit Entire C	Routio Diagram				
https://kis	s.kenexis.com/OpenPha/Defa	+ Number 000 405 ault.aspx#	Bowlie Diagram				

This will open the Open PHA Premium Report Generator, shown below.

Open PHA Premium Report Generator									
Basic Reports - Select Iter	ms to Include								
Study Data									
Drawings Revalidation History	Team Members	Sessions							
Worksheets & Recommendations									
Nodes PHA Worksheets LOPA Worksheets Page Size 8.5 x 11 Page Orientation Portrait	Parking Lot     PHA Recommendations     LOPA Recommendations     Genera     Genera	Safeguards IPLs te Basic Report							
Upload your *.doc or *.docx Rep Choose File No file chosen	port Template Generate	e Custom Report							
		Close							



Open PHA Premium reporting can generate two types of reports; basic reports and custom reports.

#### 5.3.1 Generating a Basic Report

Basic reporting in Open PHA Premium will generate a Microsoft Word (\*.docx) file contains one or more tables based on the options selected when generating the report. The page size and page orientation of the basic report can be modified using the dropdown menus in the basic reporting section of the premium report generator.

To add tables to your basic report, click on the toggle for the desired tables. Options which blue toggles will be printed. In the following figure, a report will be generated on an 11x17 page size with landscape orientation containing the PHA and LOPA worksheets. Clicking the Generate Basic report button will generate the report and initiate a download.

Open PHA Premium Report Generator									
Basic Reports - Select Items to Include									
Study Data									
Drawings Team M Revalidation History	embers	Sessions							
Worksheets & Recommendations									
Nodes Parking	Parking Lot								
PHA Worksheets     PHA Re	commendations	Safeguards							
LOPA Worksheets     LOPA F	ecommendations	IPLs IPLS							
Page Size 11 x 17  Page Orientation Landscape	Page Size     11 x 17       Page Orientation     Landscape   Generate Basic Report								
Custom Report - Upload Custom Repo	rt Template								
Upload your *.doc or *.docx Report Template Choose File No file chosen	Generate Custom Report								
		Close							

#### 5.3.2 Generating a Custom Report

Custom reporting in Open PHA Premium allow you to use a custom Microsoft Word (\*.docx) report template to generate your PHA and LOPA reports. Custom Reporting allows you to quickly generate a complete PHA/LOPA report in your preferred report format complete with your companies branding and imaging. This is one of the most

powerful features of Open PHA premium and is a very useful productivity feature. Learning to leverage custom reporting can greatly reduce report generation time.

To start using the custom reporting tool you'll need to create a PHA/LOPA report template in Microsoft Word. For many users you may already have a report template that you have used previously. Existing report templates are a good starting point for the custom report generator.

The custom report generator works by identify and replacing specific text patterns in an existing Microsoft Word document. When a text pattern is recognized, it will be replaced with data extracted from your Open PHA study. Text patterns always take the following form.

<%Text\_Pattern%>

When the words Text\_Pattern represent a piece of data that you would like extracted from your Open PHA study and inserted into your report. In some cases this data may be a single field. For example, including the text patter <%Facility%> in your custom report template will replace with text pattern with the data entered in the Facility field on the Study Data Overview Page.



In other cases, the text pattern may be replaced by one or more tables. For example, including the text patter <%Pha\_Worksheets%> will replace the text pattern with all of the PHA worksheets from your Open PHA study.





Node 1	M <sup>a</sup> Gas) Production Header Werough High Pressure Separator (V-300) to Gas Exp Groupsmo	Nort I	1	-	LORA. Required	Cause	Selepard	Salapard Type	Pith fla some endation	Pillin Communit
nge A waare	Potential perspective of 1 223. Antential touril mechanical integrity. Potential regions of the Potence Reserver multitative between these of the transitions and estimates for an estimation.	t	۲t	1	**	Foduction header pressure spectras above 1200 auto	Refer value PDV (25 opens to films			-
							PT stilling presses shottown does 19 regenter inter othe SDV 201.			•
							Control value Pri citità uni speciali fare.			-
						Examples in the worky of the parater (note)	Relief volve Plin cits opens to fam			-
							PS 2020 high pressure shutdown dooss of responses inter-only 100-101.			-
							Fire detection system allowing time for personnel evaluation			*
							Control value Pri CILB with open to flate. No cited when for this PC-bar to inedequate story		•	•
in Pears	Polential locals of the general polenne of a close perturbative to the Superior 10.22. Polential hydrogeneous to an incommental and subsequent impacts. Nametial fragilagistics.	ſ	ľ	1	10	Production header pipeline test or napture (due to obtain impact) opsimum of 320 44	P 222 to prese dublics religion hand by during 121 22.			
						<u> </u>	Automated <u>too pressor</u> shutdown-updream of the production header.		-	•
nge Temperature	No public cham		Π	1	•					
ine Temperature	No couldre course - Auto-refrigeration of gas feating across Pr ((), A not expected to result in other servation.	t	Π	1						
righ Land	Presenter a werft of the <u>high Tenners</u> Separate 1912; with fault flow to the Das Doport Rystme. Potential Re-OR Specification.	ľ	1	1	10	Parture of control loop UC S21 such that Reput outline where is how much closed.	High Seven dructilisers UP 02528 Classes intel value RDV 025.			
							Eperator response to high level alarm (1920), not independent from control loop failure		-	
						Falue of Automation and Strattant to the Dated position.	High local dructions 17-5258 cover mint value RDV-125			
							Eperator response to high level atoms (3-2004- nat independent from cantrol loop feiture			1
						hig padar that H 🔛 han production basine.	Eperator Augusta to high lever alarm 13-3254- nat independent than control long februre			1
							righ lanet abuttions (7-5258 closes mint value 824-525			*
100.000	Provided for gas blocks into the <u>part Provide</u> Reporter V (2). Potential for overpressive of <u>part Provide</u> Reporter. Prioritia for iosis of machinese imperts. Prioritia for rightness of wood or associated parts Reporter interest of Reported reports.	ľ	M	1	10	Refure of control long UC DDA such that refue is too much open	Nation was an Article control of a state for gas between			
							Deliver publics U-222 common pressure		ŀ	-

<%Pha\_Worksheets%> will be replaced by one or more PHA Worksheet tables.

Open PHA Premium recognizes a large number of text patterns. The recognized patters are list on the Kenexis Support website at the following url.

https://www.kenexis.com/support-post/open-pha-custom-reporting-text-patterns/

Once you have a custom report template configured with the text patterns of your choosing you can generate a custom report using the Open PHA Premium Report Generator by following the steps below.

- 1.) Click on the Choose File button and select your report template from the file dialog.
- 2.) Click on the Generate Custom Report button.

Your report template will be populated with data from your Open PHA study and a download will start with your completed report.





#### 5.4 Translations and Spell Check

Open PHA premium has a translation and spell-checking engine which is powered by Microsoft cloud API's. The spell-checking tool will automatically detect the input language and generate appropriate results. To spell check a study simply click on the Spell Check option under the premium tool's menu.

KEN	VEXIS	OPE	N PH	A Texas City Gas	Plant HAZOP					Signed In As Sean Cunning	gham of Kenexis 🔁
	Study Data	$\mathcal V$ Nodes	Deviation:	S ঢ় PHA Worksheets	LOPA Worksheets	3 ∃ ■ Recommendations	Safeguards	🖨 Parking Lot	📦 Risk Criteria	Ø₀ Premium Tools ▼	<b>H</b> Back
	Overview									Report Generator	
		Study	Name Texas Cit	y Gas Plant HAZOP							
		Study Coord	dinator Scarlett	Inn Gray						Spell Check	
	Study Coordi	inator Conta	ct Info scarlett.g	ray@kenexis.com						Translate Study	
			Facility Bayou Ba	y Gas Plant						,	
		Facility Lo	ocation Chemica	City, Texas, USA						Revision Manager	
		Facility	Owner 🗌							Current and inclusion with Mantin	
			Unit Entire Ga	s Plant						Synchronize with vertig	
		Report N	lumber							Import From PHA-Work	s 🗌
( <del>*</del>		Project N	umber 900.123								
	i i	Project Desc	ription Initial (Pr	e-Startup) PHA of the gas pl	ant						
9											
æ											

You be presented with the following window. Click start to begin spell checking the study. The spell-checker will review the entire study, not just the visible worksheets.

Spell Check Study	
Not in Dictionary:	
Suggestions:	
	Replace
	Replace All
	Ignore
	Ignore All
	Add To Dictionary
	Start Pause Close

Translation of the study is also a very simple process. To translate a study, select the translate study option from the premium tool's dropdown menu. You will be presented with a window prompting you to select your desired language. Clicking the translate button will begin the translation process in the background. When the translation process is complete you will receive an email at the email address associated with you Open PHA premium subscription.

E	NEXIS OPEN	PHA	Texas City Gas	Plant HAZOP					Signed In As Sean Cunning	ham of Kenexi
	🕽 Study Data 🦞 Nodes 🍔 🛙	eviations	្រុដ្ឋ PHA Worksheets	LOPA Worksheets	∃	Safeguards	🖨 Parking Lot	Risk Criteria	Ø <sup>8</sup> <sub>0</sub> Premium Tools ▼	<b>H</b> Back
63	Overview								Report Generator	<b></b>
	Study Name	Texas City G	as Plant HAZOP							
2==	Study Coordinator	Scarlett Ann	Gray			1_			Spell Check	
	Study Coordinator Contact Info	scarlett.gray	@kenexis.com	Translate Study					Translate Structu	
£	Facility	Bayou Bay G	as Plant	You can translate you	r Open PHA Study to an	v language			franslate study	
	Facility Location	Chemical Cit	y, Texas, USA	listed below.					Revision Manager	
65	Facility Owner	[		Translations can take	up to 30 minutes and wi	I run in the				5
~	Unit	Entire Gas Pl	ant	background while you	work. You will recieve a	n e-mail			Synchronize with Vertig	• =
	Report Number	[		when the translation is	s complete.				Import From PHA-Works	. 61
<u></u>	Project Number	900.123		Closing Open PHA or	logging out from your Kl	SS account			import rom risk from.	
<u> </u>	Project Description	Initial (Pre-S	tartun) PHA of the ga	will not interupt the tra	inslation.	1				
Э		initial (Free S	iantap, rink of the gu	Select Language		-				
_			1	Afrikaans		•				
æ										
_	1	1			Translate	Cancel				

# PREMIUM FEATURES

#### 5.5 Revision Management

Open PHA premium features a revision management tool which allows you to create and manage a revision history for a PHA or LOPA study. The revision manager can be reached either by selecting the option from the Premium tool's menu or selecting the revision manager tab under study data.

l	a 🛛	Study Data	$\mathcal V$ Nodes	Deviations	PHA Worksheets	U LOPA Worksheets	∃ ∃ ⊟ Recommendations	Safeguards	🖨 Parking Lot	📦 Risk Criteria	$Q_0^0$ Premium Tools $igstar{}$	-
	(C)=	Revision Hi	story								Report Generator	
			2 1 1	<b>\$</b> >							Onell Observe	
	4=	There are no re	evisions in th	s study. You can cr	eate a new revision above.						Spell Check	
	<u></u>										Translate Study	
											Revision Manager	
	22°											
											Synchronize with Vertige	lo
	_										Import From PHA-Works	s
	Ŧ											
	อ											
ſ	æ											

In the revision manager you will be presented with a revision history for the current Open PHA study. In the above figure, no revisions exist. Once a revision is added, it will appear in the revision history table. The toolbar in the header of the revision history table is used to interact with revisions. The following buttons are available in the revision manager.



#### 5.5.1 Adding a New Revision

Add Revision – Opens a Dialog to Add a new Revision

The add review button will open the following dialog for creating a revision. All fields are optional. When a revision is created the creator of that revision and the creation date will be set automatically.

Revision Name		
Revision Description		
Revision Remarks	 	
Revision Remarks		
Revision Remarks		
Revision Remarks		

#### 5.5.2 Loading a Revision for Viewing

• View Revision – Loads the selected revision for viewing

When a revision is loaded for view, the current working revision of the study will be unloaded and replaced the state of the study when the selected revision was created. The ability to load and view a previous revision allows you to understand how a study has changed over time. Once a revision is loaded you will receive a notification informing you the you are viewing a previous revision of the study and Open PHA will transform to read-only mode.





To stop viewing a previous revision and return to the working revision of the current study return to the revision manager and click on the view working draft button shown below.

View Working Draft – Unloads previous revision being viewed and returns to editable working revision.

#### 5.5.3 Updating and Approving a Revision

Edit Revision – Opens a dialog to edit the selected revision

Clicking the edit revision button will open the following dialog.

Update Re	evision
Revision Na	me
Rev 0	
Revision De	scription
Initial Rele	ase - For Client Review
Revision Re	marks
	Approve Revision Update Cancel

Editing the revision name, description or remarks and clicking the update button will update the properties of the revision. Clicking on the Approve Revision button will mark the revision as approved by whichever user clicks the approve button. The approval date will be set automatically based on the time the button was clicked.



#### 5.5.4 Copying and Deleting Revisions

Revisions can be copied or deleted using the copy and delete buttons in the revision manager toolbar.



Clicking the delete icon will prompt you to delete the selected revision.

Clicking the copy icon will create a new Open PHA study which is identical to the selected revision. The new copy of the study will appear in the Study list with the same study name as the revision but suffixed with the revision name. You will also review a notification informing you that the revision has been copied.

×	
Revision Copied Return to Study List to View	

#### 5.6 Synchronize with Vertigo

Open PHA studies can be synchronize with Vertigo SIS Lifecycle Management studies when working in Open PHA Premium. The Vertigo synchronization tool can be reached with by clicking on the synchronize with Vertigo option in the Premium tool's menu, or navigating the safeguards page and clicking on the synchronization tab.

	Study Data 💡 Node	es 🛢 Deviatio	ns 🎵	PHA Worksheets	C LOPA Worksheets	∃ = Recommendations	Safeguards	🖨 Parking Lot	🗑 Risk Criteria	Øo Premium Tools ▼ 4
	IPL's									Report Generator
		<b>∧ ∨</b> ∥Q	Q    🖨							
	IPL	IPL Tag	PFD	IPL Type	Reference					Spell Check
	1 Relief Valve on High Pressure Separator	PSV-101	0.01	Relief Valve	1.1.1.1					Translate Study
=	2 High Pressure Separator (V-101) High-High Pressure	UZC-101A	0.1	SIF	1.1.1.1					Revision Manager
	Closes Inlet Valve	1170 1010	0.01	cir.						Synchronize with Vertigo
	Separator (V-101) Low-Low Level Closes Outlet Valve	020-1018	0.01	SIF						Import From PHA-Works
	4 High Pressure Separator (V-101) High-High Level Closes Inlet Valve	UZC-101C	0.1	SIF						

When performing a synchronization, you will be presented with the following prompt.

h Vertigo IPF's
Update Existing Vertigo Study
ted by semi-colon

The first time you synchronize Open PHA with a Vertigo study you will need to create a new Vertigo Study as part of the synchronization. Once you Open PHA study is synchronized with an existing Vertigo study you will have the option to update that synchronized study with the current data in Open PHA.

The Vertigo synchronization tool is uni-directional. This means that data can only flow in one direction, from Open PHA to Vertigo. Changes to a synchronized Vertigo study can't be written back to Open PHA. In addition, updating a synchronized Vertigo study from Open PHA could potential over-write changes made manually to your Vertigo study.

To create a new Synchronized study, enter a study name and click synchronize. This will create a new Vertigo study located in the same facility as the synchronized Open PHA study. You will need to navigate back to the study list page to view the results.

Unless IPL type filtering is applied, the new Vertigo study will contain one Independent Protective Function (IPF) for each Independent Protection Layer (IPL) in your Open PHA study. This is usually not the desired outcome as not all IPL's in LOPA are IPF's in SIS Lifecycle Management. Therefore, it is often useful to use IPL type filtering to limit of IPL's that are converted to Vertigo IPF's.

#### 5.6.1 IPL Type Filtering

IPL type filtering allows you to limit the IPL's in Open PHA which are converted to IPF's in Vertigo when synchronizing. The IPL type filter is applied if any information is

entered the "IPL Type Filters" text area. The filtering occurs based on the data entered in the IPL Type field of each IPL record.

In the following figure we have a list of IPL's in an Open PHA study which contain four IPL types (Relief Valve, SIF, MPF and Check Valve). Only the SIF and MPF IPL types are desired to be synchronized with Vertigo the relief valve and check valve types are not.

IPL	IPL Tag	PFD	IPL Type	Reference
1 Relief Valve on High Pressure Separator	PSV-101	0.01	Relief Valve	Synchronize Open PHA IPL's with Vertigo IPF's
2 High Pressure Separator (V-101) High-High Pressure Closes Inlet Valve	UZC-101A	0.1	SIF	Create New Vertigo Study  Update Existing Vertigo Study Vertigo Study Name My Synchronized Study
3 High Pressure Separator (V-101) Low-Low Level Closes Outlet Valve	UZC-101B	0.01	SIF	IPL Type Filters
4 High Pressure Separator (V-101) High-High Level Closes Inlet Valve	UZC-101C	0.1	SIF	Synchronize C
5 Manual ESD Pushbutton		0.1	MPF	
6 Dual Critical Check		0.1	Check Valve	

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IPL type filtering can be applied to only synchronize SIF and MPF IPL types. IPL type filters should be entered into the IPL Type Filters text area, separated by semi-colons. The filter string "SIF; MPF" will return only the IPL's with the types SIF or MPF. Therefore, IPF's will be created in Vertigo for IPL's 2, 3, 4 and 5 in the above list.

#### **5.6.2 Updating Existing Vertigo Synchronizations**

Once a Vertigo study has be synchronized with Open PHA the "Update Existing Vertigo System" button will be enabled in the synchronization dialog. Clicking on the update button will display the following.









When updating an existing synchronized Vertigo study you will have the option to select what fields you would like to synchronize. These options are provided to allow you to maintain changes to your Vertigo study which were made after the initial synchronization with Open PHA.

When updating an existing study, the first option you have is to select which study you would like to synchronize. There is no limit to the number of Vertigo Studies which can be synchronized with a single Open PHA study.

Below the study select are several optional fields which are described below.

#### Append new IPL's to IPF List

Check this option if you would like to search your Open PHA study for new IPL's not previously synchronized with Vertigo. Uncheck this option is you only want to synchronize IPF's which already exist in Vertigo.

#### Update Tag Numbers

Check this option if you would like the synchronization to automatically synchronize the Open PHA "IPL Tag" to the Vertigo "IPF Tag"

Update IPF Descriptions

Check this option if you would like the synchronization to automatically synchronize the Open PHA "IPL Description" to the Vertigo "IPF Description"

#### Update IPF Types

Check this option if you would like the synchronization to automatically attempt to cast the Open PHA "IPL Type" into a Vertigo "IPF Type".

#### Update Required RRFs

Check this option if you would like the synchronization to automatically synchronize the Open PHA "PFD" field for an IPL to the "Required Risk Reduction" field for an IPF.

Once you have set the selected options for your synchronization you can apply IPL type filtering as described in *Section 5.6.1* and click synchronize to update the existing Vertigo study.

#### 5.7 Import as Working Revision

Earlier in this section, the functionality for importing and exporting files through the KISS study manager was discussed. This functionality is essentially only a file transfer, moving the file from the desktop to cloud, or cloud to desktop. Also, earlier in this section, the functionality for locking and tracking versions of a study was discussed. This functionality essentially freezes the study in its current state where it can be viewed in perpetuity while a new "working revision" is created which will subsequently contain any changes that occur after the new revision was created.

Open PHA Premium-Cloud also includes the ability to import as a working revision. This means that a user can freeze the current status of the study by creating a Revision, and then download the cloud-based copy of the study to the desktop for subsequent work. After the work is completed, the file can then be re-uploaded as a new revision to an existing study as opposed to a completely new study. It is important to upload as a new revision of an existing study, especially in situations where a PHA study has links to other studies in KISS, such as a Vertigo IPF list which is connected to an Open PHA Safeguard list. If the user simply uploads the study as though it were a new document, all the links to the Vertigo study will be lost.

To employ this functionality, a user would download the Open PHA file to their desktop and edit the document as they normally would in the course of work. When the file is ready to be re-uploaded in the Premium-Cloud version, the user would select "Import





as Working" from the Premium Tools dropdown list as shown below.

	8	Study Data 🦻 Nodes	Deviations	orksheets DLOPA Worksheets	Check Lists	ions 🔀 Safeguards
æ	Parki	ng Lot 📦 Risk Criteria	🗱 Premium Tools 👻 📢	Back		
ſ	لمع	Revision History	Report Generator			
		🗄 👁 🖋 🖓 🛍	Spell Check			
		Revision	Translate Study	Description	Remarks	Revision Cre
		Rev 0	Revision Manager	gn		Edward Marszal
	<b>#</b> #	Rev 1		resolve LOPA		Edward Marszal
			Synchronize with Vertigo	ndations		
	22	Rev 2	Import As Working Revision	o Plant		Edward Marszal
		From Open PHA Standard	Liorary - Node Templates			Edward Marszal
		From PHAWorks®	Bowtie Diagram			
	ren					
	5	4				•
	9					

After doing so, the user will be warned that all of the data in the "working revision", i.e., any changes that were made from the time that data was exported until the current time, will be lost, and prompts for confirmation of the upload. At that point, the Desktop fiole is imported and becomes the new working revision of the study.

In addition to importing a desktop file of Open PHA, the Import as Working Revision function can also be used to import PHA study data from some<sup>1</sup> PHA-Works files.

	Study Data 🦻 Nodes	E Deviations	orksheets 🛛 LOPA Worksheets	Check Lists	Recommendations	Safeguards
🔒 Parki	ing Lot 📦 Risk Criteria	😂 Premium Tools 👻 📢	Back			
162	Revision History	Report Generator				
	🗄 👁 🖋 🖆 🛍	Spell Check				
	Revision	Translate Study	Description	Remarks	;	Revision Cre
	Rev 0	Paulaiate Study	gn		Edw	ard Marszal
	Rev 1	Synchronize with Vertigo	resolve LOPA ndations		Edw	ard Marszal
<b>80</b> 8	Rev 2	Import As Working Revision	o Plant		Edw	ard Marszal
	From Open PHA Standard	ibrary - Node Templates			Edw	ard Marszal
4	From PHAWorks®	3owtie Diagram				
-0-0						

To access the PHA-Works import tool select the "Import PHA-Works" option from the Premium tool's menu.

<sup>&</sup>lt;sup>1</sup> Import subject to structure of input data file. Importing will only succeed for the default unmodified data structure. Customization of data structure will cause import to fail.

When Importing from PHA-Works, the data in the Open PHA study will be over-written completely. For this reason, it is usually the case that you will want to create a new Open PHA study in Open PHA Premium to receive the import.

The first thing you will need to do to import from PHA-Works is export the study data. Open PHA can import data exported from PHA-Works in the export format. To export data in this format open the PHA-Works study and select File -> Export. In the "Choose Export File Format" window, select Online (entire project, hierarchical). Save the resulting (\*.txt) export file.

Man PrANNerks File Edit Navigate Project Tools Utilities Window Help Di Di D	📙    🔮 📙 🗸    folder 🛛 🚽	o x
	File Home Share View	^ <b>(</b> )
Sample PHA Phyler Talk Center     Control Control      Proper Hamaton:     Samadheet     Drawga     Drawg	Image: State	
Protect Outcome Go To Become	$\leftarrow \rightarrow \checkmark \uparrow$ - we consider with the second sec	Q
Peed configuration Calum c	Name Date modified Type	Size
Global parameter lats help for occurre relieve project, initial citital Cancel	Solution Open PHA Study.opha 1/31/2019 9:58 AM Open PHA Study	256 KB
Worksheet views Passwords C Recommendation records (comma delimited) Help	Pha Works Export.txt 2/4/2019 4:11 PM TXT File	51 KB
Constant	PHA-LOPA Report Template-r1.docx 10/12/2018 10:59 Microsoft Word D	174 KB

Next, from Open PHA Premium, in a new Open PHA Study click on the Import PHA-Works option in the Premium Tools menu and select the file that was exported.

	Study Data 🦻 Nodes	Deviations	다. PHA Worksheets	U LOPA Worksheets	∃ ∃ Recommendations	Safeguard	s 🖨 Parking Lot	Risk Criteria	Ø₀ Premium Tools ▼	
	Overview								Report Generator	
	Study I	Name test	Lawrence of							
	Study Coord	inator	Open			×			Spell Check	
	Study Coordinator Contac	t Info	← → ∽ ↑ 📘	> This PC > Desktop > folder	✓ Ö Search folder	Q				-
	study coordinator contac		Organize - New	folder	100	0			Translate Study	
	F	acility	ConeDrive	^ Name ^	Date modified	Туре				ь.
	Facility Loo	ation	OneDrive	😹 Open PHA Study.opha	1/31/2019 9:58	AM Open PHA			Revision Manager	
	Facility C	Owner	3D Objects	Pha Works Export.txt	2/4/2019 4:11 1	PM TXT File				
$ \vdash  $		11=14	Desktop	E PHA-LOPA Report Ten	nplate-r1.docx 10/12/2018 10:	59 Microsoft			Synchronize with Vertigo	> =
		Unit	Documents	1						
$\square$	Report Nu	imber	Downloads					(	Import From PHA-Works	
1 AM	Project Nu	imber 🗌	Music							
			Pictures	v <		>				_
			1	File name: Pha Works Export.txt	<ul> <li>All Files (*.*)</li> </ul>	~				
					Open	Cancel				

Once the import has completed you will be redirected to the Study Data overview tab and the PHA-Works data will be available in Open PHA. You can now save your Open PHA study and work normally.

#### 5.8 Bowtie Diagram Visualization

Bowtie diagrams provide an approach for better visualizing hazardous scenarios. Bowtie diagrams include causes, barriers, and consequences formed into a bowtie shape. The information contained in a LOPA scenario can benefit from visualization as a bowtie diagram. Open PHA Premium can do this automatically using the Bowtie Diagram tool.

After a LOPA scenario has been completed, it can be viewed as a bowtie diagram. The first step is to go to the LOPA Worksheet and select the scenario, or a group of scenarios that you would like to view as a bowtie diagram. Once the scenario is selected, the user should click on the Bowtie Diagram button from the Premium Tools Navigation bar button menu. This will pop of a new window the contains the bowtie diagram of the LOPA scenario.

R	eport Generator										
	sport contractor	ader through High Pressure Sep	oarato	r (V	101) to Gas Expo	rt Pipeline					
Ì	oell Check	✓ II Q Q II ⊕							0 0	Search Worksheet	
	anslate Study				C14 C		TAF			Causes	Con
		Consequence	S		Description	Prob.	Safety	Cause	Frequency	IDI	IPI Ta
	vision manager	.1.1 Potential overpressure of V-101. Potential loss of mechanical			Probability of Ignition	0.1		1.1.1.1 Production header pressure operates	0.1	1 Relief Valve on High Pressure Separator	PSV-101
	nport As Working Revision	High Pressure Separator resulting in large release of hydrocarbons and potential fire or explosion.	4	~			1E-4	above izoo psig.		2 High Pressure Separator (V-101) High-High Pressure Closes Inlet Valve	UZC-101A
	owtie Diagram	J						1.1.1.2 External fire in the vicinity of HP Separator V-101.			
	1.6 Low Level 1	1.6.1 Potential for gas blowby into the Low Pressure Separator V- 102. Potential for overpressure of Low Pressure Separator.						1.6.1.1 Failure of control loop LIC-101A such that valve is too much open	0.1	5 Relief valve PSV-102, which is sized for gas blow-by	PSV-102
		Potential for loss of mechanical integrity. Potential for rupture of vessel or associated piping. Potential release of flammable materials. Potential fire/explosion.	5	•			1E-5			6 Low level shutdown LT- 101B closes low pressure separator inlet SDV- 102A	UZC-101C



The bowtie diagram pop-up window offers a few controls to allow the user to work with the diagram. Two of the buttons are zoom in and zoom out to make the image in the window larger or smaller. There is also a download button which, if clicked, will cause the bowtie diagram to be saved as an image in the default download location of the web browser (usually, the downloads folder). Finally, the close button will close the bowtie diagram pop-up and return the user to the main Open PHA window.

#### 5.9 Facility Dashboarding

In the Kenexis Integrated Safeguard Suite, Open PHA Premium Studies are organized into Facilities. The Open PHA Premium Facility Dashboarding feature allows you to visualize Statistics about the studies in your Facility aggregated to the Facility level.

Open PHA Premium Dashboarding displays the following

- The Number of PHA Studies and the age of the current revision
- A breakdown of PHA recommendations by their implementation status
- A breakdown of LOPA recommendations by their implementation status
- A total count of Risk Ranked scenarios broken down by risk ranking
- A total count of consequence severities uses broken down by consequence type and severity

You can reach the Open PHA Premium dashboard from the Study List page of the Kenexis Integrated Safety Suite by clicking on the "View Facility Dashboard" icon in the

header of the Facility list. Below is an example of an Open PHA Premium Facility Dashboard.



#### 5.10 Library – Node Templates

Open PHA Premium includes functionality that allows the use and development of libraries of node templates and check list templates. This functionality allows the entire contents of a node or check list to be either imported from a library or exported out to a library. This functionality is accessed by clicking on the Premium Tools button in the action ribbon, which displays the list of premium tools. Once the tools are listed, clicking on the "Library – Node Templates" menu item will cause a sub-menu to be displayed which allows you to select either "Import Node (or Check List) from Template" or "Export Node (or Check List) as Template".

	Study Data 🦻 Nodes	Seviations	orksheets UOPA Worksheets	Check Lists	E Recommendations	Safeguards
🚗 Parkii	ng Lot 🛛 😭 Risk Criteria	🗱 Premium Tools 👻 📢	Back			
	Overview	Report Generator				<b>^</b>
	Stud	Spell Check	t HAZOP			
	Study Coc	Translate Study				
	Study Coordinator Cor	Revision Manager	exis.com			
		Synchronize with Vertigo	nt			
	Facility	Import As Working Revision	is, USA			
	racin	Library - Node Templates				]
	Import Node from Templa	te Diagram				
+	Export Node as Template	900.123				
	Import Check List from Te	Initial (Pre-Startup)	PHA of the gas plant			
2	Export Check List as Tem	plate				

When the user chooses to import, the "Import Node (or Checklist) from Library Template" dialog box is displayed.

Import Node from Library Template	Import Check List from Library Template
Create a new node in this study from a node template in a Kenexis Integrated Safety Suite Library. <u>Learn more about node templates</u> Select Library	Create a new check list in this study from a check list template in a Kenexis Integrated Safety Suite Library.
Custom	Select Library
Select PHA Node Template	OREDA 2015 - SIS Equipment
No Node Templates in this Library	Select Check List Template
Merge List Items 🚯	No Check List Templates in this Library
SafeguardsImage: Coloradia stateIPLsImage: Coloradia statePHA RecommendationsImage: Coloradia stateLOPA RecommendationsImage: Coloradia state	Merge List Items () Check List Recommendations
Import Node Close	Import Check List Close

Prior to importing a node (or check list) into the currently open study the user must first select the library that contains the desired node template. All the libraries that the user has access to will be displayed including the Kenexis Standard library which has many generic templates for common pieces of process equipment and unit operations and several typical checklists that can be used in PHA. Once the library is selected, the specific node that is desired can be selected from the "Select PHA Node Template" drop-down box, which will contain a list of all of the nodes that are available in that library. Finally, before importing the user can select, using the associated toggle

switches, whether or not certain merge list items should be included or ignored. These items include safeguards, IPLs, PHA recommendations, and LOPA recommendations. After all the selections are made clicking on the "Import Node" will cause the information to be inserted into the currently opened study.

In order to export a node (or check list), first open the study file that contains the node that is desired to be uploaded. Once the study has been opened, click on Premium Tools and then select "Library – Node Templates" and subsequently "Export Node as Template" from the sub-menu. This will bring up the "Export Node As Library Template" dialog box.

Export Node As Library Template	Export Check List as Library Template
Create a template from a node in this study and store it to a Kenexis Integrated Safety Suite Library. Learn more about node templates	Create a template from a check list in this study and store it to a Kenexis Integrated Safety Suite Library.
Select PHA Node	Select Check List
(HP Gas) Production Header through High Pressure Set	1. Inherently Safer Checklist
Select Library	Select Library
Custom	Custom
Enter Node Template Name	Enter Check List Template Name
Export Node Close	Export Check List Close

In the dialog box, begin by selecting the PHA node which is desired to be inserted into Library using the "Select PHA Node" drop-down box which will contain a list of all the nodes in the currently open study. Next, select the target library from a list of all the libraries that the user has access to from the "Select Library" drop-down list. Finally, set the name of the template that will be stored in the library in the "Enter Node Template Name" text box and then click on the "Export Node" button.

